

Feb. 22, 1938.

W. G. H. FINCH

2,109,109

CONTINUOUS SHEET FACSIMILE RECORDER

Original Filed Feb. 3, 1937 3 Sheets-Sheet 1

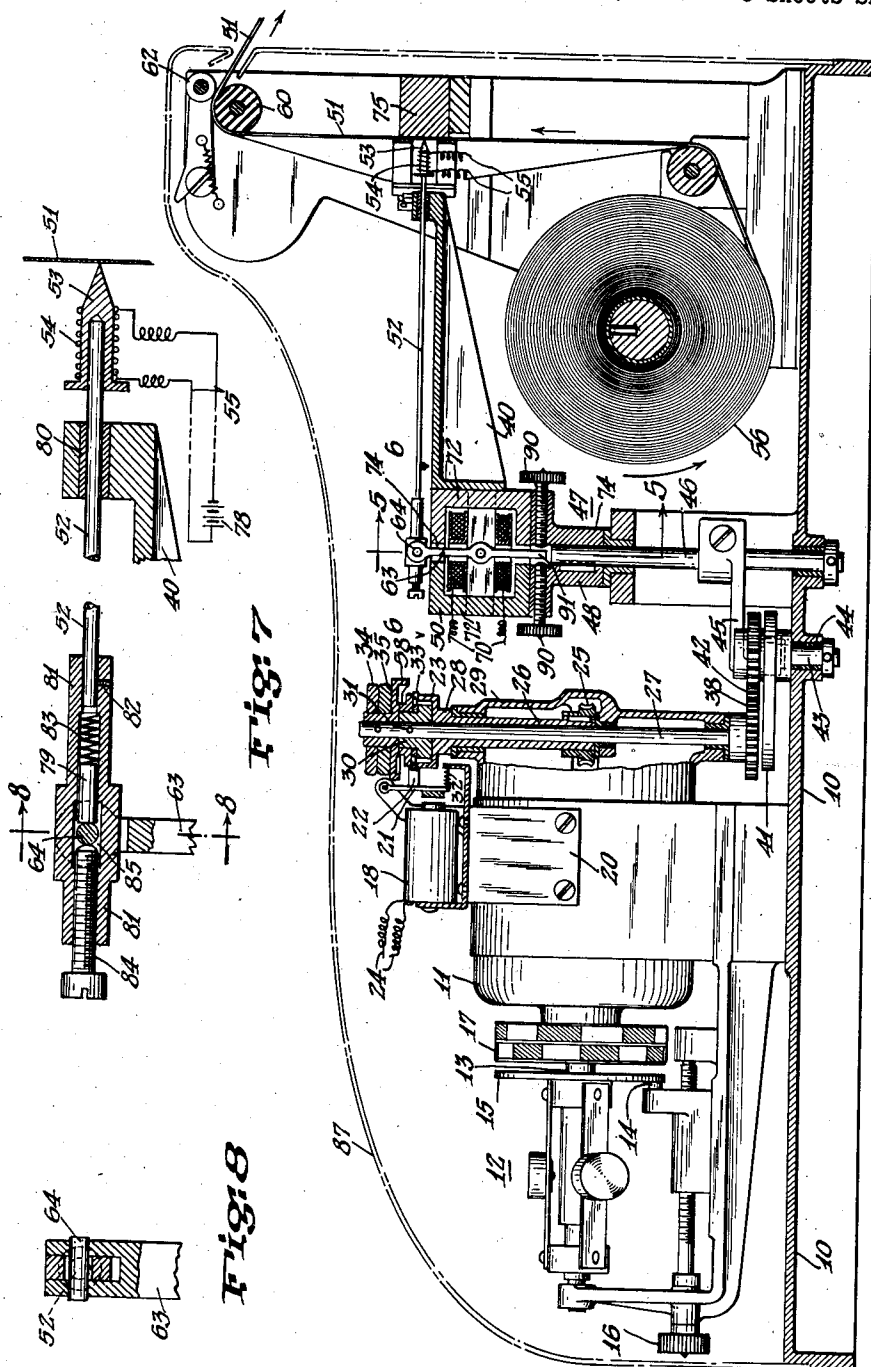


Fig. 7

Fig. 8

Fig. 1

INVENTOR.
William G. H. Finch
 BY *Samuel Ostrofsky*
 ATTORNEY.

