

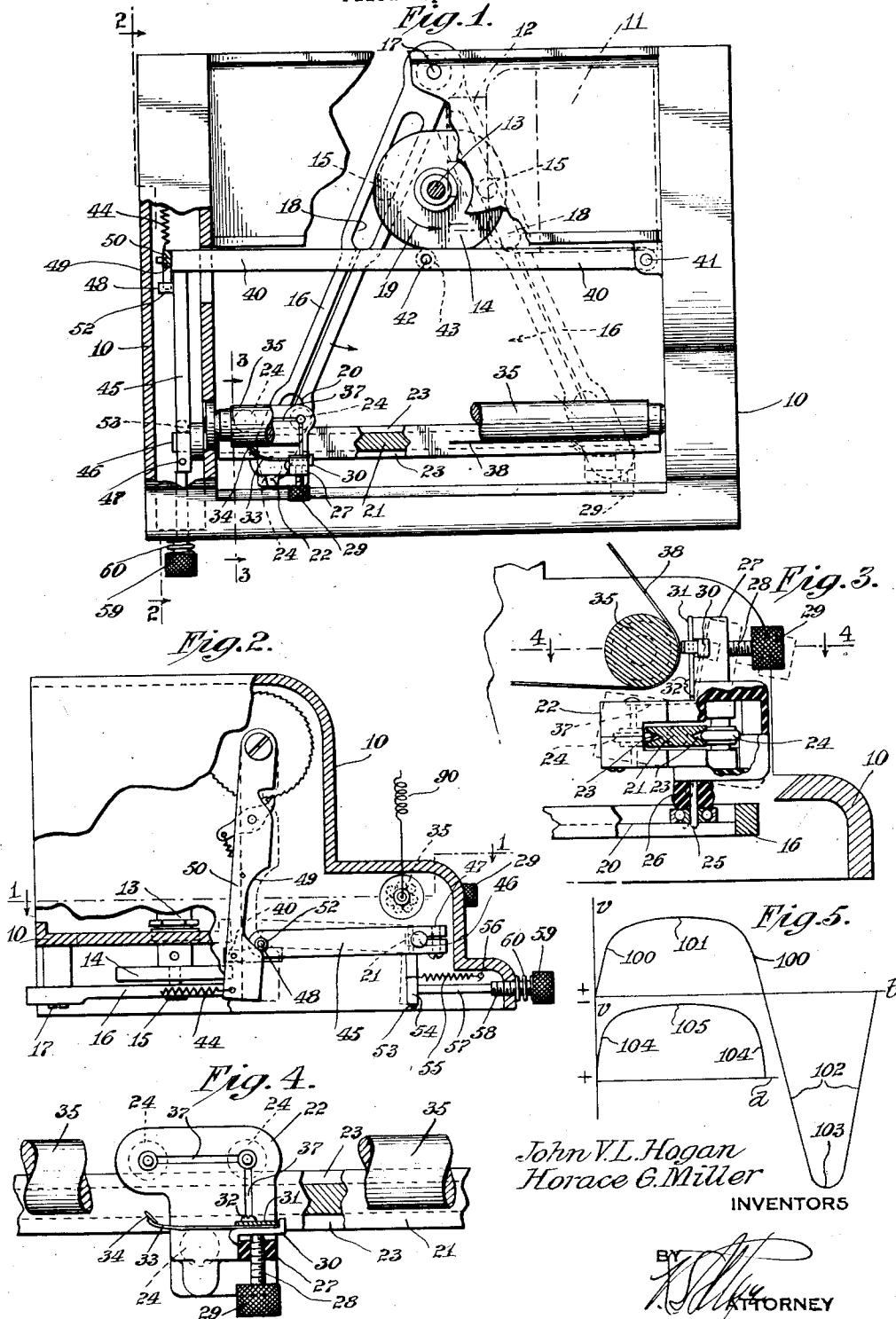
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MEANS AND METHOD FOR FACSIMILE RECORDING

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MEANS AND METHOD FOR FACSIMILE
RECORDING

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This invention pertains to facsimile recording devices used as receivers in facsimile transmission systems, either over wire or radio channels, and more particularly to such receivers as embody devices for securing relative motion between a marking stylus and a platen.

