May 1, 1945. W. G. H. FINCH 2,374,673

FACSIMILE RECORDER

Filed Sept. 22, 1942 13 Sheets-Sheet 1

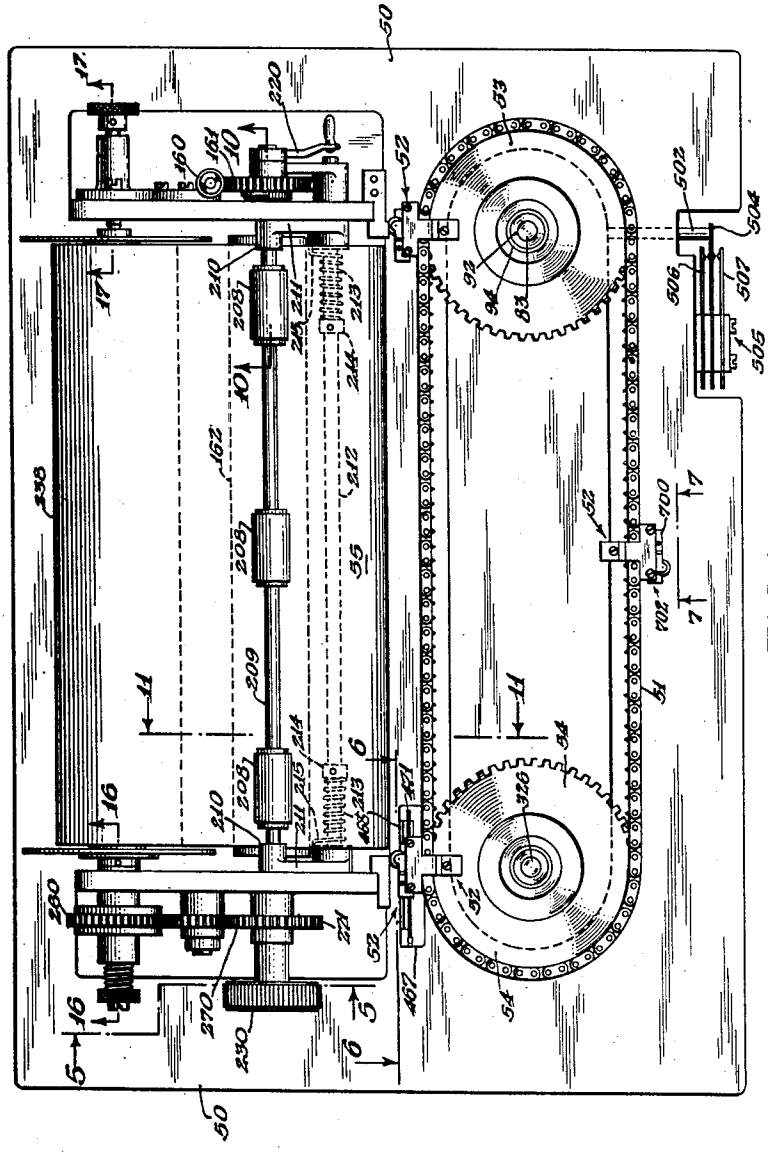


FIG. 1.

INVENTOR
WILLIAM G. H. FINCH

BY Samuel Astrobuk

ATTORNEY.

May 1, 1945. W. G. H. FINCH 2,374,673

FACSIMILE RECORDER

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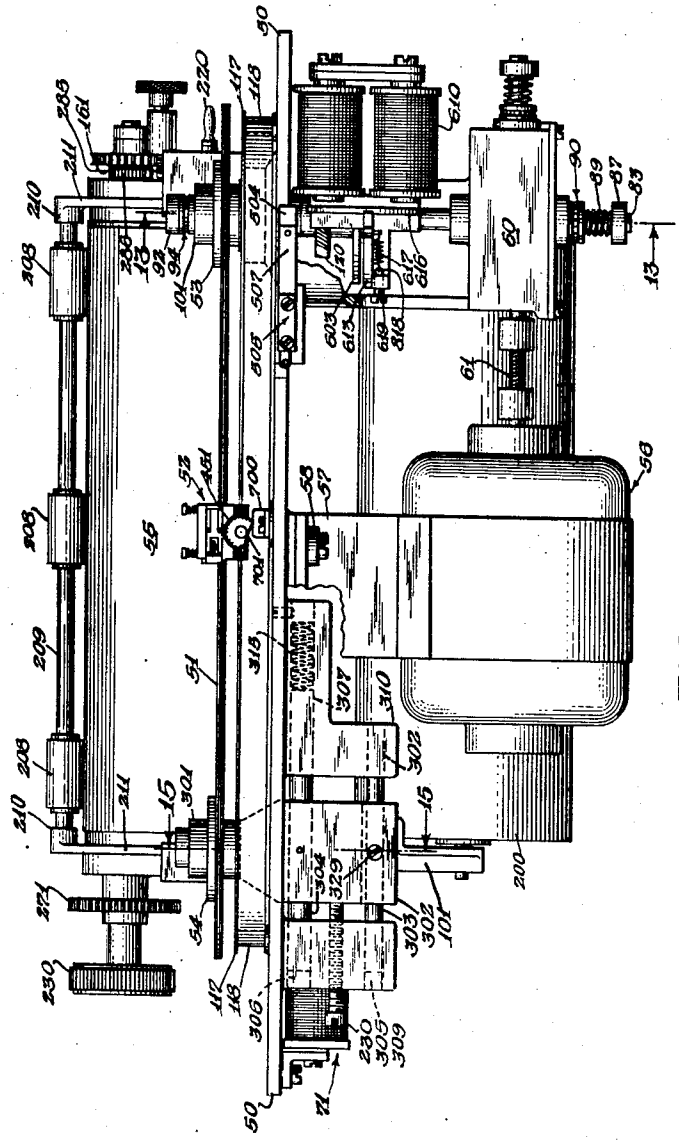


FIG. 2.

INVENTOR.
WILLIAM G. H. FINCH

BY Samuel Arthur
ATTORNEY.

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FACSIMILE RECORDER

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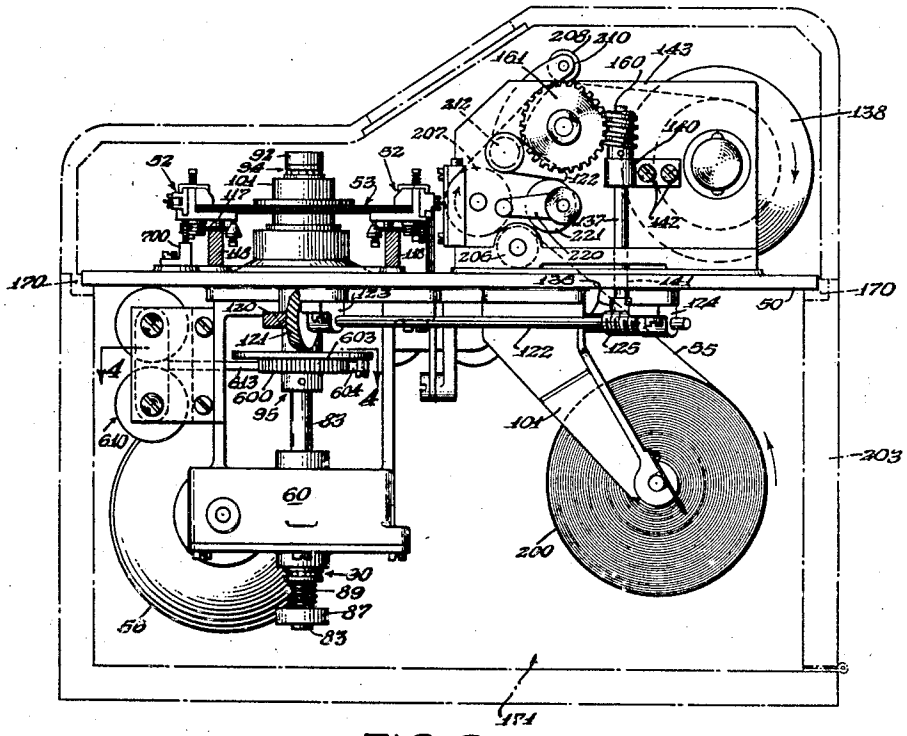


FIG. 3.

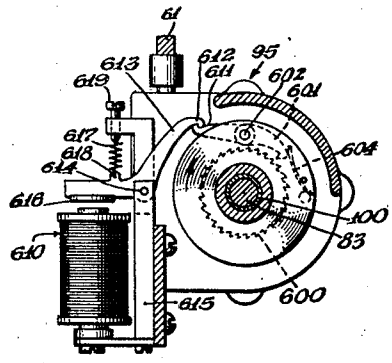


FIG. 4.

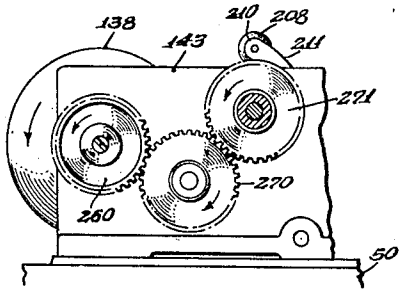


FIG. 5.

INVENTOR.
WILLIAM G. H. FINCH

BY Samuel Ostrolenk
ATTORNEY.

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FACSIMILE RECORDER

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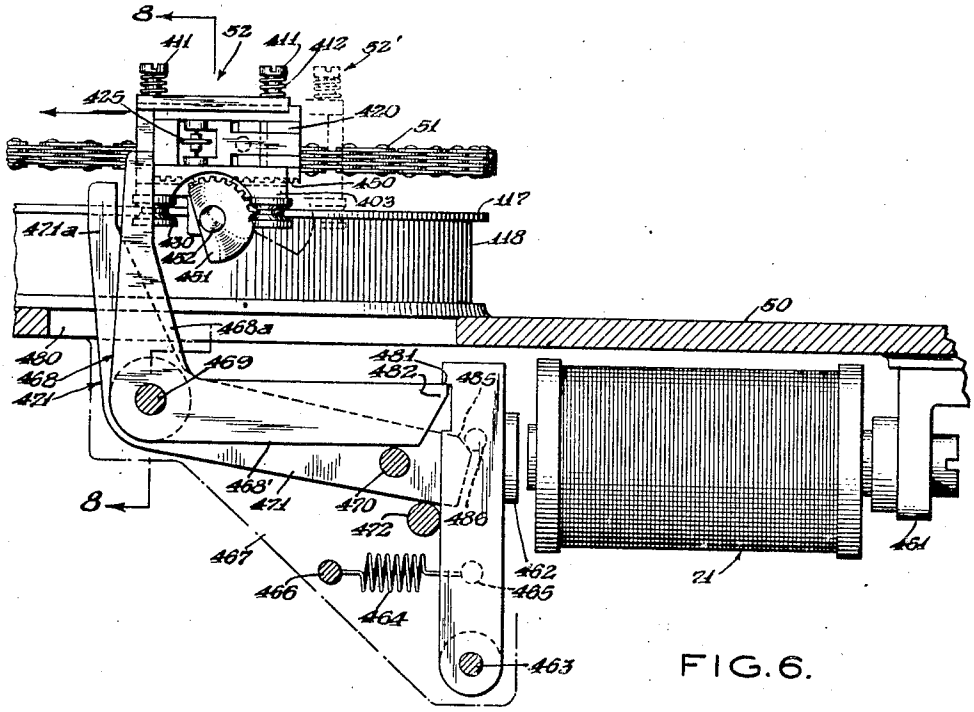


FIG. 6.

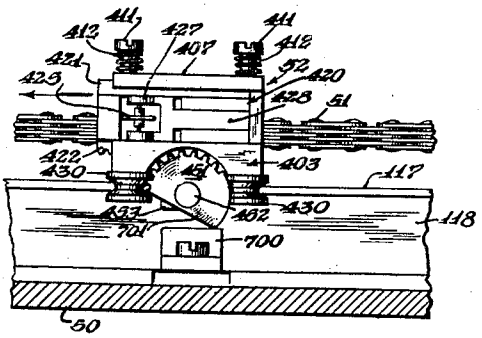


FIG. 7.

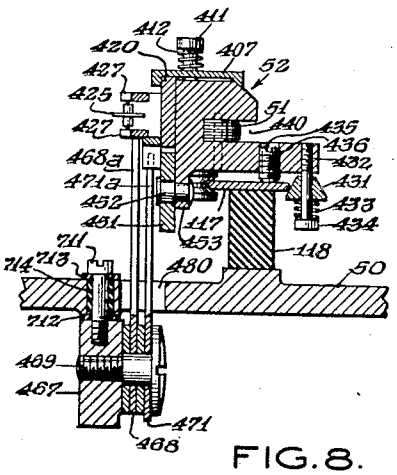


FIG. 8.

INVENTOR.
WILLIAM G. H. FINCH

BY Samuel Rothstein
ATTORNEY.

May 1, 1945. W. G. H. FINCH 2,374,673

FACSIMILE RECORDER

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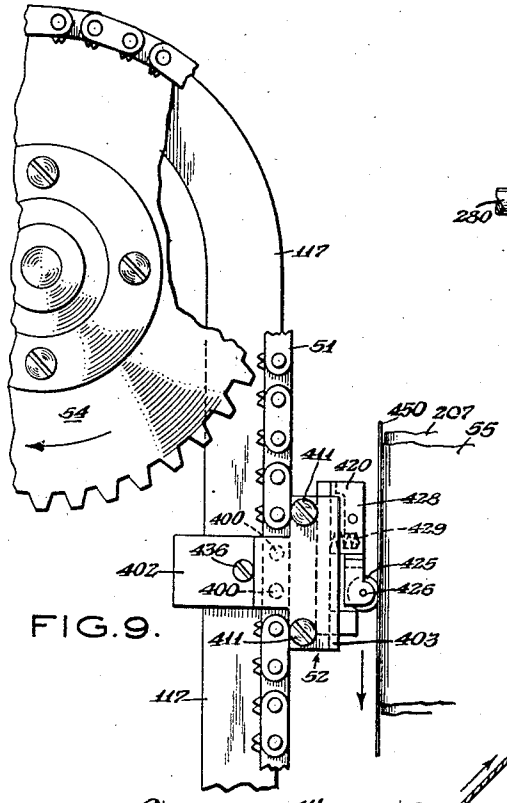


FIG. 9.