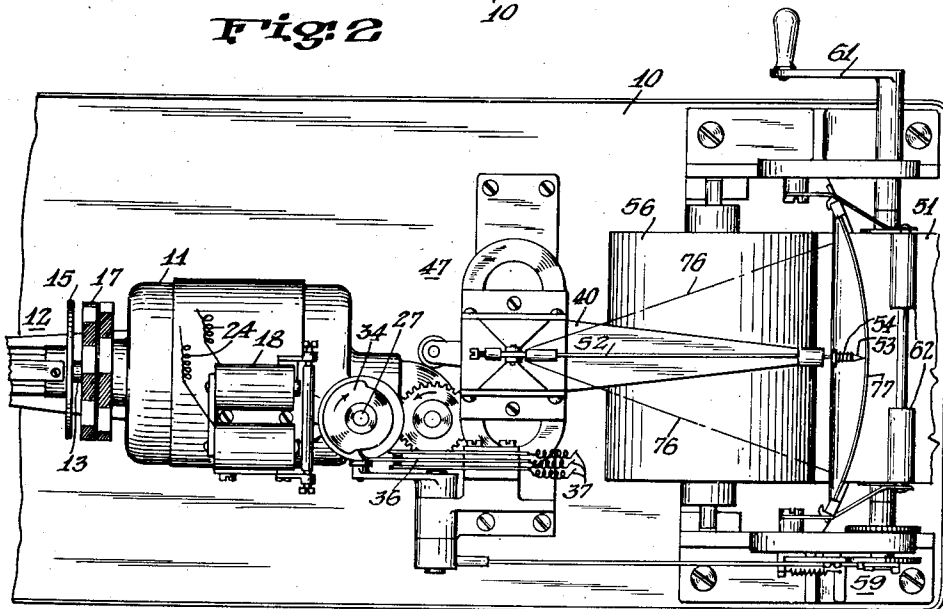
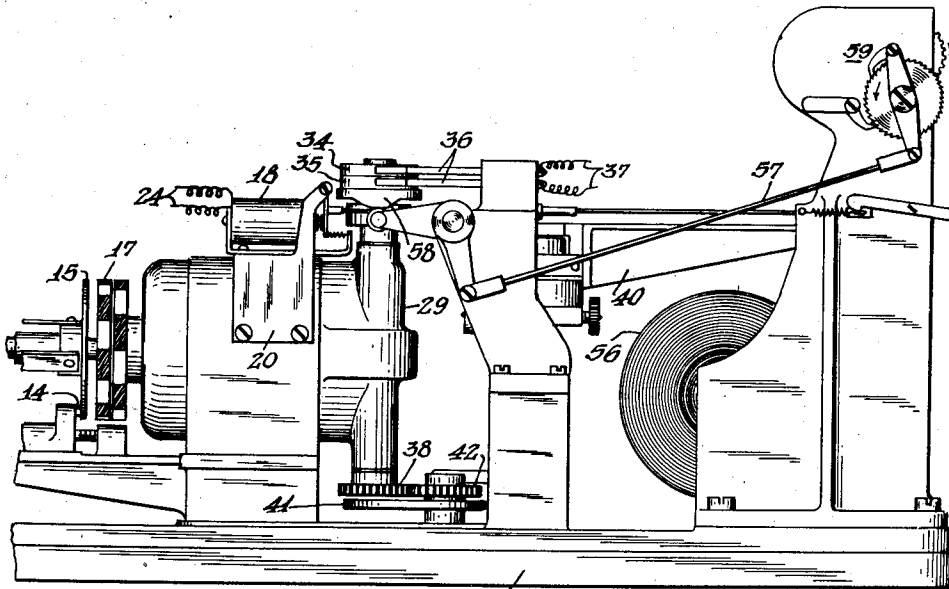
Feb. 22, 1938.