This invention is particularly applicable to such devices which maintain the marking stylus substantially constantly in contact with the recording paper surface during the period of recording, such as in the case of electrolytic recorders.

This invention includes apparatus for reciprocatingly or intermittently moving a stylus across the portion of a recording paper strip which is in contact with a platen situated beneath the paper, and also includes devices for adjusting the pressure exerted by the stylus upon the paper, while the stylus is in comparatively rapid motion across the surface of the paper, and without interfering with such motion, in order that the synchronism of the receiving apparatus shall not be disturbed when it becomes necessary to make such adjustment of pressure, thus saving much time and promoting convenience of operation.

One purpose of this invention is to provide mechanism for moving the stylus more rapidly in one direction than in the opposite direction and also for lifting the stylus from the surface of the paper during the traverse of the stylus in one direction, when it is not marking upon the paper, and for restoring the contact of the stylus with the paper when it is ready to make contact with the surface thereof upon its marking stroke, both of these operations being performed without loss of synchronism and without substantial alteration of the effective pressure between the stylus and the paper during its repeated marking strokes.

Another object of this invention is to lift the stylus from the platen during the time that it is not situated over the paper, or from the paper during such time as it is desired that no marking shall be made upon the paper, such as for the purpose of leaving unmarked margins thereupon, or when it is desired that synchronizing or other signals be impressed upon the receiving apparatus without any extraneous marks being produced thereby.

Yet another object is to provide a platen in the form of a cylindrical roller, which shall minimize the frictional resistance offered the paper while passing thereover, and at the same time shall afford a linear contact path between the platen and the stylus, during the traverse of the

latter. The cylindrical platen likewise distributes the wear thereof over a large surface, which feature is particularly important in the case of electrolytic recorders, since such wear in this case may be of a chemical nature in addition to the usual mechanical wear, and therefore may often give rise to pitting of the platen surface.

Still another purpose is to provide mechanism for producing a substantially linear velocity of the stylus during its effective marking period, a much greater velocity during at least a portion of its non-marking stroke and a gradual change from one velocity to the other in order to avoid mechanical shock and preserve accuracy of marking.

A further object of this invention is to provide a mechanism for easily and rapidly changing the contact point of the stylus for a new point without the need of elaborate tools or great mechanical skill, so that this operation may readily be performed by a layman in the art, thereby more easily allowing the use and upkeep of a receiver so equipped, in domestic recording service.

In order more completely to describe this invention, we refer to the hereunto appended drawing, where:

Fig. 1 is a plan view partly in section on the lines 1—1 of Fig. 2, showing a facsimile recorder embodying our invention.

Fig. 2 is a side elevation, partly in cross section, on the lines 2—2 of Fig. 1.

Fig. 3 is a side elevation, partly in section, on the lines 3—3 of Fig. 1.

Fig. 4 is a plan view of a portion of the carriage, partly in cross section on the lines 4—4 of Fig. 3.

Fig. 5 is a graphical showing of the time-velocity relations in the operation of the recorder and also showing the distance-velocity relations thereof.

A framework 10, serves as a general support for the recorder, and may be constructed of any suitable material of sufficient strength and rigidity, such as aluminum, and the various elements may conveniently be supported by the lateral sections of this framework, as hereinafter described.

Supported upon the framework 10 is driving motor 11, which conveniently may be of the synchronous type, in order to facilitate synchronization when this recorder is used upon alternating current circuits. The output of this motor is delivered through reducing gears 12 to shaft 13 and upon this shaft is mounted a substantially disc-like member 14. Disc 14 is provided near its periphery with a stud 15 extending

at right angles to the plane of the disc. An oscillating arm 16 reciprocatingly moves about a pivot 17, affixed to the frame.

Arm 16 is provided near its pivotal end with a slit 18, of a width so that stud 15 may move therein without substantial lost motion. The rotation of disc 14 causes stud 15 to describe a complete arc, and in so doing, it will have a longitudinal motion in slit 18 and will cause arm 16 to reciprocate around axis 17. Due to the different distances between stud 15 and pivot 17 at different parts of the arc described by stud 15, the arm 16 will move at a certain rate of speed in one direction and will move at a much greater rate of speed when returning in the opposite direction.