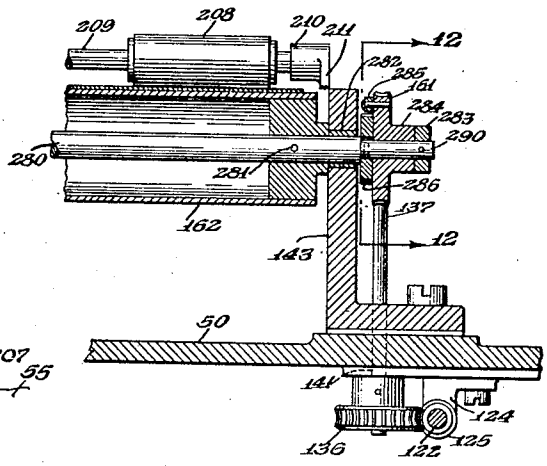


FIG. 10.

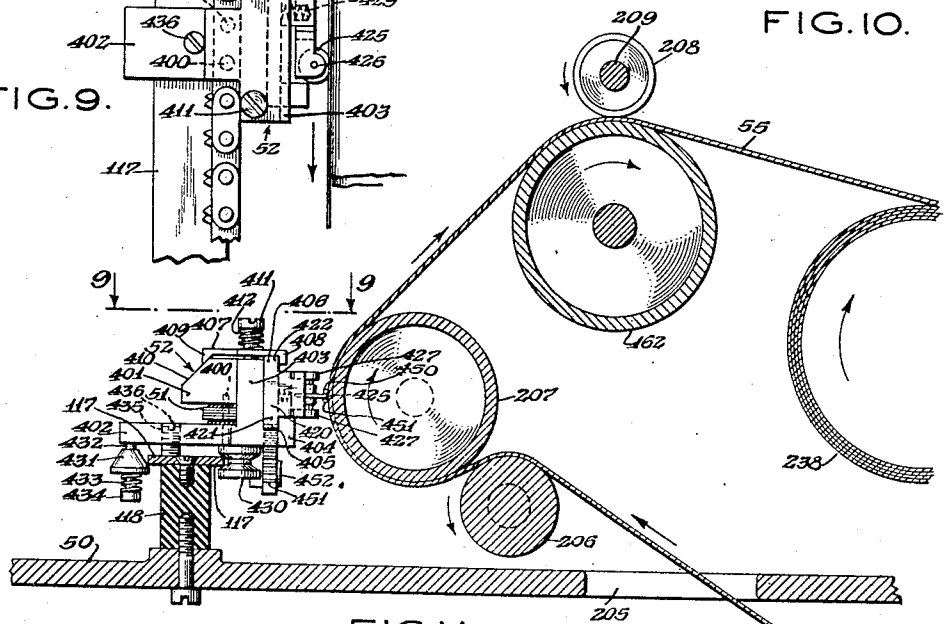


FIG. 11.

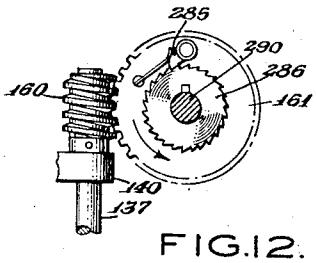
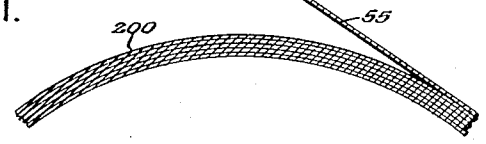


FIG. 12.



INVENTOR.
WILLIAM G. H. FINCH

BY Samuel Ostrolenk
ATTORNEY.

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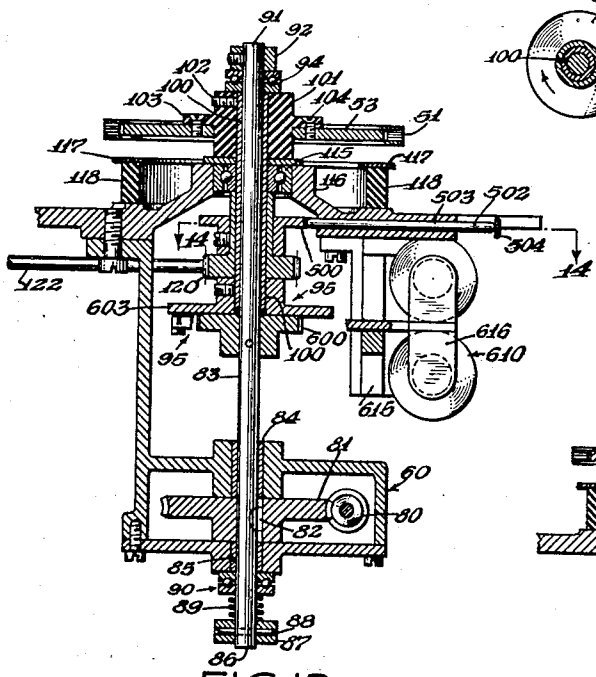


FIG.13.

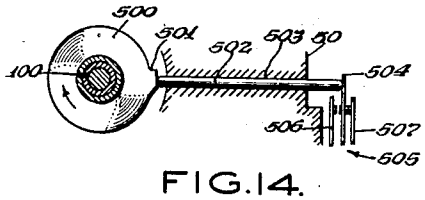


FIG.14.

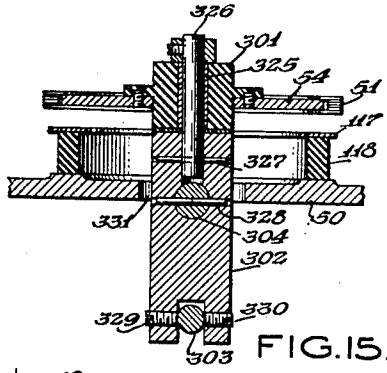


FIG.15.

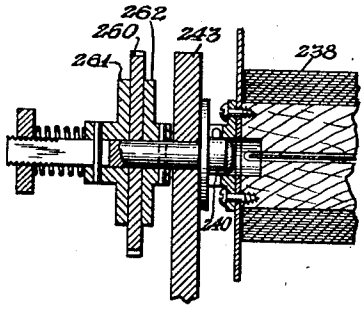


FIG.16.

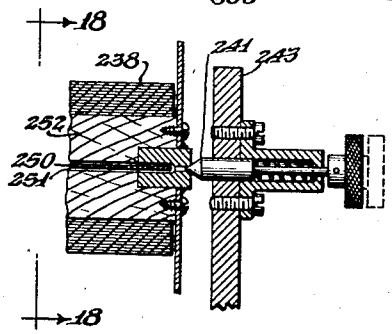


FIG.17.

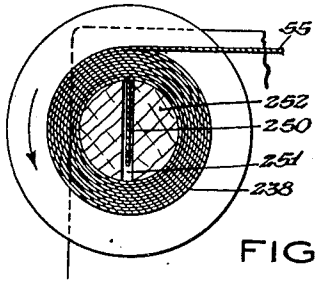


FIG.18.

BY

INVENTOR.
WILLIAM G. H. FINCH

Samuel Ostrolenk
ATTORNEY.

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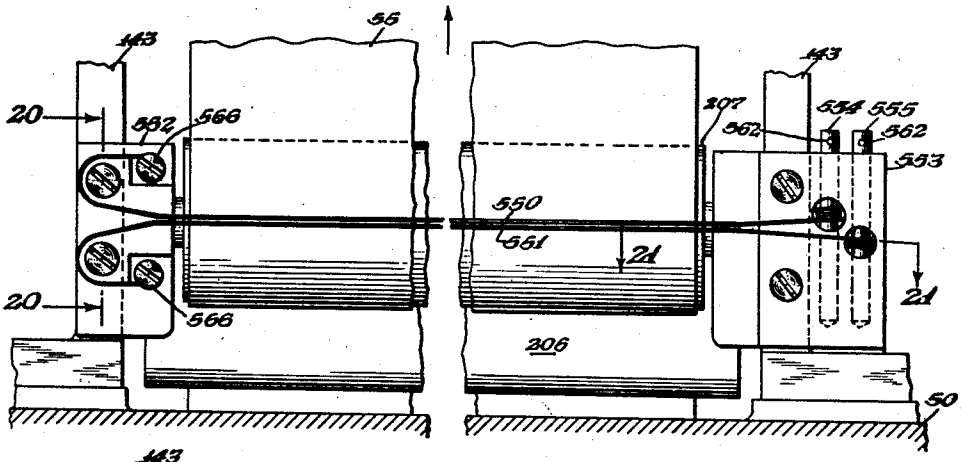


FIG. 19.

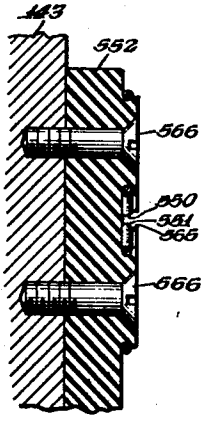


FIG. 20

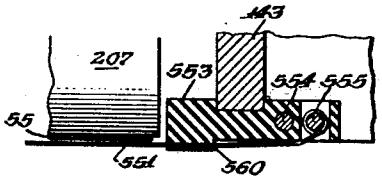


FIG. 21.

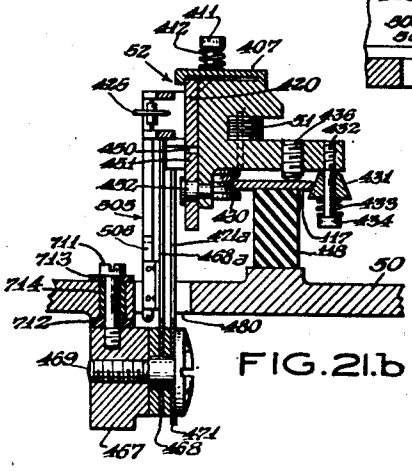


FIG. 21.b

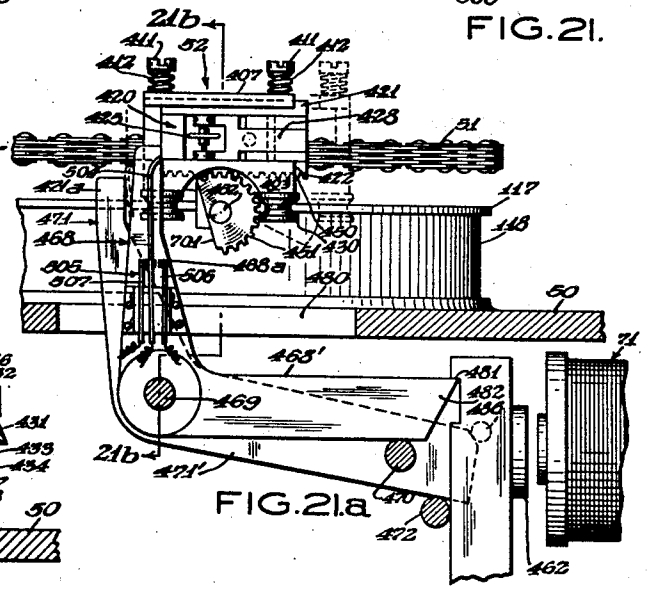


FIG. 21.a

INVENTOR.
WILLIAM G. H. FINCH

BY

ATTORNEY.

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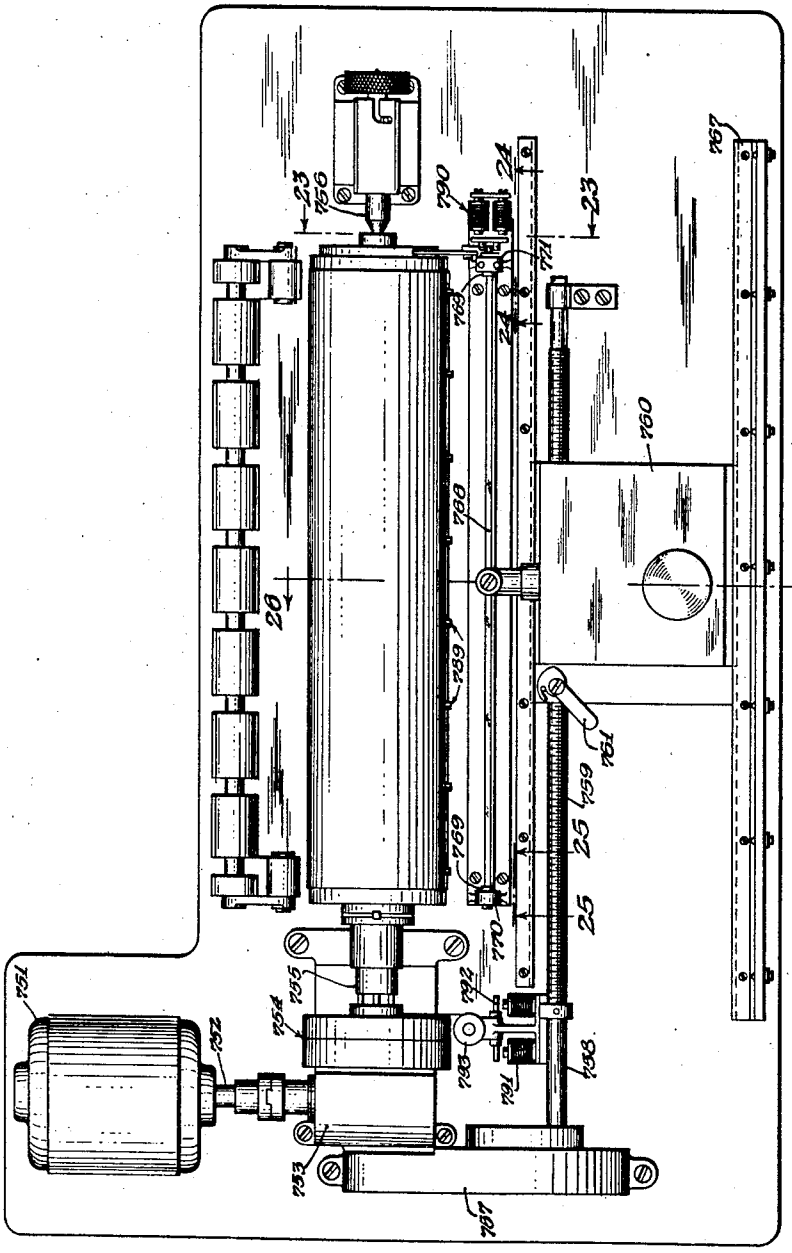


FIG. 22.