W. G. H. FINCH

2,109,109

CONTINUOUS SHEET FACSIMILE RECORDER

Original Filed Feb. 3, 1937 3 Sheets-Sheet 2



INVENTOR.
William G. H. Finch
BY
Samuel Costantino
ATTORNEY.

Feb. 22, 1938.

W. G. H. FINCH

2,109,109

CONTINUOUS SHEET FACSIMILE RECORDER

Original Filed Feb. 3, 1937 3 Sheets-Sheet 3

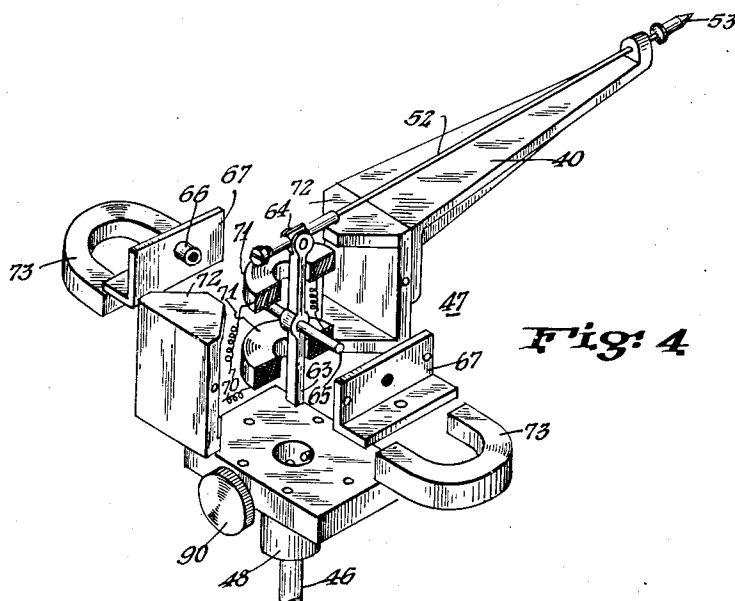


Fig. 4

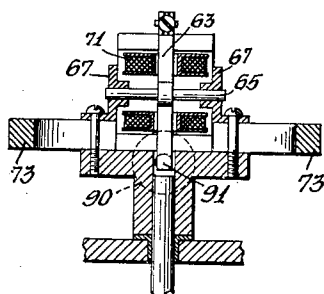


Fig. 5

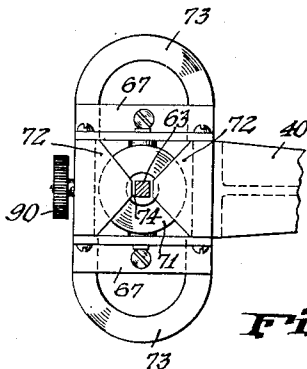


Fig. 6

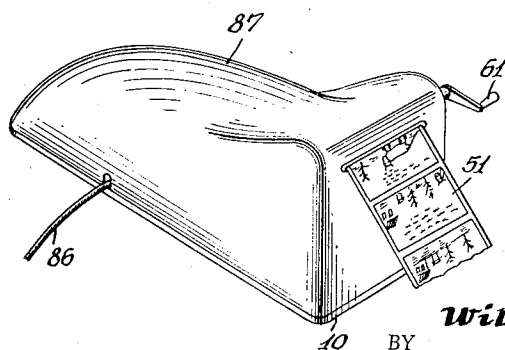


Fig. 9

INVENTOR.

William G. H. Finch

BY

Samuel Ostrolenk
ATTORNEY.

UNITED STATES PATENT OFFICE

2,109,109

CONTINUOUS SHEET FACSIMILE
RECORDER

William G. H. Finch, Spuyten Duyvil, N. Y.

Continuation of application Serial No. 123,770,
February 3, 1937. This application March 24,
1937, Serial No. 132,690

5 Claims. (Cl. 178-11)

This invention relates to facsimile systems and more particularly relates to improvements in facsimile receivers for recording pictures or messages on a continuously fed record sheet.