In Fig. 1, the arrow 19 represents an assumed direction of rotation for disc 14 and the full line representation of arm 16 shows it when it is just commencing to move from left to right in this figure. Under these conditions stud 15 will be at a comparatively great distance from pivot 17 and accordingly arm 16 will move comparatively slowly. This slow movement of arm 16 is the stroke upon which the recording is done, as later described.

The dotted line representation of arm 16 shows it at the commencement of its return stroke and under these conditions the similar dotted line representation of stud 15 shows that the distance between the stud and the pivot is much less during this return stroke than it was during the marking stroke, thus causing a quick return for arm 16, during the portion of its cycle when it is doing no useful work, and so economizing the time available in a complete cycle.

The outer end of arm 16 is provided with a slit 20 and opposite the arc formed by the traverse of the end of arm 10, is located a track 21, so that this track assumes the position of a chord relative to the arc thus formed. During the traverse of the arm, some portion of the slit 20 is always opposite this track. Track 21 carries thereupon a carriage 22, arranged to slide along the track in grooves 23, 23 running longitudinally of the track. This carriage is provided with suitable wheel-like bearings 24 which engage in the grooves of the track, so that the carriage can move very freely along the length of the track, but has any transverse or rotary motion thereupon reduced to a minimum. The carriage also carries a projecting stud 25 preferably encased in a soft rubber bushing 26. This stud and bushing move longitudinally of arm 16, in slit 20. The upper portion of carriage 22 is provided with a projection 27, through which is threaded a screw 28 provided with a suitable knurled head 29. This screw acts to determine the space between a clamping member 30 and a fixed back plate 31, firmly affixed to the carriage by screw 32.

In the space between members 30 and 31 is placed a piece of wire or narrow spring 33, bearing at its outer end a marking point or stylus proper 34, which latter may be of any suitable hard material, such as an alloy of platinum or iridium or other chemically resistant material. It can be seen that the stylus member 33, 34 can readily be inserted between members 30 and 31 and that the rotation of screw 28 will then cause clamping member 30 to hold the stylus firmly in place. It is a relatively simple matter even for one not skilled in the mechanical arts to loosen screw 28, remove the stylus and substitute a new one therefor, when replacement of the

stylus is necessary. We prefer to use a leaf type spring in order to avoid vertical play, and to firmly fasten the actual stylus point to the end thereof. By making member 33 fit snugly in place on its side edges and against the shoulder of member 30, the correct positioning thereof when making replacements may be assured.

The recording paper 38 may be drawn from a suitable roll and passes over the surface of roller 35. This roller may be formed of any suitable material such as aluminum or other preferably non-reactive conductor such as carbon or the noble metals and is carried in bearings located upon either side of framework 10 and which serve to afford a good electrical connection between this roller and the framework, as well as allowing the rotation of the roller with the minimum friction. Stylus point 34 is so located that it presses upon the surface of the recording paper, during the movement of the carriage, along a linear path substantially parallel to the axis of the roller.

It will be seen that as the recording paper is fed forward by any suitable means, it will be bent in a smooth arc of uniform and slight radius over the surface of roller 35 and that the rotation of this roller will allow the paper to pass thereover with a minimum frictional resistance and also with very little bending of the fibres of the paper, as compared with the case where the paper is fed sharply bent over a fixed platen. Likewise the cylindrical roller promotes the precision of the linear contact provided and makes it virtually impossible for the paper to warp or wrinkle as it passes thereover.

In the operation of electrolytic facsimile recorders it has been found that the maintenance of a proper and uniform pressure between the stylus and the platen is a factor of great importance in determining the successful operation of the recorder. By sliding the stylus element 33 in or out of the space between elements 30 and 31 to a greater or less degree, and then clamping it by screw 28, the effective stiffness of spring member 33 may be varied, thus affording some control of this factor of pressure just referred to. However, such a means of adjustment is not only lacking in precision but also a change of this adjustment necessitates the complete stoppage of the recording operation. Such stoppage is extremely undesirable, not only from the viewpoint of the loss of a portion of the reproduced image but also because it requires the re-synchronization of the receiver, when operation is again started.