INVENTOR.
WILLIAM G. H. FINCH

BY

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May 1, 1945. W. G. H. FINCH 2,374,673

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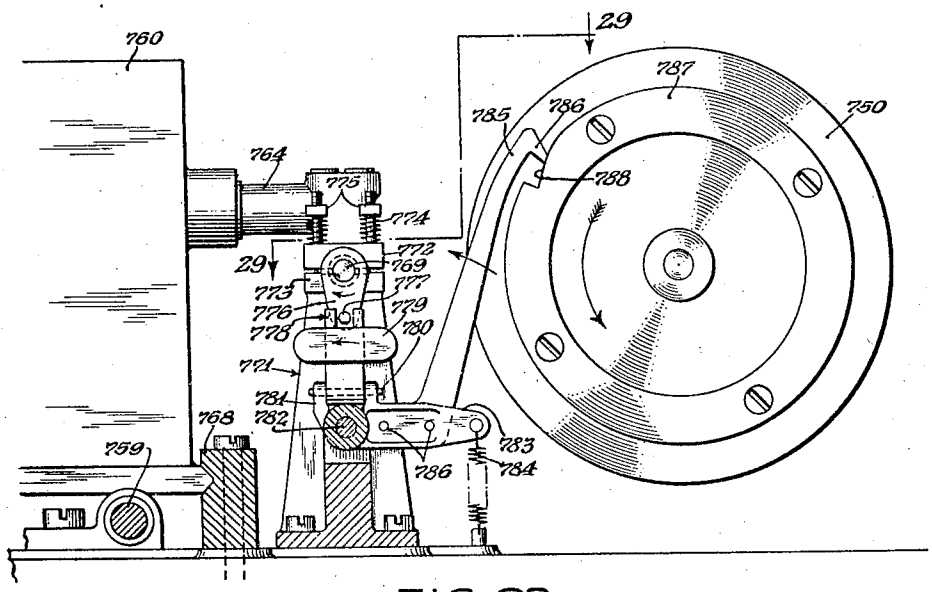


FIG.23.

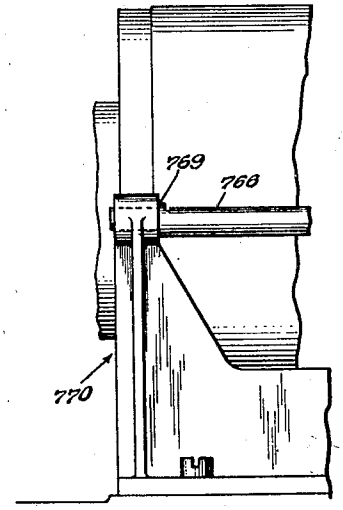


FIG.25.

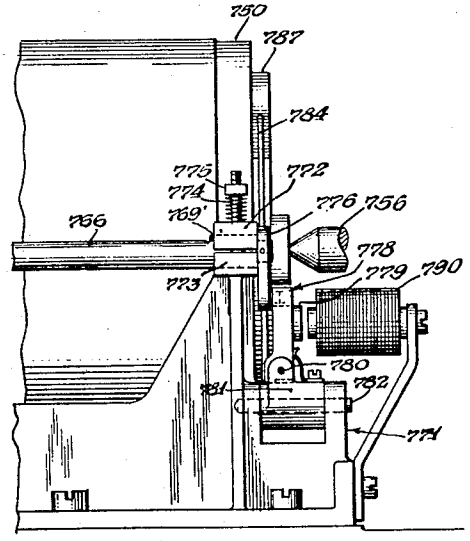


FIG.24.

INVENTOR.
WILLIAM G. H. FINCH

BY

ATTORNEY.

May 1, 1945. W. G. H. FINCH 2,374,673

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FIG. 27.

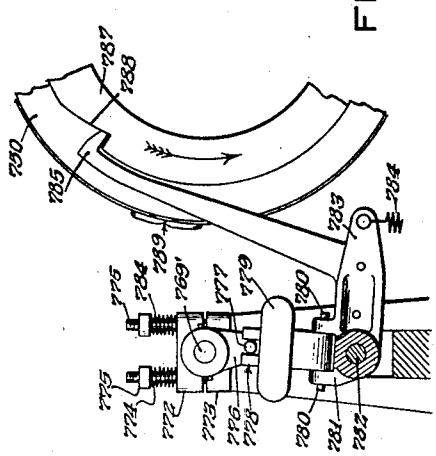


FIG. 26.

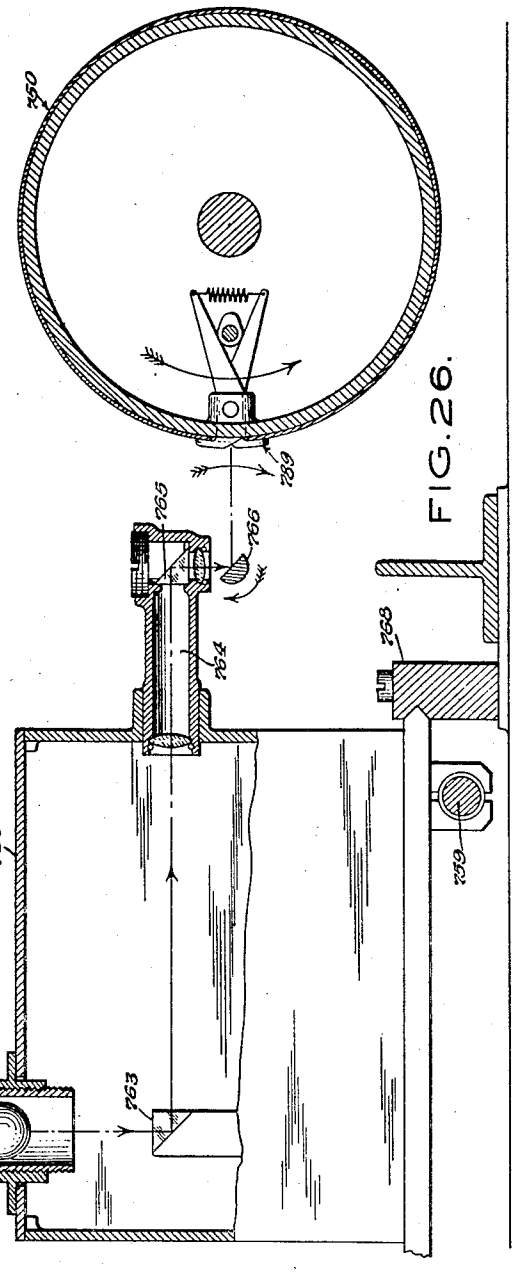
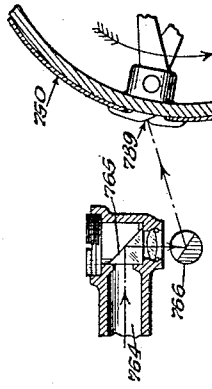


FIG. 28.



INVENTOR.
WILLIAM G. H. FINCH

BY

ATTORNEY.

May 1, 1945. W. G. H. FINCH 2,374,673

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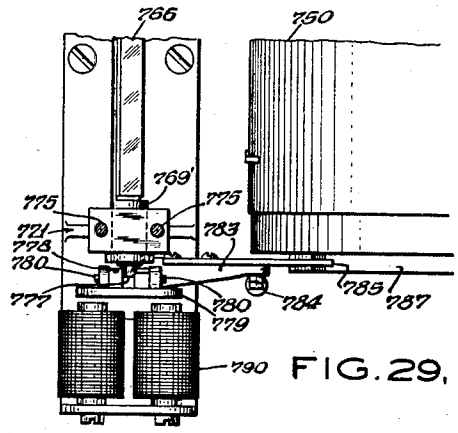


FIG. 29.

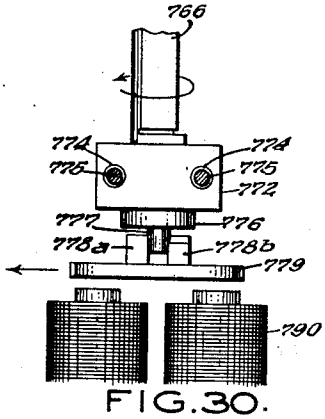


FIG. 30.

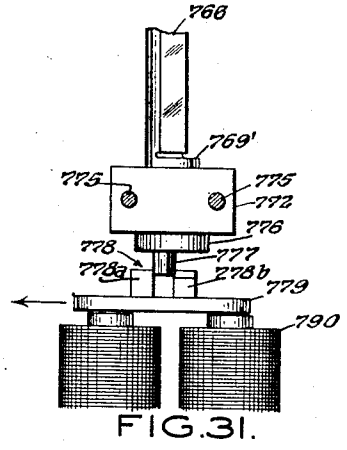


FIG. 31.

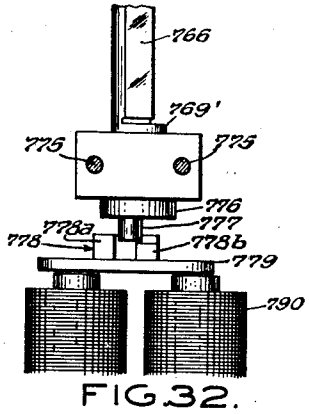


FIG. 32.

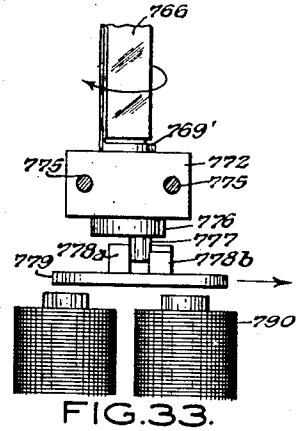


FIG. 33.

INVENTOR
WILLIAM G. H. FINCH

BY

ATTORNEY.

May 1, 1945. W. G. H. FINCH 2,374,673

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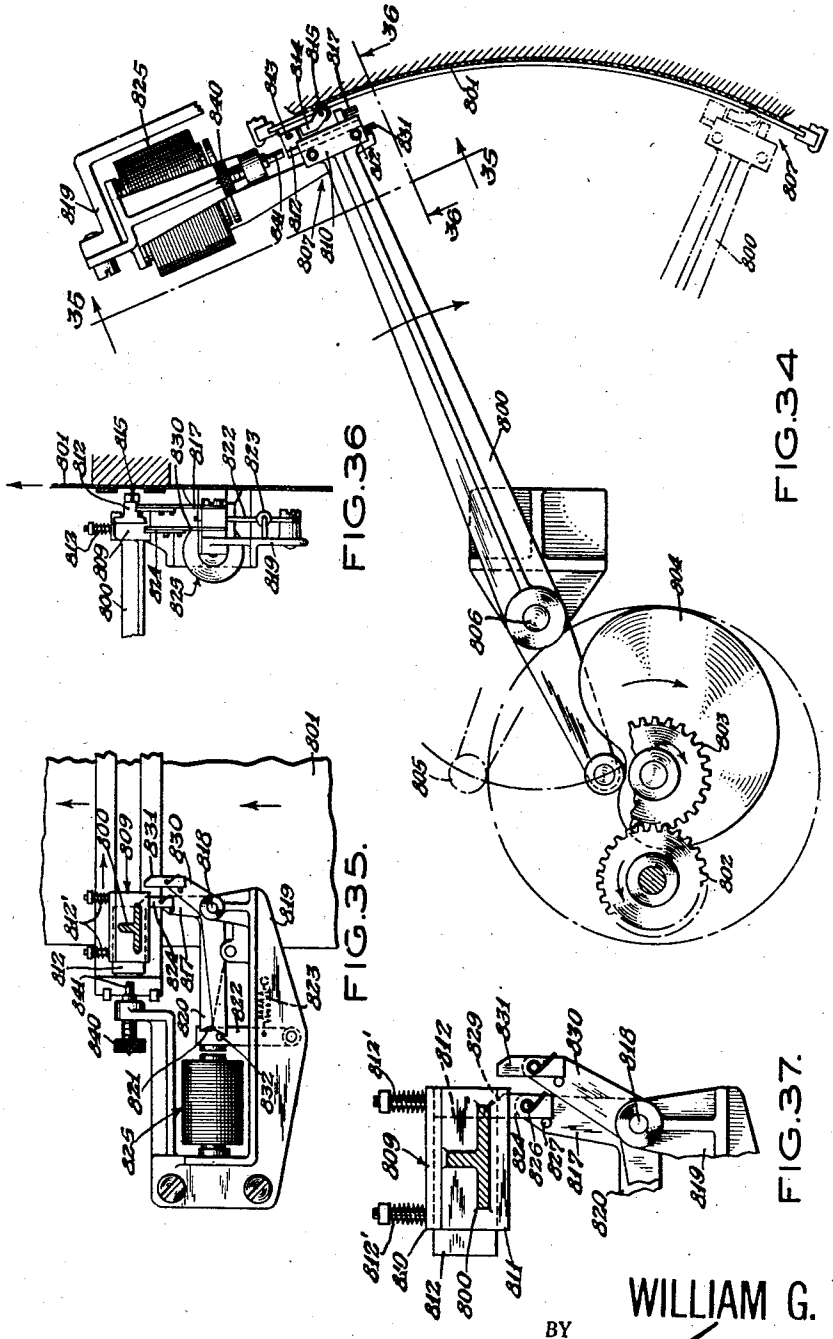


FIG. 34

FIG. 36

FIG. 35.

FIG. 37.

INVENTOR.
WILLIAM G. H. FINCH

BY

ATTORNEY.