5 This invention is a continuation of my co-pending application Serial No. 123,770, filed February 3, 1937, entitled "Continuous sheet facsimile system." In this co-pending application I have disclosed novel and simplified mechanism particularly useful for rugged, compact and mobile facsimile units, and have particularly described their application to a transmitter unit. The present application relates to a receiver unit embodying the scanning and sheet feeding arrangements disclosed therein together with novel methods of and means for actuating the recording stylus and maintaining synchronous movement between the transmitter and receiver.

The mobile facsimile receiver of my present invention operates from a roll of treated paper and directly records the messages or pictures thereon, without intermediate photography processes. The simplified mechanism results in a mobile receiver which is particularly useful for aircraft, ship and automobile, as well as for home reception and other instances where a compact and relatively inexpensive unit is required.

The objects of my present invention reside in providing a novel electromechanical stylus for direct quality recording upon a record sheet; to provide a novel translating unit which is electromagnetically balanced and substantially uniformly responsive to the frequency range necessary for quality black-white recording; and to provide improved methods of and means for maintaining the receiver unit at synchronous speed.

These and further objects of my present invention will become apparent in the following description taken in connection with the drawings, in which:

Figure 1 is an elevational view, partly in cross-section, of a preferred embodiment of a mobile facsimile receiver employing the features of my present invention.

Figure 2 is an elevational view of the receiver unit.

Figure 3 is a top view of the receiver unit.

Figure 4 is a perspective view of the electromechanical recorder with its elements detached.

Figure 5 is a cross-sectional view taken along 5-5 of Figure 1 through the electromechanical recording unit.

Figure 6 is a top view of the recording unit

corresponding to the view taken along 6-6 in Figure 1.

Figure 7 is an enlarged cross-sectional view of a preferred arrangement for the stylus mechanism.

Figure 8 is a cross-sectional view taken along 8-8 of Figure 7.

Fig. 9 is a perspective view of the assembled receiver unit.

Referring to the figures, and more particularly to Figures 1, 2, and 3, I illustrate the facsimile receiver mounted on a cast iron base 10. A motor 11 supplies the continuous drive for the operation of the scanning unit. Motor 11 is preferably a constant speed direct current motor for operation at a substantially constant speed. I prefer to employ a motor operable at 1800 revolutions per minute. By using a battery source for driving the motor aboard an aircraft or other vehicle, a uniform speed of operation is assured. It is to be understood that a motor at the associated transmitter is operated at the predetermined speed which corresponds to the scanning speed of the system.

To facilitate maintaining the speed of motor 11 close to the predetermined value over a relatively long period of operation, I prefer to use a speed governing device appended thereto. In Figure 1 I illustrate a mechanical speed governor 12 attached to the shaft 13 extending from the motor. By adjusting the position of the friction pad 14 against the disk 15 by means of thumb screw 16, the governor may be set for the predetermined speed, which speed will be satisfactorily maintained over many days or even weeks of use. The disk 17, having alternate dark and light markings, is employed to adjust the governor 12 setting to the required speed with the aid of a tuning fork in the manner described in my co-pending application Serial No. 128,920, filed March 4, 1937.

I prefer to employ the synchronizing circuits and arrangements disclosed in my Reissue Patent No. 19,575, filed May 21, 1935 entitled "Image broadcasting system" and also disclosed in my Patent No. 2,047,863. This synchronizing system employs a synchronizing magnet 18 shown mounted upon motor 11 by bracket 20; an armature 21 for magnet 18 having a projection 22; and a single revolution positive clutch 23 co-operating with the armature projection 22.