Likewise, as previously mentioned, it is often desirable to have element 33 located in the proper position by placing it snugly against the shoulder of element 30 and thus assuring its proper location, for example when replacements are made.

Accordingly we have provided a special device for adjusting this pressure while the recorder is in actual operation, without the need of stopping the same.

Track 21 is carried in framework 10 by means of insulated bushings, which act as bearings therefor, thus insulating the track from the framework. An electrical connection is made to any convenient point upon this track, such as one end thereof, as by means of a flexible insulated wire 90. The electrical circuit for supplying marking signals may accordingly have one terminal connected to the track by means of this insulated wire and the other terminal may be connected to the framework of the recorder.

The roller 35, being connected to the framework, will afford a complete circuit through the recording paper, when stylus 33 presses the paper thereagainst, since the current picked up from track 21 by roller bearings 24 is conducted through the metallic portions of carriage 22, as partly indicated by connecting elements 37, to plate 31, stylus 33 and point 34.

As previously explained, the marking by the stylus is performed only when it is moving in one direction, and accordingly it is desirable that the stylus be removed out of contact with the paper during its non-marking stroke. We have found it possible to combine in a single mechanism the means for so removing the stylus from the paper and the means for adjusting the pressure between the stylus and the paper during its marking stroke.

It is also often desirable to lift the stylus from the paper not only during its non-marking stroke but also during the marginal portions of its marking stroke. This arrangement provides, inter alia, a positive determination of the blank margins of the paper and also reduces stylus wear.

The method of accomplishing this result is by making track 21 capable of rotation in its bearings. This rotation of the track will cause the stylus carried by carriage 22 to be displaced away from the paper surface, when the track is so rotated as to tilt the carriage forward. Likewise it can be seen that if the rotation of the track is capable of adjustment, at one end of the arc of its rotary motion, to a relatively fine degree, the actual pressure exerted by the stylus upon the paper may be varied, without removing the stylus from the paper surface. The movement of the track is brought about through the agency of a main follower arm 40 which rotates about a pivot 41 and which bears at one spot along its length a stud 42 which may be provided with a suitable bushing 43, rotatable about stud 42 with the minimum of friction, as by the provision of ball bearings between the stud and the collar. Collar 43 presses against the periphery of disc 14. This periphery does not constitute a true circumferential arc about the center point of the disc, but is so shaped that one side of the disc has an effective radius greater than the other side, and these two sides are separated by portions of the periphery which are somewhat flattened. Follower arm 40 is maintained under tension by means of spring 44, which ensures the maintenance of the proper pressure between collar 43 and the periphery of disc 14 at all times. As disc 14 revolves, it can be seen that follower arm 40 will assume two distinct positions according to whether the disc is presenting its maximum radius or its minimum radius to roller 43 carried by the arm. The flattened portions of the periphery of disc 14 will allow arm 40 to pass from one position to the other.

There is provided an auxiliary follower arm 45 which is clamped about the rounded end 46 of track 21 by means of a suitable opening in the follower arm and the provision of a clamping screw 47. Any movement imparted to the free end of auxiliary follower 45 will then result in rotation of the track 21. The free extremity of auxiliary follower 45 is provided with a projecting pin 48 which engages a groove 49 provided in the surface of another pivoted arm 50. Arm 50 is moved by main follower arm 40, when the latter oscillates about its pivot 41. This arm 50 serves to operate paper feeding mechanism which is shown in part in Fig. 2 but which is not described

in detail, as this particular form is not essential to the present invention.

Arm 50 may then be considered for the purposes of the present description, merely as an extension of main follower arm 40 and the back and forward movement of arm 50 will result in the raising and lowering of pin 48, thus causing track 21 to rotate and thus to vary the position of the stylus with regard to the paper. Auxiliary follower 45 is insulated from framework 10, by covering pin 48 with an insulating collar 52 and since this auxiliary arm is supported from the track 21, it will be insulated at its other end for the same reason that the track is so insulated.