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FACSIMILE RECORDER

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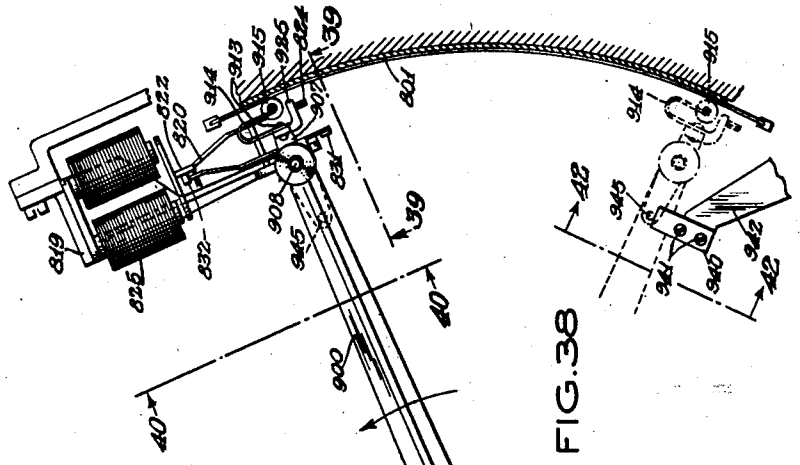


FIG. 38

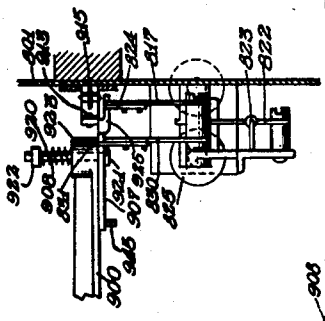


FIG. 39

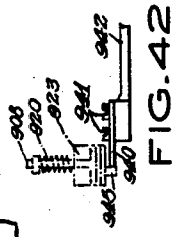


FIG. 42

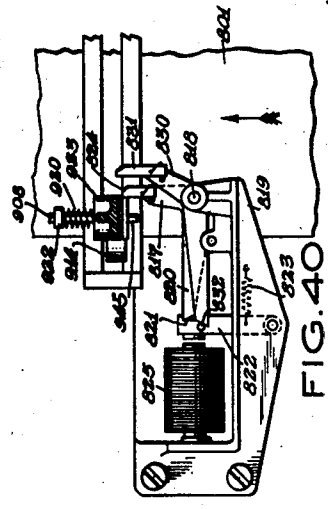


FIG. 40

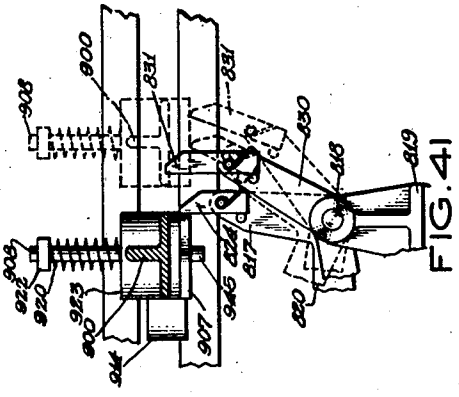


FIG. 41

INVENTOR.
WILLIAM G. H. FINCH

BY Samuel Osterlund
ATTORNEY.

Patented May 1, 1945

2,374,673

UNITED STATES PATENT OFFICE

2,374,673

FACSIMILE RECORDER

William G. H. Finch, Newtown, Conn., assignor to Finch Telecommunications, Inc., Passaic, N. J., a corporation of Delaware

Original application May 10, 1940, Serial No. 334,404. Divided and this application September 22, 1942, Serial No. 459,319

13 Claims. (Cl. 178—6.6)

My present invention is a division of the application Serial No. 334,404, filed May 10, 1940, patented Sept. 22, 1942, No. 2,296,274, and relates to the transmission and reception of facsimile signals and more particularly to synchronizing apparatus for use in connection therewith, said synchronizing apparatus particularly at the receiving and being so arranged that a minimum number of parts are brought to a stop in order to await any particular synchronizing signal.

Heretofore in the operation of facsimile apparatus and particularly of facsimile receivers, it has been necessary in order to obtain line by line synchronism in line by line scanning to halt some portion of the reception apparatus sometime after the end of a scanning cycle and just before the commencement of the next one.

The apparatus then was started by the reception of the synchronizing impulse which permitted the scanning member of the receiving apparatus to commence a new scanning excursion simultaneously with the commencement of the scanning excursion at the transmitting end.

Accordingly it was necessary to design the apparatus so that the scanning means itself was brought to a stop at the end of a scanning cycle and before the beginning of the next scanning cycle and it was necessary to design means for holding the entire scanning apparatus in a stationary position pending the receipt of the synchronizing impulse.

In the ordinary case, therefore, where exact synchronism was desired, it was necessary that the receiving apparatus be slightly faster than the transmitting apparatus in order to ensure that the receiving apparatus would be ready for the receipt of the next synchronizing impulse.

The difficulties which arose by reason of the necessity of halting the operation of the receiving apparatus pending the receipt of the synchronizing impulse were present in each of the general types of receiving apparatus. Thus, whether the receiving apparatus comprised a multistylus chain drive or an oscillating stylus mounted on a scanning arm or a light beam scanning device moving longitudinally along a revolving drum, it became necessary to stop a relatively great mass at the end of a particular scanning cycle and to bring this relatively great mass into motion once more immediately upon receipt of the synchronizing impulse.

Thus in the case of the multistylus continuous facsimile receiver wherein a number of styli (preferably three) were mounted upon a chain and wherein the chain was supported by a pair of oppositely disposed sprockets which in turn were driven from the motor or other source of power, it was necessary to bring the drive shaft of the sprockets, the sprockets themselves, and the chain to a stop at the end of each scanning excursion in order to bring the stylus to a stop and then to bring all of these elements into movement once more immediately upon the receipt of the synchronizing impulse.

Likewise in the case of the stylus mounted upon an oscillating arm wherein the oscillating arm was continuously reciprocated back and forth, scanning on its excursion in one direction and returning in the opposite direction while the paper advanced; and wherein the oscillating arm was driven in any suitable manner by, for instance, a cam connection to a shaft, it was necessary to bring the shaft, cam and oscillating arm to a stop immediately before the commencement of the scanning excursion in order to await the synchronizing impulse and then to bring all of these elements into motion once more immediately upon receipt of the synchronizing impulse.

The difficulty arising from the necessity of bringing all of these elements to a stop was not merely academic. In many cases of facsimile reception there are a hundred or more scanning lines to an inch and it is important that adjacent scanning lines should not overlap.

It is further important that the individual facsimile impulses be properly spaced with respect to each other in order to obtain clear definition in the received picture.

Accordingly any even slight vibration inherent in the operation of the reception apparatus might tend seriously to mar the picture. Accordingly in prior facsimile apparatus it was essential that the apparatus be mounted on a heavy cast iron base and it was further useful to incorporate therein various complicated shock absorbing devices which would tend to inhibit whatever vibration necessarily resulted from the continuously recurring starting and stopping of masses which, with respect to the size of the actual scanning stylus or beam were relatively great.

This same difficulty was present with equal if not greater force in the light beam scanning reception apparatus wherein the light beam traversed a reception drum longitudinally while the drum revolved. In this case it was necessary not merely to bring the light beam scan-

ning apparatus itself to a stop but also to bring the receiving drum to a stop upon the completion of a scanning line and immediately before the inception of the next scanning line in order to await the receipt of the synchronizing impulse.

A second and equally important object of the present invention is to make it possible for virtually all of the moving parts of the receiving apparatus to maintain their constant movement while at the same time relying upon the synchronizing impulse to initiate the actual scanning operation.

Another object of the present invention is to so mount and relate the actual scanning member itself to the various other moving parts that it is only the relatively small mass of the actual stylus or other scanning element which must be stopped or the motion of which must be changed in order to obtain proper synchronization.

Still another object of the invention is to obtain proper synchronization while the moving parts of the receiving scanner may maintain constant uninterrupted unchanged movement.

Still a further object of the present invention is to provide a synchronizing apparatus wherein the speed of the receiving apparatus may be cut down to almost that of the transmitting apparatus.

Still another object of the present invention is to provide a means for obtaining automatic phasing at the start of the picture transmission and for automatically phasing the receiving apparatus at various selected intervals controllable from the transmitting station.

Since in many cases, facsimile receiving apparatus is to be used in the home by unskilled operators, it is essential that virtually all of the operations thereof be either greatly simplified or if possible, controlled from the transmitting station.

Accordingly, the automatic phasing means herein provided will increase the utility of this apparatus in the home. Furthermore, the automatic phasing means herein provided may be arranged to coact with the scanning element in order to reposition the scanning element with respect to its drive apparatus at selected intervals in order to ensure that the scanning element will remain aligned with its driving elements.

There are many other objects and uses of the present invention part of which will be apparent and part pointed out in the following description and drawings, in which:

Figure 1 is a top plan view of a multi-stylus facsimile recorder utilizing the principle of my invention.

Figure 2 is a side view of the apparatus of Figure 1.

Figure 3 is an end view of the apparatus of Figure 1.

Figure 4 is a cross-sectional view taken on line 4—4 of Figure 3.

Figure 5 is an end view taken along the line 5—5 of Figure 1.

Figure 6 is a view partly in cross-section showing the front of the scanner and is taken from line 6—6 of Figure 1.

Figure 7 is a view partly in cross-section taken along line 7—7 of Figure 1 showing the resetting means for the stylus.

Figure 8 is a cross-sectional view taken along line 8—8 of Figure 6.

Figure 9 is a top view partly broken away taken along the line 9—9 of Figure 11.

Figure 10 is a cross-sectional view taken along line 10—10 of Figure 1.

Figure 11 is a cross-sectional view taken along line 11—11 of Figure 1 showing the paper feed.

Figure 12 is a cross-sectional view taken along line 12—12 of Figure 10.

Figure 13 is a cross-sectional view taken along line 13—13 of Figure 2 showing the chain and sprocket drive.

Figure 14 is a cross-sectional view taken along line 14—14 of Figure 13.

Figure 15 is a cross-sectional view taken along line 15—15 of Figure 2.

Figure 16 is a cross-sectional view taken along line 16—16 of Figure 1.

Figure 17 is a cross-sectional view taken along line 17—17 of Figure 1.

Figure 18 is a cross-sectional view taken along line 18—18 of Figure 17.

Figure 19 is a view of the portion of the paper surface contacted by the stylus and showing guides for the scanning stylus of Figure 1.

Figure 20 is a cross-sectional view taken along line 20—20 of Figure 19.

Figure 21 is a cross-sectional view taken along line 21—21 of Figure 19.

Figure 21*a* is a view corresponding to a portion of Figure 6 showing a modified form of relay construction.

Figure 21*b* is a cross-sectional view of line 21*b*—21*b* of Figure 21*a*.

Figure 22 is a top plan view of light beam scanner recorder utilizing the principles of the present invention.

Figure 23 is an end view partly in cross-section taken along line 23—23 of Figure 22.

Figure 24 is a cross-sectional view partly in elevation taken along line 24—24 of Figure 22.

Figure 25 is a cross-sectional view partly in elevation taken along line 25—25 of Figure 22.

Figure 26 is a cross-sectional view taken on line 26—26 of Figure 22.

Figure 27 is a view corresponding to a portion of Figure 23 showing another position of the parts thereof.

Figure 28 is a view corresponding to a portion of Figure 26 showing another position of the parts thereof.

Figure 29 is a top plan view taken along line 29—29 of Figure 23 showing one position of the synchronizing elements.

Figures 30, 31, 32 and 33 correspond to Figure 29 showing the different positions of the parts thereof.

Figure 34 is a top plan view of an apparatus illustrating a modified application of my invention to an oscillating arm scanner.

Figure 35 is an elevation partly in cross-section taken along line 35—35 of Figure 34.

Figure 36 is a cross-sectional view taken along line 36—36 of Figure 34.

Figure 37 is an enlarged view of a portion of Figure 35.

Figure 38 is a top plan view illustrating a slight modification of the construction of Figure 34 as likewise applied to an oscillating scanning arm.

Figure 39 is a cross-sectional view partly in elevation taken on line 39—39 of Figure 38.

Figure 40 is a cross-sectional view partly in elevation taken on line 40—40 of Figure 38.

Figure 41 is an enlarged view of a portion of Figure 40.

Figure 42 is a view taken along line 42—42 of Figure 38.

Referring now to Figures 1, 2 and 3, the recorder of this embodiment is arranged for compactness and simplicity of construction and operation consistent with quality high speed recording. The recorder may be designed for mounting in a portable cabinet of a type and size similar, for instance, to a radio console cabinet, a suitcase or other similar stationary or portable article. The recorder arrangement may also be designed for directly viewing the recorded matter as the recording progresses.

The multistylus drive assembly may, if desired, be mounted upon a cast iron base 50 (Figures 1 and 3). An endless belt or sprocket chain 51 (Figures 1 and 2) is used as a carrier for the individual styli assemblies 52 (Figures 2 and 3), and is driven by sprocket gear 53 (Figure 1) cooperating with idler sprocket 54. The chain 51 is preferably of such length that it is relatively taut between the sprockets and the sprockets are correspondingly spaced for this purpose. The styli assemblies 52 are mounted at equidistant points on the chain 51 at intervals substantially equal to the width of the recording sheet 55.

Stylus assemblies 52 are movable in a plane parallel to the base 50 and individually and successively cooperate with the recording sheet once for each revolution of the chain 51.

An electric motor 56 is supported beneath the recorder base 50 by bracket 57 which in turn is secured to the under side of the recorder base by the bolt 58. Motor 56 is preferably of the non-synchronous type operable from an alternating or direct current power supply.

Motor 56 is coupled to a drive shaft 83 through worm gear arrangement enclosed in housing 60 shown in section in Figure 13. Any suitable connection may be made between the motor 56 and the arrangement enclosed in housing 60. A preferred form shown particularly in Figure 2 is the flexible cable 61 which is used to connect the motor shaft with the gearing arrangement.

The synchronizing magnet 71 supported beneath the base 50 as seen in Figures 2 and 13 is responsive to received cyclic impulses and cooperates with the driven mechanism to establish a proper phase position for each stylus of each of the stylus assemblies 52 at the beginning of each recording excursion of each of the stylus assemblies.

This cyclic synchronizing action which constitutes the major portion of this invention will be hereinafter described in greater detail and will be more fully understood when the action of the various parts of the recording unit is first explained.

The motor 56 through the flexible cable 61 drives the worm 80 within the housing 60. This worm 80 meshes with the worm gear 81 which by means of the key 82 is mounted upon the drive shaft 83 in such manner that rotation of the worm gear 81 results in rotation of the shaft 83. The shaft 83 is positioned by and rotates in the journals 84 and 85, the end 86 of the shaft 83 being captured in the collar 87, which is connected thereto by the pin 88.