A synchronizing impulse is transmitted cyclically between the intervals of the line by line recording, which impulses are impressed upon the synchronizing magnet through connection

leads 24 to attract the armature 21 and projection 22 away from the single revolution clutch 23 to permit the execution of a single scanning line in a manner to be described in more detail. I have omitted the electrical circuit connections for receiving and producing the rectified impulse at magnet 18 since these circuits are clearly disclosed in my patents above referred to and are not part of my present invention. I prefer to employ such synchronizing system whereby the accurate phase positioning of each line is accurately determined by means of cyclic synchronizing signals at the transmitter since the continuous sheet recording is more satisfactorily performed by such regular phasing operations. Accordingly, the motor 11 speed need not be precisely synchronous with the corresponding transmitter motor speed but be substantially close to the predetermined speed as will be evident. The constant speed motor in combination with the mechanical or an equivalent electrical governor performs excellent picture synchronizing and phasing for long periods of operation.

Motor 11 continuously drives the pinion 25 which is keyed to a sleeve 26 surrounding the vertical shaft 27. The housing or driven member of clutch 23 is integral with the sleeve 26 at the extended or shoulder portion 28 thereof. The sleeve 26 is rotatably supported in the casing 29 of the motor 11. The driven or interior portion 30 of the positive clutch 23 is secured to the vertical shaft 27 by a pin 31. When the clutch 23 is in engaged condition, the continuously driven pinion 25 drives the vertical rod 27 through the clutch 23. A spring 32 biases the armature projection 22 against the periphery 33 of the clutch 23 to disengage the clutch at the end of a single revolution and maintains such disengagement until the synchronizing magnet 18 is energized by the cyclic synchronizing impulse. I prefer to drive the motor 11 at a slightly greater speed than the predetermined speed for example, in the ratio of 101:100 to insure the disengagement of the clutch before the advent of the synchronizing impulse. Cams 34, 35 are secured to the top of vertical shaft 27 and cooperate with the synchronizing cam switch 36 which switch is connected to the synchronizing electrical circuit (not shown) by leads 37.

A gear 38 is attached to the bottom of the vertical rod 27. The gear 38 operates the oscillating scanner arm 40 which carries the stylus. In the illustrated arrangement, one oscillation comprising a single forward and return movement of the scanner arm 40 is performed during one revolution of the rod 27. A preferable scanning speed for this system is sixty lines per minute corresponding to one revolution per second of the vertically driven shaft 27. A cam 41 is used to execute the desired movement of the scanner arm 40. Cam 41 is connected to gear 42 which meshes with and is driven by gear 38. Cam 41 is rotatably supported on rod 43 which is affixed to the base 10 in bushing 44. A cam follower 45 is actuated by the cam 41. The follower 45 is connected to the vertical rod 46 which in turn is directly connected to the electromechanical recording unit 47. The cam and oscillatory motion mechanism 41 to 45 is similar to the corresponding mechanism of the transmitter described in more detail in my co-pending application Serial No. 123,770 hereinabove referred to.

The base 48 of the recording unit 47 is keyed to the top of vertical rod 46 and is accordingly oscillated therewith as will now be evident. The

scanner arm 40 is secured to the magnetic casing structure 50 of the recording unit 47. Arm 40 extends from the magnetic unit 47 to the record sheet 51 and supports the stylus rod 52. A steel point 53 is carried at the end of rod 52 for direct recording on the record sheet 51 in a manner to be described. The stylus is oscillated against the record sheet 51 in accordance with facsimile signals. By maintaining synchronous movement of the scanner arm 40 and by proper advancing or feeding of the record sheet 51, line by line past the scanning position, accurate reproductions are readily made thereon.

The stylus point 53 is preferably made of steel to resist wear. A heater coil 54 is wound at the stylus tip. The heater coil 54 is connected to a heating current supply by leads 55. A direct current of six to twelve volts is a suitable supply to maintain the stylus point 53 continuously heated for the recording operation. The record sheet 51 in my preferred mobile facsimile unit is a colored sheet having a wax coating. The wax coating is melted along the portions at which the heated stylus 53 operates against the waxed surface. For black-white reproductions I employ a black paper coated on the recording surface with a layer of white colored waxy substance. The wax coating exists on the surface under all weather conditions and is melted at the portions at which the heated stylus point 53 makes contact. The picture signals represent the black and white markings and actuate the stylus rod 52 in a manner to be described, to and fro against the sheet 51 to reproduce the picture. The continuous record sheet 51 is arranged in a large roll 56, and is fed past the stylus 53 in a positive manner a predetermined amount between each scanning line.