Auxiliary follower 45 is provided with another laterally extending pin 53 covered with an insulating collar 54. A tension spring 55 is fastened around the collar at one end and to a suitable point of the framework 56 at the other end. This spring tends to keep pin 48 in contact with the surface of groove 49 and tends to rotate track 21 in such a direction as to keep the stylus in contact with the paper, when follower arm 45 is not forcibly directed in the opposite direction. The maximum extent to which spring 55 may rotate the track will be determined by the contact of collar 54 with a shaft 57 which functions as a stop. Shaft 57 is formed as a prolongation of the threaded portion 58 of a screw provided with a knurled head 59 conveniently located exteriorly to framework 10 and provided with a coil spring 60 located between the knurled head and the framework. The rotation of the knurled head 59 will then cause the slight rotation of track 21 which may be needed to adjust the pressure of the stylus upon the paper and also will determine that after the stylus has been completely removed from the paper surface before or at the beginning of the non-marking stroke, it will return again into contact with the paper with substantially the same amount of pressure exerted thereupon.

We have found this uniform pressure of the greatest importance in securing uniformity of density in the successive lines making up a reproduced image, as well as in causing the stylus to glide smoothly over the paper surface without picking up fibres therefrom.

In Fig. 5, the vertical axis represents the velocities of translation of the stylus carriage and the upper horizontal axis represents the time elapsing. The duration of one complete cycle is shown in this graph. The portions 100, 100 represent the intervals during which the stylus is passing over the two margins of the record strip. During these times the stylus is not marking and preferably is out of contact with the paper. Accordingly the non-linear velocities are then unimportant.

The substantially linear portion 101, of this graph, represents the time when the stylus is marking and is secured by, inter alia, offsetting the increase of arm rotational velocity due to the increase of effective lateral motion of the cam stud with a decrease of carriage velocity due to its distance from the arm center of radius 17 being decreased. Both these velocity changing effects are present when the carriage approaches the centre of its traverse and by suitable choice of the various dimensions involved, according to well-known mathematical principles, the two effects may be substantially counterbalanced so as to give very nearly uniform velocity during the active portion of the marking stroke, which may

occupy approximately fifty percent (50%) the total time.

The portions 102, 102 of this graph represent the two end portions of the back stroke of the stylus, and portion 103 is the central portion of the back traverse. The time needed for the complete back stroke is much less than for the marking stroke, due to the lessened effective distance between the driven portion of the arm and its centre of radius. Thus we may secure a substantially uniform and slow active portion of the marking stroke, a non-uniform margin, and a non-uniform and rapid return stroke.

From this graph it can be seen that for the active portion of the marking stroke, taking place during about one-half the total cyclic time, the velocity of the stylus need not vary more than a few percent from its average value. This uniformity is still more evident in the lower graph in Fig. 5, where the lower horizontal axis represents the distance traversed by the stylus during its marking stroke, and the vertical axis continues to represent velocity. From this it may be seen that at all times except when at the margins, the stylus has an almost constant velocity as indicated by the slowly changing curve portion 105, thus aiding in securing a reproduced image having minimum distortion even when the scanning at the transmitter is performed at a uniform velocity, as in the case of a drum type scanner. This lower graph also shows that the stylus velocity is so proportioned that only comparatively small portions of its working stroke as indicated by the portions 104, 104 are unavailable for marking when uniform velocity is used at the transmitter. In such case these unavailable portions conveniently may be used as margins to the record strip. They may also be used for marking by making the transmitter scanning velocity change according to substantially the same law.

In the upper graph of Fig. 5, it will be noted that the return portion of a cycle, 102, 103, 102, is almost sinusoidal in shape, as it has been found that such a shape curve represents a type of motion which gives rise to the least mechanical shock, so that the frame of the apparatus may be made of lighter weight than otherwise would be possible, and the gradually changing acceleration so provided permits greater marking precision to be obtained by allowing the use of more rugged and positive stylus carrier and stylus drive elements than otherwise.

It is to be understood that Fig. 5 is merely illustrative of one particular set of design factors, and the various portions thereof can be modified by suitable choice of these design factors. Furthermore, the arm drive here shown may be replaced by an internal or external follower, held tightly, as by a spring, to the contours of a cam of any desired shape.