Compression spring 89 is located on the shaft 83 between the collar 87 and the thrust bearing 90 and thus serves accurately to position the shaft 83 while it rotates and thus serves further to reduce any possible frictional loss at the base of the housing.

The opposite end 91 of the shaft 83 is likewise captured in a collar 92 by means of the screw 93. This collar bears against the thrust bearing 94 which in turn carries the thrust of the end of the shaft 91. Compression spring 89 thus accurately positions the shaft 83 against the two thrust bearings and the thrust bearings 90 and 94 serve to isolate the shaft 83 from the remainder of the mechanism and make it possible to provide a releasable drive or clutch 95 for the sprocket 53. While this releasable drive or clutch 95 appears in Figures 3 and 13, it is shown most clearly in Figure 4 and will be hereinafter described in connection with the further description of the process of obtaining and maintaining synchronism.

The sprocket 53 is not driven directly by the shaft 83 but instead is driven by the hollow shaft or sleeve 100 (Figure 13) which rotates about the shaft 83 and which is independent of shaft 83. Shaft 100 carries at the upper end thereof, as seen in Figure 13, an insulating sleeve 101 which is secured thereto in any suitable manner as, for instance, by the screw 102. The insulating sleeve 101 has a peripheral extension 103 thereon which, by means of the screws 104 carries the sprocket 53. The sprocket 53 is thus insulatedly supported upon the shaft 100 and when the shaft 100 is driven, the sprocket 53 is caused thereby to rotate and hence to move the chain 51 in the appropriate direction as is hereinafter described.

Appropriate bearings 115 may be provided for the sleeve 100 in suitable extensions or mountings 116 of the base 50. The track member 117, mounted on the insulating support 118, serves as a guide for the stylus assemblies in the manner hereinafter described; these members, for this purpose, extend longitudinally along the path of the stylus assemblies and guide the assemblies around the sprockets.

The driven synchronized shaft carries a spiral gear 120 (Figures 13 and 3), which drives the gear 121. The gears 120 and 121 are the source of power for the paper drive and hence ensure that the movement of the paper will be exactly synchronous with the operation of the scanning device.

The gear 121 is keyed to the rod 122 which is mounted in suitable bearings 123 and 124 on the under side of the base 50. The rotation of the rod 122 results in rotation of the worm at the opposite end thereof, 125. This worm meshes with the gear 136 which in turn is keyed to rod 137 and hence rotates the same. (See Figure 10 as well as Figure 3.)

Rotatable rod 137 is mounted in appropriate bearings 140 and 141, the bearing 140 being secured by screws 142 to a bracket 143 which in turn is supported on the base 50 and the bearing 141 being provided by a suitable bore in the base 50.

The rod 137 carries at the opposite end thereof from the gear 136 a worm 160 which meshes with a cooperating gear 161. (See Figure 3 and especially Figure 10.) Worm gear 161 rotates the paper feed roll 162 in a manner hereinafter to be described.

In a suitable embodiment of this form of the invention, as shown in Figure 3, a supporting cabinet indicated by the dotted lines of said figure may be used. The recorder base 50 sets into recesses at the top corners 170 of the bottom section 171. A removable cover 172 is fitted onto the bottom section of the cabinet 171. A transparent window 173 may be set above the recording area in order to permit direct viewing of the recording as it is performed; the transparent window may simply be an opening or may have a glass or any other transparent protective surface.

A roll of sensitized paper 200 is mounted beneath the recorder base 50 between the brackets 201—201 (see Figures 2 and 3). The rear side 203 of the cabinet may be hinged at 204 to permit the insertion of the roll of recording paper without otherwise making it necessary to disassemble the recorder.

The recording sheet 55 passes from the roll 200 through an opening 205 in the recorder base 50 whence it is then threaded over the guide roll 206 around the platen 207 over the drive roll 162 and onto the take up roll 238 (see also Figure 11).

A plurality of spaced rollers 208, Figures 1, 2, 10 and 11, preferably of rubber are arranged on a rod 209 in such a manner as to press the record sheet 55 against the feed roller 162 during the recording operation. The pressing rod 209 is mounted at either end in sockets 210 of the brackets 211. The brackets 211 are mounted on the ends of the rod 212 (see dotted lines of Figure 1).

Spiral spring 213 is at one end secured at 214 to the rod 212 and at the other end at 215 biases the brackets 211 in such direction as to press the presser rod 209 upon the feed roll 162 and hence to force the rubber rollers 208 upon the feed roll.

A crank arm 220 is provided for separating the rubber rollers 208 from the feeding roll 162 when it is desired to thread the sheet 55 between the spring biased pressure rolls 208 and the feed roller 162. As seen in Figure 3, a cam or eccentrically positioned disk 221 is arranged on the axis of support of the lever or crank arm 220 and coacts with the finger 222 secured to the rod 212.

Rotation of the handle 220 results in corresponding rotation of the cam 221 thus raising the finger 22 and thereby rotating the rod 212 against the mechanical bias of the springs 213 and thereby rotating the brackets 211 and moving the pressure roller 208 away from the feed roller 162.

In order further to assist in the threading operation, a knurled hard rubber knob 230 (Figure 2) may be secured to the left end of the shaft supporting the feed roller 162. By turning the knob 230 feed rollers 162 may be independently driven and record sheet 55 may be advanced until all the recorded matter projects beyond the pressure rollers 208.

The recording sheet may then be torn at the region beyond the pressure rollers and the recorded matter may then be withdrawn from the facsimile unit by removal of the take up roll 238.

As is seen in Figures 16 and 17, the take up roll 238 is removably supported by the drive shaft 240 and the tail stock 241 as will be hereinafter more specifically pointed out.

The recording paper in the present invention is positively fed in the appropriate direction for successive line by line scanning and the tension is uniformly maintained across the recording region of the recording sheet 55 no matter how wide the particular sheet may be.

As shown in Figure 18, the free end 250 of the recording sheet 55 is inserted in the slot 251 in the spool 252 of the take up roll 238. The take up roll 238 is mounted for rotation between the frame up-rights 143—143 by means of the driving shaft or plate 240 and the tail stock arrangement 241. Drive shaft or plate 240 is connected with the gear 260 through the friction clutch 261—262 as seen in Figures 1 and 16.

Gear 260 is driven through the idler gear 270 by the gear 271 which in turn is mounted upon and rotates with the shaft of the feed roller 162. The gearing ratio between the gear 271 and the gear 260 is designed to overdrive take up roll 238 to maintain a constant tension in the record sheet 55 during the normal feeding operation of recording.

A frictional slip occurs at the over driven feed roll 238 to keep sheet 55 taut as will be further described in detail in connection with Figures 16 and 17. The feed or drive roll 162 is operated through the gear 161 as heretofore described particularly in connection with Figure 10. Figure 10 shows in section the connection between the gear 161 and the shaft 280 of the feed roll 162.

The roller 162 is secured by pins 281 or any other suitable means to the shaft 280, the said shaft 280 being mounted in suitable bushings 282 in the uprights 143. The gear 161 is mounted on the extension 290 of the shaft 280 and is rotatable with respect to said extension.

A washer 283 is pinned at the end of the extension 290 of the shaft 280 and abuts the outer end of the hub 284 of the gear 161 in order to retain the gear 161 in fixed axial position. A pawl 285 is mounted near the periphery of the gear 161 and an associated ratchet 286 is pinned to the extension 290 of the shaft 280 in order to effect a positive drive connection between the gear 161 and the roller shaft 280.

The surface of the feed roll 162 is metallic in order to afford a continuous electrical contact to the recording sheet for electrochemical recording action. The metallic portion of feed roll 162 is connected to ground or frame potential forming the opposite potential to that of the stylus assembly. As seen in Figure 12, engagement of pawl and ratchet 285—286 occurs when the gear 161 rotates in a counterclockwise direction. A positive drive is thus effected between the gear 161 and the drive roller 162 in the proper counterclockwise direction during the continuous feeding of the record sheet 55 while a recording is being made thereon.

When the knob 230 as seen in Figures 1 and 2 is manipulated to turn the shaft 280 counterclockwise, that is in the sheet feeding direction, ratchet 286 slips with respect to pawl 285 permitting the feed roll 162 to be advanced independently of the continuous drive thereof through gear 161.

Manual rotation of shaft 280, and roller 162 causes a corresponding rotation of take up roll 238 through the gearing arrangements 269, 270 and 271 in the manner herein described in connection with Figure 1. Any recorded matter on sheet 55 may thus be manually advanced onto the take up roll 238 for removal from the facsimile unit.

Each stylus of the present invention is rigidly guided when it is in recording position. In the present embodiment three individual stylus assemblies 52 are shown mounted on the link belt or chain 51 at equidistant spacings substantially corresponding to the width of the recording to be made upon the sheet 55. After one stylus has passed through the recording excursion, the next successive stylus is thus in position for starting its recording excursion. The link belt 51 affords a rigid positive driving means for the styli.

The whole mobile stylus assembly including the chain drive 51 and sprockets 53 and 54 and the guide roll 300 are insulatingly mounted with re-

spect to the remainder of the facsimile unit. The record sheet **55** is at the potential of the frame or base of the unit which is at ground potential. The stylus assembly is insulated from the frame and is at the opposite potential.

In order to ensure a rigid linear path for each stylus during the recording excursion, means are provided for maintaining the chain **51** at a predetermined tension or tautness. This means is provided at the left end of Figure 2 where means for maintaining the predetermined tension in the link belt or chain **51** are shown.

Post **301** carrying the sprocket **54** is carried by an adjustable member **302** which is secured to the rods **303** and **304** which rods are in turn slidably mounted in the openings **305, 306, 307, 308** of the brackets **309** and **310** which latter are in turn secured to the under side of the base **50**.

A compression spring **315** is arranged to mechanically bias a rod **304** and hence also the member **302** towards the left of Figure 2. Spring **315** is so designed that its force will be sufficient to keep the belt or chain properly taut for carrying the stylus assemblies **52** successively in their recording path by tending to drive the sprocket **54** on its slidable mounting away from the sprocket **53**.

Any temperature variation or any other variation which would tend to expand or contract the belt **51** or any wear which may occur in the chain or belt **51** may automatically be compensated for by the continuous automatic action of the spring **315**. A predetermined constantly maintained adjustment of the tension of the chain or belt **51** is thus effected.

A set screw **230** is arranged on the side of member **302** opposite that of the spring **315** and is used to hold member **302** further against spring **315** when it is desired to remove the chain **51** from the associated sprocket wheel.

After the chain **51** is mounted upon the sprockets **53** and **54** set screw **230** should be clear of the member **302** after proper adjustment has been effected in order that biasing action of the spring **315** may be effective to maintain proper continuous adjustment of the chain **51**.

Figure 15 is a cross sectional view along line **15—15** through the compensating mounting for the sprocket **54**. Sprocket **54** is secured to the insulating post or hub **301** having a concentric bushing **325** rotatably mounted on the rod **326**.

Rod **326** is secured by the pin **327** to the adjustable member **302** the adjustable member **302** is in turn secured to the rod **304** by means of the pin **328**; and it is secured to the rod **303** by means of the opposed set screws **329** and **330** which provide for a variable positioning of the slidable member **302** with respect to the rod **303**.

The slot **331** in the base **50** permits the member **302** to slide back and forth in response to the various tensioning effects exerted between chain **51** and the spring **315**.

As seen in Figures 9 and 11, the stylus assembly **52** is mounted on the chain **51** in any suitable manner as, for instance, by a pair of pins **400—400** which pass through the openings in the chain originally designed for the link pins thereof and which are engaged in the brackets **401** and **402** of the main stylus assembly support **403**. The main stylus assembly support **403** has an additional front bracket **404** forming a U-shaped channel **405** between the bracket **404** and the main support **403**.

A similar complementary U-shaped channel **406** is formed at the top of the main stylus support **403** by the plate **407** having the angular dependent flange **408** at one side thereof and the additional flange **409** at the opposite side which registers with the chamfered side **410** of the bracket **401**. Screws **411** pass through openings in the plate **407** into the main support **403**. Compression springs **412** are captured between the heads of each of the screws **411** and the upper side of the flange plates **407** thus pressing the plate downwardly and serving to tend to narrow the distance between the base of the U-shaped channel **406** and the base of the U-shaped channel **405**.

A slidable stylus support **420** having projecting rails **421** and **422** is mounted on the main stylus assembly support member **403**, the rails **421** and **422** being engaged in the U-shaped channels **405** and **406**. The slidable stylus support carries a rotatable stylus **425** which is mounted on the shaft **426** which in turn is rotatably carried in the brackets **427**. The brackets **427** are as is seen particularly in Figure 7 extensions of the pivotally mounted member **428** which, as seen in Figures 9 and 11, is spring biased by means of the spring **429** towards such position that the stylus **425** is forced outwardly from the stylus supporting member **403**.

The slide **420** which supports the stylus is slidable in the channels **405** and **406** and is frictionally retained in such channels by means of the spring pressure of spring **412** upon the plate **407** which tends to narrow the distance between the bases of the said channels.

That is, although the slide which supports the stylus may move longitudinally with respect to the channels nevertheless the frictional engagement is such that the slide **420** tends to remain in said position with respect to its support member **403**.

The support member **403** carries on the under side thereof the slotted pulleys **430** which engage the rail **117** mounted upon the insulating support **118**. These slotted pulleys **430** serve to position the front of the stylus assembly with respect to the rail. The rail of the stylus assembly carries the conical pulleys **431** mounted on the post **432** extending downwardly from the bracket **402**.

A compression spring **433** is placed between the under side of the conical roller **431** and the head **434** of the post **432** and serves to bias the conical roller **431** so that its apex tends to ride close to the under side of the bracket **402**. The conical roller **431** thus serves to support the opposite side of the assembly on the rail **117** and as seen in Figures 9 and 11, an opening **435** may be provided in the bracket **402** of the stylus assembly and a set screw **436** may be inserted therein in order to adjust the height of the bracket **402** above the rail **117**. The base of the set screw **436** has been smoothed to minimize the frictional restraining forces between this screw and the rail **117**. The brackets **401** and **402** are so arranged that a channel **440** is formed therebetween, the said channel registering with the periphery of the sprockets **54** and **53** when the stylus assembly and the portion of the chain upon which it is mounted passes over the said sprockets, the said channel **440** receiving the said sprockets and the stylus assembly being thereby so arranged that it will not in any way interfere with the operation of the chain.