The line by line sheet feeding mechanism is similar to the corresponding feeding mechanism disclosed in my co-pending application Serial No. 123,770 and comprises a rocker arm 57 actuated by a cam 58. The cam 58 is secured to the vertical driven rod 27 which is rotated in accordance with the scanning movements. The rocker arm 57 actuates a pawl and ratchet arrangement 59 which rotates the presser roller 60 to a degree sufficient to advance the record sheet 51 by the distance between successive scanning lines. The advancing movement is executed once per revolution of the rod 27 and corresponds to one scanning oscillation of the scanner arm 40. I prefer to employ sixty lines per inch whereby one inch of the final picture is recorded in one minute.

The record sheet may be independently advanced by means of the handle 61 which operates the rollers 62. The operator may thus advance a recorded portion from the region of the stylus 53 beyond the interior of the machine. Figure 9 is a perspective illustration of the facsimile recorder unit with the record sheet 51 containing pictures made thereon. The handle 61 is used to move the sheet 51 out of the machine for viewing of the recordings thereon.

An important feature of my present invention resides in the novel electromechanical arrangement 47 for operating the stylus 52-53 against the record sheet 51. Figure 4 is a perspective illustration of the unit 47 "blown-up" to more clearly illustrate the construction thereof. The electromechanical unit 47 provides a balanced torque action on the armature 63. The stylus rod 52 is mechanically pivoted at 64 to the top of armature 63. The armature 63 is independently

pivoted on rod 65. Rod 65 is supported in bushings 66 set into angle brackets 67.

The electromagnetic mechanism 47 is arranged to oscillate armature 63 about its pivotal support 65 in response to the electric signal impulses corresponding to the shade or black-white characteristics of the transmitted picture. The facsimile signals are received and preferably rectified in a conventional manner and introduced to the connection leads 70 of the coils 71. The coils 71 are arranged concentric with and at opposite ends of the pivoted armature 63 to variably magnetize the armature and cause it to vibrate between the pole faces 72-72. The pole faces 72 are formed in two C-shaped opposing portions inwardly tapered toward the armature 63. Permanent magnets 73-73 are placed adjacent opposite sides of the pole pieces 72-72 to create a permanent magnetic field across the air gaps including the pivoted armature 63. Although my preferred illustration shows permanent magnets 73, it is evident that electromagnets may be substituted therefor to produce the uniform direct current field across the pole faces 72-72.

The coils 71-71 are preferably connected in series and the leads 70 for the coils 71 are directly connected to the output of an electronic amplifier for the received facsimile signals. The coil 71 may be connected in push-pull relation with a push-pull amplifier output stage or connected to a single tube amplifier output as desired. The single currents flowing through the coils 71-71 superimpose a variable magnetic field on the armature 63 and across the air gaps 74 to correspondingly oscillate the armature 63 about its pivotal support 65. The stylus arm 52, pivotally connected at 64 to the armature 63 is correspondingly oscillated in accordance with the signals received. The stylus point 53 is impinged against the record sheet 51 preferably during the black portions of the picture shading. By arranging the circuits to send current through the coil 71 during the dark picture portions, the stylus point 53 will be pressed against the record sheet during such dark portions to melt the wax coating thereon and represent a corresponding black or colored line on the reproduction.

A block 75 (Figure 1) is placed against the record sheet 51 opposite the scanning region to rigidly hold the sheet 51 in position during the excursions of the stylus point 53 against the sheet. The block 75 is arcuate to correspond to the path of the oscillating scanning point. The radial lines 76 on Figure 3 define the end portions of the scanner arm 40 in its oscillation path. By holding the record sheet 51 in the arcuate path 77 defined by the radius of the stylus, the sheet will be equidistant with respect to the stylus 53 at any point in its excursion. By adjusting the stylus point 53 to clear the record sheet 51, signals impressed upon the electromagnetic system 47 will cause the stylus point to advance toward the sheet held in the arcuate path 77 and correspondingly mark the record sheet. Accordingly, a black-white reproduction will result from the marking impulses of the stylus 53 moving in synchronism with the transmitter scanner.