It is possible not only to secure the substantially linear velocity of marking stroke for fifty percent (50%) of the time, but also to secure and use non-linear velocities during this period, if so desired, provided that the transmitter and recorder are both supplied with cams or other drives giving substantially similar time/velocity graphs. It is to be noted that we provide a positive drive for the carriage at all times, rather than depending upon spring returns or the like, of uncertain and easily variable velocities.

While we have herein described a recorder of the reciprocating type, yet many of the features described, such as the adjustment of stylus pres-

sure, may also be applied to recorders of other types. In addition, the use of a photo-electric cell or other electro-optical translation device in lieu of the stylus shown will permit our invention to be applied to a facsimile transmitter, by such simple changes as will be obvious to those skilled in the art.

We claim:

1. In a facsimile recorder a cam, means for rotating the cam, a stylus reciprocatingly driven by one portion of the cam, a follower resting upon another portion of the cam and oscillated thereby between two substantially stationary positions and means actuated by the follower whereby one position of the follower allows said stylus to rest upon a recording surface and the other position of the follower controls the amount of space between the stylus and said surface.

2. A facsimile recorder including a stylus, a platen for supporting a recording surface and a cam, means for rotating the cam at a speed synchronously related to signals received by said recorder, a mechanism actuated by the cam and raising the stylus from said surface during a portion of a complete rotation of the cam and allowing contact between the stylus and said surface during the other portion of a cam rotation, and a device associated with said cam and actuating an oscillating arm which determines the reciprocating motion of the stylus across said surface, whereby said periods of contact between said stylus and said surface and the motion of the stylus across said surface are synchronously determined by said cam.

3. The method of facsimile paper recording by a moving stylus resting against paper passing over a rotary cylindrical platen, which includes the steps of rotating the platen solely by the friction of the paper passing thereover, moving the stylus at a relatively slow speed along the length of the platen in a substantially linear path, while maintaining contact between the stylus and the paper, removing the stylus from contact with the paper, moving the stylus in the opposite direction along the length of the platen at a relatively high speed and restoring contact between the stylus and paper.

4. In a facsimile scanning apparatus of the stylus and paper type, means for positively moving a scanning element in one direction at a slow speed while scanning, means for positively returning said element in the other direction at a higher rate of speed, independent means for varying the operative pressure of the stylus upon the paper, and stationary control means situated remotely from said stylus and acting upon said pressure varying means whereby said variation may be made without impeding the freedom of motion of said stylus, while the latter is in scanning motion.

5. A reciprocating facsimile scanner including a marking element, means for moving said marking element in one direction at a rate of speed substantially linear for the marking portion of said unidirectional movement, and means for positively moving said element in the opposite direction at a greater rate of speed, and also including means for gradually changing from one rate of speed to another, whereby mechanical shocks are minimized and accuracy of marking promoted, and including a cam carrying a driving member causing said marking element to move, and means for moving said driving member in a substantially circular path.

6. A scanner according to claim 5, wherein

said motion at a higher rate of speed is substantially sinusoidal over at least a portion of its cycle.

5 7. A facsimile recorder including driving means, driven means rotating in a circular path, an oscillating arm driven by said first driven means, a track forming a chord to the arc described by said arm, a carriage driven linearly along said track by said arm, a stylus carried by said carriage, a marking platen for supporting a recording surface, and means for putting said stylus into contact with said surface when moving in one direction, and keeping said stylus out of contact with said surface when moving in the other direction.

10 8. In a facsimile scanner, the combination of a platen for supporting a recording surface, a marking electrode, means for moving said electrode back and forth across said surface, means

for guiding the motion of said electrode, means for making and breaking contact between said electrode and said surface, means for determining the point of contact between said electrode and said surface, and means for determining the path length of said electrode across said surface independently of said point of contact. 5

9. In a facsimile recording system of the type embodying a pair of electrodes pressing upon opposite sides of a recording sheet, the combination of means for moving at least one of said electrodes with respect to said sheet, means for varying the pressure of one of said electrodes upon said sheet, and stationary control means situated remotely from said electrodes for controlling said pressure 10
15 varying means.

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