In suitable cases where that may be desirable, the lower rail **422** of the stylus carriage **420** may, as is seen in Figures 5 and 7, have a series of teeth **450** therein forming a rack. A gear segment or wheel **451** is pivotally mounted at **452** upon a de-

pendent bracket 453 supported by the main support 403 of the stylus assembly, the said gear segment 451 meshing with the rack 450 and being so arranged that rotation of said gear segment will result in corresponding movement of the rack 450 and a corresponding sliding motion of the stylus carrier 420 within the channels 405 and 406 of the stylus assembly 52.

The chain 51 is so arranged that when the picture is being received, the said chain is always in continuous motion without any necessity for the chain or any portion of the driving mechanism thereof to come to a stop at that time.

Nevertheless in spite of this fact the arrangement of the present stylus and the cooperating synchronizing elements hereinafter described is such that synchronization may be had for each scanning excursion of each stylus and the actual rolling stylus 425 may be brought to a stop for the purpose of obtaining such synchronization without the necessity for stopping even the stylus assembly itself or anything connected therewith.

In other words, the synchronizing apparatus of the present invention does not coact with any of the driving elements whatever of the sprockets and the chain itself and even the movement of the stylus assembly and the supports thereof is constant and continuous during the recording.

The slidability of the subsidiary stylus carriage 420 within the U-shaped channels 405 and 406 is the sole means of permitting synchronization. The relative mass of the stylus carriage 420 and the associated stylus 425 is, it will be noted, so small that the momentary stopping of the stylus carriage 420 for the purpose of synchronizing will not have any vibratory or disrupting effect of any nature whatsoever upon the picture or upon the recording operation.

In other words, instead of having the synchronizing operation take place in such manner that the moving mass of the chain and all of the stylus supports and sprockets which drive the chain as well as the shafts which drive the sprockets are brought to a stop, it is necessary only to interfere with the forward movement of the stylus carriage 420 momentarily until the receipt of the synchronizing impulse in order to obtain the necessary synchronization.

Accordingly, as is seen in Figures 6 and 8, the synchronizing apparatus operates only upon the subsidiary stylus carriage 420 and does not interfere with the operation of any other portion of the mechanism and in fact is so arranged that should there be any tendency for it to interfere in any other portion of the mechanism or should the stylus carriage 420 be moved to such position that it may tend to be removed from the main support 403 of the stylus assembly 52, then the hold upon the stylus carriage will be released so that the stylus carriage might proceed with the remainder of the mechanism.

As is seen in Figures 6 and 8 the synchronizing mechanism comprises the synchronizing magnet 71 which is mounted in any suitable manner as for instance on the bracket 461 which is in turn supported from the base 50 of the mechanism. The electromagnet 71 is arranged to coact with and when energized to attract the armature 462, the said armature 462 being pivoted at 463 and being biased by the tension spring 464 away from the magnet 71. The tension spring 464 is connected at one end to the pin 465 of the armature 462 and at the other end is connected to the pin 466 which is mounted upon the bracket 467 which in turn is also supported from the base 50.

The synchronizing lever 468 is pivotally mounted on the pin 469 which is also supported on the bracket 467. The synchronizing lever 468 is so arranged that the portion 468' thereof is of greater mass and weight than the portion 468a thereof so that the natural tendency of the lever 468 is to rotate in a clockwise direction with respect to Figure 6, its mounting upon the pin 469 being sufficiently frictionless in character to permit of such rotation.

As is seen in Figure 8, the lever 468 is so positioned with respect to the stylus assembly 52 that it will abut against only the leading edge of the subsidiary stylus carriage 420 and will not in any way engage any other portion of the main stylus assembly.

The lever 468 is restricted against the counterclockwise movement which the balancing of its weight would otherwise create by the pin 470 of the protective lever 471 which is also pivoted on the pin 469. The protective lever 471 also comprises two arms, one arm 471' having increased mass or weight and the other or tripping arm 471a being of lesser mass or weight, the arms of the lever 471 being so arranged that the two are normally biased to rotate in clockwise direction with respect to Figure 6.

The possible clockwise rotation of the protective lever 471 is inhibited by the stationary pin 472 which is mounted upon the bracket. Thus immediately before the synchronizing impulse is received, the synchronizing lever 468 is arranged in the position shown in Figure 6 where its arm 468a is disclosed in the path of the subsidiary stylus carriage 420 while its arm 468' is supported on the pin 470 of the protective lever 471. The protective lever 471 is so arranged that its arm 471a is in the path of the main portion of the stylus assembly 52 and its other arm 471' is supported on the stationary pin 472.

The arm 468a of the synchronizing lever 468 as well as the arm 471a of lever portion 71 project through the opening 480 in the base 50, the said opening being sufficiently large to permit of the operation hereinafter described.

The arm 468a is arranged at the beginning of the scanning excursion, that is, it is, with respect to Figure 1, set at the left hand side of the sheet 55. Thus it is arranged so that it will interrupt the movement of the stylus carriage 420 at the beginning of each scanning excursion. When the chain 51 is moved so that stylus assembly 52 arrives at the beginning of a scanning excursion, the chain 51 and the entire stylus assembly 52 continue their movement without interruption. (This, it should be noted, is directly opposite to anything previously performed in the facsimile art).

The arm 468a however is so arranged that it will abut against the leading edge of the subsidiary stylus carriage 420 and hold the said subsidiary stylus carriage 420 stationary with respect to the left hand side of the sheet and hence stationary with respect to the beginning of the scanning line.

Accordingly, owing to the continued movement of the chain 51 and of the remainder of the stylus assembly 52, the subsidiary stylus carriage 420 will slide in the U-shaped channels 405 and 406 of the main stylus assembly and will continue to slide therein, moving outwardly as, for instance, shown in Figure 6 until the synchronizing impulse is received.

Thus, for instance, as seen in Figure 6, should the subsidiary stylus carriage 420 have originally

projected outwardly from the leading side of the stylus assembly **52** and should the entire stylus assembly **52** have reached the synchronizing arm **468** so that the leading edge of the subsidiary stylus carriage **420** contacted the said arm at the time when the right hand end of the stylus assembly **52** was in the position shown by the dotted lines, then although the stylus assembly **52** and the chain will have nevertheless continued their movement to the position shown by the solid lines, the subsidiary stylus carriage by reason of the fact that it was thus held stationary will have with respect to the stylus assembly **52**, been apparently moved backwards to await the synchronizing impulse which would permit it to commence its scanning excursion.

In order to effect this operation the arm **468'** of the lever **468** is held against counterclockwise motion under the influence of the force supplied by the stylus assembly **52** to the subsidiary stylus assembly **420** by the detent **481** in the armature **462** which engages the pawl **482** at the end of the arm **468'**.

On receipt of a synchronizing impulse, the magnet **71** is energized and attracts the armature **462**. When the armature **462** is attracted, the detent **481** is pulled away from the pawl **482** and nothing now prevents counterclockwise rotation of the lever **468**.

The frictional engagement of the plate **407** against the subsidiary stylus carriage **420** is such that while it will yield and permit the stylus carriage to move backward with respect to the stylus assembly when the lever arm **468** is held in fixed position, it will nevertheless permit the stylus carriage to move forward with the stylus assembly and to move the lever arm **468***a* out of the way when the opposite end **481** of the lever **468** is not engaged by the detent **481**.

Accordingly, upon receipt of the synchronizing impulse the ability of the lever arm **468** to impede the movement of the subsidiary stylus carriage with its stylus assembly is terminated and therefore immediately upon the receipt of the synchronizing impulse the subsidiary stylus carriage **420** starts to move with its stylus assembly and commences the scanning excursion at the beginning of the scanning line.

The one danger that may arise where a non-technical or home user is operating the recording unit is that improper or unpracticed operation thereof may possibly result in the withdrawing of the subsidiary stylus carriage **420** from the stylus assembly **52**; but the lever arm **471** is provided to obviate this possibility.

The arm **471***a* of the lever **471** is so arranged that it will contact the main or unslidable portion of the stylus assembly. When the main portion of the stylus assembly strikes the arm **471***a*, it will cause the said arm to rotate in a counterclockwise direction. The chamfered portion **485** of the arm **471'** of the lever **471** will then strike the pin **486** of the armature **462** and owing to the counterclockwise rotation of the lever **471** move the pin towards the synchronizing magnet **71** and accordingly therefore likewise move the armature **462** in that direction in order to disengage the pawl **482** of the arm **468'** of the lever **468**, thus releasing the subsidiary stylus carriage **420** from the stopping action of the arm **468***a* and hence permitting the stylus carriage to continue its movement with the stylus assembly **52**.

The arm **471***a* of the lever **471** is so spaced and arranged that it will not merely engage the main portion of the stylus assembly **52** but also that it will engage said portion of the stylus assembly **52** only after the subsidiary stylus carriage **420** has had an opportunity to traverse a substantial portion of the channels **405** and **406** in the attempt to reach synchronism.

Accordingly, in ordinary operation unless substantial accidental misphasing of a serious and unusual type should occur the arm **471***a* should rarely come into operation for the purpose herein described but it is present as a safety factor in order to prevent the subsidiary stylus carriage **420** which is very light in weight and very small in size from being accidentally removed from the stylus assembly **52** and thus becoming lost.

The synchronizing magnet **71** is energized upon the receipt of synchronizing impulses in order to operate the synchronizing levers and in order to release the synchronizing lever **468** to permit the subsidiary stylus carriage **420** to begin the scanning excursion. For this purpose, the current must be made to flow through the magnet **71** in time to receive the synchronizing impulse.

Accordingly, the driven shaft **100** (Figure 13) of the sprocket **53** which drives the chain carries a cam **500** (Figures 13 and 14) which is arranged to disconnect the current from the stylus assembly and to make the circuit to the synchronizing magnet whenever a scanning excursion is completed and whenever a synchronizing impulse is thus to be received.

The cam **500** has a lug **501** extending therefrom for this purpose. A rod **502** is carried in an opening **503** of the base **50** and is so arranged that one end thereof bears against the cam **500** and the other end thereof bears against the central contact **504** of a cam switch **505**.

The central contact **504** of the cam switch **505** is spring biased in such manner that it tends always to drive the rod **502** against the side of the cam **500**. Normally the current flows from contact **504** into contact **506** of the cam switch **505** in order to energize the styli and to record the picture modulations upon the recording sheet **55**.

The cam **500** is so arranged that upon completion of the scanning excursion a lug **501** has driven the rod **502** to the position shown in Figure 14 where the contact **504** is engaged with the contact **507** which energizes the synchronizing magnet and thus permits the synchronizing impulse to be received and to be impressed upon the synchronizing magnet and hence to permit the starting of the scanning excursion at the proper moment.

In order for the lug **501** to be in position at the termination of each scanning excursion, a single revolution of the sprocket wheel **53** must represent the length of a scanning line. Thus, the circumference of the shell must equal the linear scanning distance.

By means of this arrangement only the stylus itself may be moved and only the small carriage associated with it in order to obtain proper synchronism. In actual practice, the subsidiary stylus carrige **420** need not be more than a gram or two in weight and is of the relatively small size and mass shown in Figures 1, 6 and 8.

The construction of the cam switch of Figure 14 and the manner of actuation thereof is such that for most practical purposes and ordinary utilization of my invention the circuit will be changed so that the synchronizing means will be energized by the synchronizing impulse and so that the current will not flow through the styli when the synchronizing impulse is received.

It will be noted, however, that the cam switch operation of Figure 14 is from the drive shaft of the sprocket while synchronization takes place at the stylus assembly 52. Hence when the rotation of the sprocket and of the chain which carries the stylus assembly is at such speed that a considerable amount of movement of the styli with respect to the chain becomes necessary, there is a possiblity (remote, however) that the switching operation of Figure 14 may be out of phase with the operation of the stylus assemblies; that is, the subsiding stylus carriage may possibly at some stage of the operation commence its movement pursuant to the synchronizing impulse before the cam of Figure 14 has changed the switch. This may require a sufficient delay in the commencement of the picture impulses to ensure that they will be recorded. In order to provide for this remote contingency in order to make it possible to record picture impulses as soon as the stylus moves, and in order therefore to ensure that switch operation from the synchronizing magnet to the stylus will occur only when such operations are necessary and only when the stylus has been brought up against the synchronizing lever, I may mount as is seen in Figures 21*a* and 21*b*, the switch 505 upon the synchronizing lever 468*a* and arrange the central member 504 of the cam switch so that it will ordinarily contact the member 506 and hence energize the styli.

The central member 504 is also so arranged that when the stylus mounting 420 is brought to a stop against the lever 436*a* it will also press the member 504 of the cam switch against the member 407 of the switch and hence disconnect the stylus assemblies and connect the synchronizing magnet in the circuit.

Upon receipt of the synchronizing impulse resulting in the dropping of the lever 468*a* in the manner previously described, and the consequent continued movement of the stylus assembly, the central member 504 of the cam switch will be disengaged from the stylus assembly and will again by reason of the direction of force of its spring be engaged with the member 506 of the cam switch to reenergize the stylus assembly.

By this modification of my apparatus, it is therefore possible to ensure that all operations for switching the current from the stylus assembly to the synchronizing magnet are exactly synchronized with the scanning head of the stylus assembly and are in fact a function of the movement of the scanning head so that no matter what the position of the stylus may be with respect to its principal mounting, it is the stylus position alone which governs such switching operation.

It should be emphasized that the construction and arrangement of Figure 14 is useful in connection with the present invention particularly where rephasing of the type hereinafter described in connection with Figure 4 takes place at relatively frequent intervals,—but that the construction of Figure 21*a* is such as to ensure an absolute relationship between the position of the stylus itself and the switching operations.

The driving mechanism for the stylus assembly is at no time stopped while a picture is being received and therefore neither the motor, the drive shafts, the sprockets, the chain or even the stylus assemblies themselves need at any time be stopped.

The only member that is momentarily stopped is the relatively small subsidiary stylus carriage itself which is such a small portion of the mechanism that its mass can have no vibratory effect of any kind whatsoever.

By reason of the fact also that any vibration caused by the starting and stopping of relatively heavy parts is obviated and by reason of the accuracy possible in the present device, the stylus assemblies and the chain drive therefor may be caused to rotate at a speed closer to that of the transmitter so that the received picture will be more accurately in phase with the transmitted picture than has ever before been possible.