The reciprocating stylus mechanism is designed to have a small moment of inertia and proportioned according to well known dynamic principles to be substantially equi-responsive to the whole frequency band necessary to translate the picture signals. Figure 7 is an enlarged detail cross-sectional view of the reciprocating stylus

mechanism actuated by the armature 63 which controls the movement of the stylus rod 52 at the end of which is secured the stylus point 53. The stylus section 53 which is heated by the coil 54 electrically connected to the battery 78, is preferably made of steel to resist wear. The stylus rod 52 is preferably made of very light material such as aluminum and is also hollow to reduce its mass and inertial reaction.

The scanner rod 52 is slidably supported in 10 bushing 80 at the end of the arm 40 and secured to the barrel 81 by set screw 82. Barrel 81 is pivotally supported by pins 64 at the top of armature 63. A spring 83 is contained within barrel 81. A plug or pin 79 is interposed between 15 the spring and the pivot 64. The spring is compressed so that the barrel is mechanically biased toward the stylus or record sheet with respect to the slidably contained pivot pin 64. A screw 84 is threaded into the barrel 81 and is operated 20 against the pivot pin 64 at the side opposite to the spring 83. The normal distance of the stylus point 53 from the record sheet 51 is adjusted by means of the screw 84. This adjustment is made by suitably positioning the barrel with respect to 25 the pivot 64 on armature 63. The barrel 81 is slotted at its midportion to permit such variable positioning. The spring 83 maintains the pivoted relation of the barrel 81 with respect to the pin 64 intake, as determined by the adjustment of screw 84. In a practical unit, I use a distance of .006 inch for the stylus point 53 away from sheet 51 corresponding to signal-off position. The signals corresponding to black energize the coils 71 of the electromagnetic structure 47 to 35 move the armature 63 and bring the stylus point 53 against the sheet 51.

I provide means to control the maximum movement or excursion of the stylus by the thumb screws 90 threaded in the base portion 48 of the recording unit 47. The screws 90 project into the unit 47 near the free end 91 of the armature 63. The end 91 is restrained from vibrating beyond the ends of the screws 90 and accordingly protects the stylus 53 from digging into the sheet 45 51 for an especially intense signal.

Figure 9 is a perspective view of the exterior of a facsimile receiver unit. The cable 86 contains the electrical connections for the motor 11, stylus heater coil 54, and the rectified facsimile 50 signals for the recording magnet structure 47. The positive reproductions of the transmitted picture are seen on the extended portion of the record sheet 51. The case 87 for the unit may have a streamlined and pleasing appearance as shown, particularly for home use where the unit should have a pleasing appearance and harmonize with the surrounding furniture. For aircraft installations and other applications where definite length or width requirements are had, 60 the arrangements of the motor and governor may be varied from the illustrated positions without departing from the spirit or scope of the present invention.

Although I have illustrated a preferred embodiment of my present invention, modifications will become evident to those skilled in the art and accordingly I do not intend to be limited except as set forth in the following claims.

I claim:

1. In a facsimile recording unit the combination of a stylus arm having a stylus at one end, with means for reciprocating said stylus against a record sheet including a rod armature, pivotally connected to said stylus arm and electromagnetic 75

means for actuating said armature in accordance with received facsimile signals comprising a magnetic pole structure having a substantially uniform field magnet portion and having an air gap individually cooperating with each end of said rod armature, coil means, responsive to said signals for variably controlling said magnetic field to correspondingly actuate said armature, said rod armature being pivotally and centrally supported within said pole structure and between said air gaps; means for moving said stylus in synchronism with the transmitter scanning operations comprising a member secured to said reciprocating means, and mechanism for oscillating said member; and means for controlling the maximum excursion of said stylus comprising two opposed screw members positioned adjacent the free end of said armature, adjustably positionable with respect to said free armature end whereby said screw members abut said armature when said armature vibrates a predetermined degree.