The styli 425 themselves may have any suitable form and thus may be a moving point or moving rounded blunt edge as the case may require. I prefer, however, to use a rotatable disk contacting stylus wherein the thickness of the stylus disk is of the order of the thickness of the recording line employed in recording.

Thus where one hundred continuous lines per inch are used, the thickness of the disk may be $^1/_{100}$ of an inch or slightly more in which latter case, the peripheral or contacting edge of the disk may be rounded to effect the desirable contacting width with the record sheet.

The stylus disk may be made preferably of a hard metal such as tungsten, molybdenum or other suitable metal or alloy. The hub of the stylus disk may be either machined integrally with the disk itself or may be brazed or otherwise secured with or to a wafer disk corresponding to the stylus 425.

The set screw 436 (Figure 11) serves to ensure the horizontal alignment of the stylus assembly frame or unit. The set screw has preferably a hard rounded bearing point for riding on top of the surface of the rail 117.

In addition, the stylus 125 may be positioned in accurate alignment with the surface of the recording sheet 55 by means of the wires 550 and 551 shown in cross section in Figure 11 and more clearly shown in Figures 19 to 21.

It should be here noted that the disk stylus is rigidly maintained at the proper scanning position and is free to rotate. In certain embodiments it may be possible to virtually displace the stylus by an amout equal to several times the thickness of the stylus disk. The wires 550 and 551 may thus constitute an accurately arranged guide for the stylus and may thus keep the stylus disk 125 in accurate position in the recording path.

The wires 551 and 552 may also prevent any fluttering or parasitic movement of the stylus disk ensuring uniform high quality high speed recording.

The wires 550 and 551 are hence arranged in the recording path and spaced by a distance equal to the thickness of each recording disk. They are held taut and close to the recording sheet 55 to form the horizontal guide for the stylus.

I have found this guide wire arrangement of particular use for high speed recording operation such as 100 to 200 lines per minute.

As seen in Figure 19, at one side of the sheet 55 I provide an anchor 552 for the wires, the said anchor being secured to the left upright 143. The opposite ends of the wires are supported in the anchor 553 which also is similarly supported upon the opposite upright 143.

The tensioning posts 554 and 555 are fixed in the block 553. Both of the blocks 552 and 553 are of insulating material to electrically isolate the conductive wires 550 and 551 from the frame.

Guide wires 550 and 551 are arranged adjacent the recording sheet 55 at the recording region without contacting therewith. The metallic guide wires necessarily contact the stylus and are therefore of the same electrical potential as that of the stylus which is opposite that of the recording sheet.

Accordingly, in order to avoid a marring of the recording sheet, the guide wires must at no time touch the recording sheet while at the same time they must be electrically clear of the frame and other associated drive mechanism.

As is seen in Figure 21, in order to provide the preferred guide wire tensioning arrangement, the slot 560 guides the lower wire 551 into its proper position on the block 553. The right end of the wire 551 is secured to the rod 555 within a hole 561 of the block 553. Both the posts 554 and 555 are frictionally tight within the block 553.

Tensioning adjustment of wire 551 is effected by turning the post 555 by passing a pin or wrench through the hole 562 therein and rotating the same. The tension of the guide wire 550 may be adjusted by the post 554 in a similar manner. The opposite ends of the wires are supported in the anchorage block 552 by passing them through an appropriate slot 565 in the block 552 and around the anchoring screws 566.

In the operation of the recorder of the present invention, it is important that proper phasing should obtain at all times and it is further important that the stylus carrying chain 51 and the stylus assembly 52 should commence their operation generally at the same time as the transmitter. That is, it is useful that an effort be made automatically to obtain proper phasing at the start of the picture reception and further to provide that this phasing be automatic so that it will be unnecessary for an unskilled operator or home user to perform any complicated technical operations which he may not understand.

Accordingly, as is seen in Figures 3 and 4, I have provided an automatic non-slipping clutch mechanism which will ensure that the stylus assemblies will commence their excursion across the recording surface 55 at the moment transmission is begun. By this means, also the synchronizing operation hereinbefore described with respect to the subsidiary stylus carriage may be caused to operate over the relatively small linear length of the channels which support a subsidiary stylus carriage and it will not be necessary to move this subsidiary stylus carriage any substantial distance with respect to the stylus assembly.

The clutch 95 of Figures 3 and 13 as is seen more particularly in Figure 4, comprises a circular ratchet 600 keyed to and rotatable with the main drive shaft 83 and a pawl 601 pivotally mounted at 602 upon a disk 603 keyed to and rotatable with the synchronized driven shaft 100. The pawl 601 is biased by means of spring 604 which also is mounted on the disk 603 towards engaging position with the ratchet 600.

When the pawl 601 is engaged with the ratchet 600, then normal driving of the shaft 100 in a clockwise direction with respect to Figure 4 by the shaft 83 is possible. When the pawl is disengaged from the ratchet 600, then the driven shaft 100 is disconnected from the driving shaft 83 and the chain and sprocket arrangement and the stylus assemblies carried thereby are no longer driven. The magnet 610 is arranged to disconnect the pawl from the ratchet and to connect the pawl to the ratchet at a predetermined point, the said point being predetermined by the position of the stylus assemblies with respect to the beginning of the scanning excursion.

The pawl 601 has at one end thereof a hook shaped engagement portion 611 which engages a hook 612 on a bell crank lever 613 which is pivotally mounted at 614 upon the bracket 615 which also supports the magnet 610.

The opposite end of the bell crank lever 613 carries an armature 616 which may be attracted by the magnet 610. Tension spring 617 engages the bell crank lever 613 at 618 and is adjustably mounted in the other end in the adjustable screw 619. The spring 617 is so arranged that it continuously biases the bell crank lever 613 into engaging position so that the hook 612 engages the hook shaped extension 611 of the pawl and thus disengages the pawl 601 from the ratchet 600.

When the magnet 610 is energized it attracts the armature 616, thus causing a counterclockwise rotation of the bell crank lever 613 disengaging the hooks 612 and 611 and thus permitting the spring 604 to drive the pawl into engagement with the ratchet 600.

When during the rotation of the ratchet 600, the magnet 610 should be deenergized, then the spring 617 will return the bell crank lever 613 to the position shown in Figure 4 in which case the pawl 601 when it comes around once more to the position shown in Figure 4 will engage the hook 612 of the bell crank lever which will thus release the engagement of the pawl and ratchet and bring the pawl to an immediate stop.

The sprocket, the chain and the stylus assemblies are so arranged that the pawl 611 will assume the position shown in Figure 4 three times during each revolution of the chain 51 and will thus assume such position every time that the stylus assembly reaches the position indicated by the dotted lines 52′ of Figure 6.

Thus whenever the members of Figure 4 are in the position shown, it will be clear that one of the stylus assemblies is in a position to commence the scanning excursion.

The magnet 610 is so arranged that it will be energized whenever impulses are being received from the transmitting station and will be deenergized upon cessation of such impulses.

The magnet 610 will be energized whether the impulses received are picture signals or synchronizing signals and thus will be constantly energized as long as a picture is being transmitted.

Accordingly, the pawl will be in engagement with the ratchet, and shaft 100 will be driven by shaft 83 as long as picture signals are being transmitted.

The shaft 100 will thus be engaged in driving relationship with the remainder of the apparatus by means controllable from the transmitter and will be disengaged from driving relationship by means controllable from the transmitter and it will thus be possible for the transmitter to control the operation and the starting annd stopping of all of the receivers tuned to the said transmitter.

When it is desired to receive a picture, it will be necessary for the receiving operator to turn on the current to his receiving machine and to place the motor in operation before the transmitting station starts sending the picture.

The shaft 83 will continue to rotate without driving the chain. As soon as the transmitter operator decides that picture transmission and reception should begin, he may immediately start the synchronizing and picture scanning impulses

in a manner now known in the art. Immediately upon the reception by the receiving apparatus of any transmitted impulse, the hook 612 of Figure 4 will be released, the pawl 601 will be engaged with the ratchet 600, the shaft 100 will start to operate and the chain will start to move.

Accordingly, the transmitter may control the starting of the scanning operation.

Immediately upon cessation of the transmission of the picture and immediately upon the cessation of the transmitting of impulses, the magnet 610 will be deenergized and the pawl will be disengaged from the ratchet and engaged with the hook 612 and the recorder will be brought to a stop with the pawl in a position shown in Figure 4 so that the stylus assembly will be in a position at the beginning of a scanning excursion.

Thus the receiving operator need not attempt to obtain proper phasing with the picture being transmitted. It is only necessary for him to turn on his receiver and to start the motor 56 thereof before picture transmission is to start. Nor is it necessary for him to stop the scanning operations at the termination of picture reception since the chain will automatically thus be brought to a stop immediately upon cessation of transmission.

The automatic phasing thus obtained may be useful in many connections. It should be pointed out that should the signal at any time drop to zero, the magnet 610 will be deenergized and the bell crank lever 613 returned to its original position. Should this occur during a scanning excursion, it will have no bearing upon the operation of the receiver since the pawl 611 will not at that time be in position to be disengaged by the hook 612.

Should it occur just before the beginning of a scanning excursion, then it will simply mean that no synchronizing impulse has been sent and obviously where no synchronizing impulse has been sent, it is not desirable that a scanning excursion should commence. So that the fact that the magnet 610 may be deenergized by the signals accidentally falling to zero will have no adverse effect at all upon the picture reception while its beneficial uses are obvious.

The phasing operation performed by the apparatus set forth in Figure 4 has still another purpose, that of resetting the subsidiary stylus carriage 420. This purpose and the operation of these members for that purpose will be more clearly understood from the following description.

As has already been pointed out, the subsidiary stylus carriage 420 is momentarily brought to a stop by the arm 468a of the lever 468 immediately before each scanning excursion; and the subsidiary stylus 420 is caused to remain stationary and (by reason of the continued forward movement of the stylus assembly 52) is caused apparently to move backwards with respect to the stylus assemblies 52.

In its movement backwards with respect to the stylus assembly 52, the rack portion 450 thereof engaging the teeth of the gear segment 451 which is rotatable on the pin 452, causes this gear segment to rotate in a clockwise direction with respect to Figure 6 and thus causes the gear segment to assume a position such as, for instance, that shown in Figure 6.

As is seen in Figures 2, 3 and 7, a lug 700 is mounted upon the base 50 in any suitable manner, the said lug 700 being so arranged that it will engage the plane surface 701 of the gear segment 451, during the return excursion of the stylus assembly 52, that is, at the position indicated by the arrows 702 of Figure 1. When the plane surface of the gear segment 701 comes into contact witht the lug 700, the forward motion of the stylus assembly 52 causes the plane surface 701 to be rotated about the pin 452 and hence causes the gear segment 451 to be rotated thus moving the rack 450 mounted upon the rail 422 of the subsidiary stylus carriage 420 and hence moves the subsidiary stylus carriage 420 forward to its original position, where it is in position once more on the next scanning excursion to be engaged by the arm 468a for the synchronizing purposes hereinabove described.

In this operation, it should be noted that the first synchronizing impulse for each of the styus assemblies may move the subsidiary stylus carriage 420 back upon its stylus assembly 52 to a considerable degree but subsequent synchronizing operations will have only slight additive effect. However, at the end of the ordinary picture transmission, this slight displacement of the subsidiary stylus carriage 420 for each scanning line may have an additive effect which may at times be sufficient to move the subsidiary stylus carriage off the stylus assembly itself; or (in cases where the protective lever arm 471a is used) it may have the effect of moving the subsidiary stylus carriage 420 back to such position that it will not await the synchronizing impulse. The apparatus hereinbefore described in connection with Figure 4 and particularly the pawl and ratchet arrangement 601—600 may be utilized in order to reset the stylus after such additive effect has produced a sufficient movement to endanger the accuracy of the recording.

I have found that by the use of my apparatus a picture transmission for as long as seventeen minutes will not displace the stylus sufficiently within its assembly to destroy the operativeness of the device; this is important since in no case is it necessary that a single picture transmission should last seventeen minutes.

Immediately upon the cessation of picture transmission, the pawl and ratchet arrangement hereinbefore described in connection with Figure 4 will bring the next stylus assembly back into proper phase relationship and into proper original position once more, thus nullifying the additive effect of all the previous synchronizing impulses which may have tended substantially to displace the stylus and upon recommencement of picture transmission, each of the other styli after having successively been brought back by the gear segment operation of Figure 7, hereinbefore described, will be properly positioned once more for recommencement of picture reception.

Should it be possible for any reason that the subsidiary styli carriages 420 of the respective stylus assemblies 52 be displaced a substantial amount during the reception of a picture, it is possible for the transmitter to cease transmission for a single scanning cycle—in other words, for an interval unnoticeable to the human eye—and then to recommence operation again, in which case the stylus resetting operation will have occurred, and the styli will be back once more to their original position.

Thus in ordinary picture transmission where it has been found that a transmission for as long as seventeen minutes still has not additively moved the subsidiary stylus carriages sufficient-

ly to prevent the synchronizing operations hereinbefore described, it will be possible, in order to produce an extremely high safety factor, to reduce the transmitting signal to zero for a single scanning cycle once in every five or ten minutes and thus reset the styli once more.

It is true that such starting and stopping may result in vibration but this type of vibration will occur only once in five or ten minutes instead of one hundred times each minute as has heretofore been necessary.

All of the elements which may in any way come in contact with the stylus or which may in any way come in contact with other portions of the picture receiver should either be properly insulated or should be so arranged as to be at the same potential as the member with which they come in contact.

The insulating elements for each of the apparatus has been above described. It should be noted in connection with Figure 8 that the levers **468** and **471** are so arranged with respect to the pin **469** that the pin **469** may be mounted in an insulating block **467** secured by means of the screw **711** to the base **50**. Should it be desirable in any case that the block **467** should be of metal then the said block **467** should be electrically isolated in any suitable manner from the base **50**; hence an insulated space as at **712** may be placed therebetween and the screw **711** may have an insulating washer **713** and an insulating sleeve **714** in order to electrically isolate the block **467**.

The foregoing means permits the obtaining of synchronism to a degree which has not heretofore been believed to be possible in the facsimile art.