2. In a facsimile recording unit the combination of a stylus arm having a stylus at one end, with means for reciprocating said stylus against a record sheet including an armature connected to said stylus arm, and electromagnetic means for actuating said armature in accordance with received facsimile signals comprising a magnetic pole structure having a substantially uniform magnetic field; means for translating the motion of said armature to said stylus arm comprising a hollow tube and a pivot connecting said hollow tube to an end of said armature, the free end of said stylus arm being secured to one end of said tube and positioned to hold said stylus adjacent said record sheet; and means enclosed in said hollow tube for adjusting the distance between said stylus and said pivoted armature end.

3. In a facsimile recording unit, the combination of a stylus with means for reciprocating said stylus against a record sheet including a rod armature connected to said stylus, and electromagnetic means for actuating said armature in accordance with received facsimile signals comprising a magnetic pole structure having a substantially uniform magnetic field, and having an air gap individually cooperating with each end of said rod armature, said rod armature being pivotally and centrally supported within said pole structure and between said air gaps and a first and second solenoid surrounding portions of said rod armature and being responsive to said signals for variably controlling said magnetic field to correspondingly actuate said armature; means for translating the motion of said armature to said stylus comprising a tube and a pivot connecting said tube to an end of said armature to maintain said stylus in a spaced relation with respect to said armature and adjacent said record sheet; and means for adjusting the distance between said stylus and said armature comprising a barrel supporting said tube pivot connection and secured to the end of said tube remote from said stylus, a spring enclosed in said barrel for mechanically biasing said barrel and tube away from said pivot towards the record sheet and means for counteracting said spring bias and maintaining said barrel in a predetermined relation with respect to said pivot.

4. In a facsimile recording unit, the combina-

tion of a stylus with means for reciprocating said stylus against a record sheet including a rod armature connected to said stylus, and electromagnetic means for actuating said armature in accordance with received facsimile signals comprising a magnetic pole structure having a substantially uniform magnetic field, and having an air gap individually cooperating with each end of said rod armature, said rod armature being pivotally and centrally supported within said pole structure and between said air gaps and a first and second solenoid surrounding portions of said rod armature and being responsive to said signals for variably controlling said magnetic field to correspondingly actuate said armature; means for translating the motion of said armature to said stylus comprising a tube and a pivot connecting said tube to an end of said armature to maintain said stylus in a spaced relation with respect to said armature and adjacent said record sheet; a bracket secured to said structure containing means for slidably supporting said tube; means for moving said stylus in synchronism with the transmitter scanning operations comprising a member secured to said reciprocating means, and mechanism for oscillating said member; and means for adjusting the distance between said stylus and said armature comprising a barrel slidably supporting said tube pivot connection and secured to the end of said tube remote from said stylus, a spring enclosed in said barrel for mechanically biasing said barrel and tube away from said pivot towards the second sheet, and screw means for counteracting said spring bias and maintaining said barrel in a predetermined relation with respect to said pivot.

5. In a facsimile recording unit, the combination of a stylus with means for reciprocating said stylus against a record sheet including a rod armature connected to said stylus and electromagnetic means for actuating said armature in accordance with received facsimile signals comprising a magnetic pole structure having a substantially uniform field magnet portion and having an air gap individually cooperating with each end of said rod armature, a pin passing through the central region of said armature for pivotally supporting said armature within said pole structure, and a first and second solenoid surrounding opposite end portions of said rod armature and being responsive to said signals, for variably controlling said magnetic field to correspondingly actuate said armature; means for translating the motion of said armature to said stylus at substantially right angles with respect to the armature movements comprising a tube and a pivot connecting said tube to an end of said armature projecting from said structure, to maintain said stylus in a spaced relation with respect to said armature and adjacent said record sheet; a bracket secured to said structure containing means for slidably supporting said tube; means for moving said stylus in synchronism with the transmitter scanning operations comprising a shaft secured to said reciprocating means, and mechanism for oscillating said shaft including a cam; means for adjusting the distance between said stylus and said armature; and means for controlling the maximum excursion of said stylus.

WILLIAM G. H. FINCH.