It is possible now to move the chain and its associated stylus so that the scanning movement is moving at almost the same speed as the scanning movement of the transmitting apparatus. Synchronizing no longer requires the starting and stopping of relatively large masses but simply the sliding of a member which need not weight more than a gram or two.

The type of operation for synchronizing purposes hereinabove described is not limited however to the chain drive arrangement set forth but may be utilized with many other elements. Thus, for instance, as seen in Figure 22, this type of continuous synchronization which results in reduction in the masses, the movement of which must be changed for synchronizing purposes, may be applied as readily to the ordinary type of light beam reception scanning in connection with telepicture recorders of the type shown in my Patents 2,100,161 or 2,047,683.

Previously, in light beam recorder scanning where a source of light regulated by the incoming picture impulses traveled longitudinally along the revolving drum, it was necessary to bring the entire drum and in fact the entire recorder assembly to a stop once during each revolution of the drum in order to ensure proper synchronization and in order to further ensure that the light beam could commence its scanning excursion at exactly the proper point.

While such apparatus performed its intended function and while commercially clear pictures were received by this means, the relatively large masses which it was necessary to bring to a stop once during each revolution of the drum were such as to make necessary various types of constructions for shock absorption, and even in such cases synchronization was nevertheless a difficult process and the elimination of the effects of vibration was not complete.

The construction of Figure 22 and the associated Figures 23–33 inclusive is such that synchronization may be obtained in accordance with the principles previously described in this application while nevertheless permitting the relatively large constantly moving masses of the recorder to continue to move at constant speed; it being necessary only to momentarily move once during each scanning revolution a single individual member having almost no appreciable mass.

It should be again emphasized in connection with this type of recorder that the motor thereof will continue to operate at a constant speed, the receiving drum will continue to be rotated at constant speed, even the scanning apparatus itself will continue to move longitudinally at a constant speed, and only the light beam will be deflected momentarily for the purpose of producing the necessary synchronism.

The elements necessary to cause such deflection of the light beam are of such small mass (relative to the other moving parts which it had been previously necessary to bring to a stop) as to make unnecessary the various types of shock absorbers previously required while at the same time, by reason of the vibrationless recording thus made possible, a greatly improved picture may be received.

The recorder of Figure 22 is essentially the same type of recorder as is set forth in my Patent 2,947,863. It consists primarily of a recording drum **750** driven by a motor **751**. The motor **751**, through the shaft **752** and the gearing arrangement **753** and the clutch **754**, drives the shaft **755** which in turn in the manner described in my Patent 2,047,863 drives the removable drum **750** which is supported at one end on the shaft **755** and at the other end by the retractable tail stock **756**.

The same motor through a suitable gearing arrangement **757** drives the shaft **758** thus rotating the screw **759** for driving the light beam housing **760** which may, by the cam lock lever **761**, be engaged with or disconnected from the screw **759**.

The light beam housing **760** is also of the general form shown in my Patent 2,047,863 and consists, as is seen more particularly in Figure 26 of a light source **762** the intensity of which is controlled by the received facsimile impulses.

A suitable reflector **763** guides the light beam to a suitable lens system **764**. Instead of permitting the light beam to impinge upon the receiving drum **750** directly through the lens system, the light beam instead is reflected by the reflector **765** to the longitudinal reflector **766** from which the light beam is impinged upon the drum **750**.

In its excursion longitudinally of the drum, the light beam housing **760** is guided by suitable rails **767**, and **768** in the manner described in my aforementioned patent.

The particular means of guiding the light beam housing is obviously of no importance for the present invention and any means which will cause the light beam housing to move longitudinally along the drum in a regular continuous manner may be used in connection with the present invention.

The reflector **766** is the particular means utilized for the purpose of deflecting the light beam in order to obtain synchronism, this reflector **766** (Figures 22 and 26) being engaged at each end in

mounting members 769 which are rotatably supportable in the mounting brackets 770 and 771.

The mounting bracket 770 is an ordinary bracket which will permit rotation of the member 769 mounted therein and hence will permit rotation of the reflector 766. As is more particularly seen in the cross-sectional view of Figures 26 and 28, the reflector 766 is preferably a mirror on a milled shaft, the reflecting surface or mirror being obtained by a suitable coating or polishing of the shaft. The rotation of the reflector 766 as is seen in Figures 26 and 28 results in a deflection of the light beam so that it strikes the drum at a different angle and hence at a different area for each different position of the reflector 766.

The synchronizing means of this modified form of the present invention depends upon proper rotation of the reflector 766 in order to ensure that the light beam will initially impinge upon the drum at the beginning of the picture only; and hence instead of causing the drum to be stopped once during each revolution thereof in order to obtain synchronism, the purpose of this modified form of the present invention is to so arrange the reflector that it will at the termination of a scanning line commence to move with the drum at such speed that the light beam will remain stationary with respect to the surface of the drum; and upon receipt of the synchronizing impulse such movement of the light beam together with the surface of the drum will be stopped so that the light beam will then, by reason of the movement of the drum with respect thereto, traverse the drum in the ordinary scanning operation.

For this purpose, the mounting 771 of the reflector 766 (see Figures 24, 23, and 27) is such as to create the desired deflection. The mounting 771 comprises spring pressed brackets 772 and 773 frictionally engaging the portion 769' of the reflector shaft between them in such a manner that the shaft 766 may be rotated by an outside force but upon removal of said force, the spring pressed members 772 and 773 will hold the reflector shaft 766 in the set position.

The springs 774 which thus hold the members 772 and 773 together are therefore so adjusted by means of their adjusting screws 775 as to permit such rotation of the shaft while at the same time insuring that upon removal of such rotative force, the shaft 776 will remain in the position which it reached when such rotative force stopped.

The end 769' of the shaft which projects through the mounting 771 to the outer side of the members 772 and 773 has a crank arm 776 keyed thereto in such manner that rotation of the crank arm will result in rotation of the shaft 766. The said crank arm carries a pin 777 securely affixed thereto at the end opposite the attachment thereof to the shaft 766.

A bifurcated member 778 having a form and arrangement hereinafter described engages the pin 777. This bifurcated member 778 carries an armature 779 for synchronizing purposes hereinafter described and the said member 778 is pivotally connected by the pin 780 to the bifurcated arm 781, which is rotatably mounted upon the pin 782. The pin connection 780 between the member 778 and the member 781 is of such nature that rotation of the member 781 about the pin 782 will result in corresponding rotation of the arm 778 but that the arm 778 may be moved out of the plane of the arm 781 in order that it may in specific circumstances hereinafter described disengage the pin 777.

The arm 781 terminates in a member 783 which by means of the tension spring 784 is biased to rotation in a clockwise direction with respect to Figure 23. A cam follower 785 is attached by rivets 786 or in any other suitable manner to the arm 781 in such manner that any movement of the cam follower 785 may be communicated to the arm 781 or vice versa. The cam follower 785 is arranged so that the pawl 786 thereof continuously follows the cam 787 which is mounted upon the main shaft of the drum 750 and rotates with the drum.

The cam 787 has a notch 788 therein, the said notch being positioned in such manner with respect to the means 789 (Figure 26) for securing the sensitized paper sheet upon the drum that whenever the pawl 786 of the follower 785 enters the notch 788 the light beam will impinge upon the drum 750 in the approximate area of the mounting means 789.

As the drum 750 rotates in the direction indicated by the arrow, Figure 23, the pawl 786 of the cam follower 785 will suddenly drop into the notch 788 and upon the continuation of the constant uninterrupted rotation of the drum 750, the pawl 786 will ride up the chamfered surface of the notch 788 until it rides on the outer surface of the cam 787.

When the pawl 786 of the cam follower 785 enters the notch 788 in the manner thus described, any resistance to the biasing effect of the spring 784 is temporarily removed and the spring 784 is permitted to rotate the arm 781 in a clockwise direction. The rotation of the arm 781 in a clockwise direction results in corresponding rotation of the bifurcated arm 778.

The arm 778 in its rotation rotates the pin 777 of the crank member 776 and hence rotates the shaft 766.

The sudden drop of the pawl 786 into the notch 788 causes the mirror to be deflected in the manner shown in Figure 28 so that the light beam strikes the beginning of the picture sheet. Then as the drum continues its rotation, the pawl 786 rises up on the chamfered surface of the notch 788 resulting in counterclockwise rotation of the cam follower 785 and the arms 781–778.

This now causes a corresponding clockwise rotation of the mirrored surface 766 and hence causes the light beam to move in the same direction as the surface of the drum. The various members are so adjusted that the light beam in its movement in the same direction as the surface of the drum remains impinged upon a single area of the drum and hence awaits the synchronizing impulses.

This selected area or spot on the drum obviously should be upon the fastening means 789 just before the leading edge of the sensitized picture recording paper.

The synchronizing system is so arranged that upon receipt of the synchronizing impulse, the shaft 766 and its crank 776 are disconnected from the bifurcated member 778 so that any continued rotation thereof owing to the movement of the pawl 786 upon the cam or in the chamfered surface of the notch will have no further effect upon the reflector.

Thus as the pawl 786 rides up the chamfered surface 788 the light beam is continuously deflected to a selected single area of the drum. At some time during this movement of the pawl 786, along the chamfered surface of the notch 788, the synchronizing impulse will be received. Upon receipt of the synchronizing impulse it is desired

that the light beam immediately become stationary so that it will traverse the sensitized recording sheet owing to the continuous movement of the drum with respect to the light beam.

Hence the function of the synchronizing impulse is to disconnect the reflector shaft **766** from the cam follower **785** so that further movement of the pawl **786** up the chamfered surface of the notch **788** will have no further rotative effect upon the shaft **766**.

For this reason as has been previously described, the bifurcated member **788** is not integrally connected to the arm **781** but is capable of being swung about the pin **780** out of the plane of the arm **781**.

The synchronizing impulse energizes a synchronizing magnet which attracts the armature **779** and hence swings the bifurcated member **788** about the pin **780** and thus effects the disconnection above described.

As is seen in Figures 22 and 29 to 33, the armature **779** of the bifurcated member **778** is arranged so that it may be attracted by the synchronizing magnet **790**. When the pawl **786** of the cam follower **785** suddenly drops into the notch **788** then the tine **778***a* of the bifurcated member **778** (see Figures 29 and 33) engages the pin **777** of the crank **776** and rotates the shaft **766** in a counterclockwise direction with respect to Figure 23 or in the direction indicated by the circular arrow of Figure 33.

As the pawl **786** of the cam follower **785** now rides up the chamfered surface of the notch **788**, the tine **778***b* of the bifurcated member **777** now produces a clockwise rotation of the shaft **766** (with respect to Figure 23) previously described or the rotation of the shaft **766** in the manner indicated by the circular arrow of Figure 30.

This causes the light beam to move with the drum **750** in such manner that the light beam is continuously impinged upon and hence stationary with respect to a particular area of the drum.

When the synchronizing impulse is received, it energizes the magnet **790** to attract the armature **779** and hence withdraws the tine **788***b* as is seen in Figure 31 to such an extent that it no longer engages the pin **777** and as is seen in Figure 32 moves past the pin **777**.

In this way, after the synchronizing impulse has been received, although the bifurcated member **778** continues to move from the position shown in Figure 31, to the position shown in Figure 32, its movement no longer has any effect upon the pin **777** and hence no longer has any effect upon the crank **776** or the shaft **766**.

In order to ensure this result, the tine **778***b* is notched or cut out so that when the armature **779** is attracted to the magnet and the bifurcated member is thus pulled from the pin, the tine **778***b* may pass the pin **777**.

In this way, as has before been pointed out, the light beam is moved to a position at the edge of the recorded picture, and maintained impinged upon said edge despite the movement of the drum; and upon receipt of the synchronizing impulse, the motion of the light beam is terminated so that it may scan the drum owing to the continued movement of the drum itself.

This is all done by merely causing a slight rotation of a single shaft **776** and the synchronizing thus effected is not dependent in any way upon the stopping of large masses and is definitely not dependent upon the starting and stopping of the drum itself.

At the termination of each scanning line, the operation described in connection with Figure 33 takes place. The reflector is then rotated in the manner shown in Figure 30 until the synchronizing impulse is received when the movement shown in Figure 31 takes place and the reflector is maintained in stationary position as shown in Figure 32.

The final stationary position shown in Figure 32 may possibly be such that the light beam will not strike the drum radially, at right angles to its surface, but may strike the drum at a slight angle thereto.

Accordingly, the cross-section of the light beam will be such that the slight additional area added thereto by reason of the fact that it strikes the drum at a slight angle will not be sufficient to make the picture unclear. It should be noted that the angle at which the light beam may strike the drum during scanning will not be more than 10° from the horizontal, and hence the spreading of the light beam by reason of such angular displacement will scarcely be appreciable.

However, if maximum definition is desired, the defocusing of the light beam due to the angular displacement occurring by reason of the mirror **766**, may be compensated for by coupling the optical system to the mirror, in a manner such that rotation of the mirror **766** will cause a corresponding motion of the lens system to maintain focus at the particular point at which the light beam strikes the drum. This coupling may comprise a cam, fastened to the mirror and cooperating with a follower in the optical system to shift the focus continuously to the proper point while the mirror is rotating and awaiting the arrival of the synchronizing pulse.

As was previously described in connection with Figure 4, of the prior modification, it may be possible that continuous displacements in the course of a long picture reception may so displace the synchronizing system that greater and greater movements are required before the synchronizing impulses are received so that the synchronizing impulse may be received after the pawl **786** has risen to the surface of the cam **787**.

In order to obviate any such possibility, a phasing signal may be utilized at the beginning or end of each picture or at spaced intervals during the transmission of the picture, said intervals being approximately five minutes apart or 500 scanning lines apart. For this purpose, a clutch **754** preferably an over-running clutch may be interposed between the motor **751** and the drive shaft **755** of the drum **750**, and with a suitable lever arm may be biased into engagement with the clutch **754** so as to prevent rotation of the drum **750** when the clutch **754** is engaged.

The magnet **791** (Figure 22) may be so arranged that it will be energized whenever impulses are received by the recorder and is so arranged in circuit with the received impulse that as long as a picture is being sent and as long as a picture or synchronizing impulse is being received, the magnet is energized.

Hence while picture or synchronizing impulses are received, the magnet **791** will attract the armature **792** of the member **793** which engages the overrunning clutch **754** and will permit rotation of the drum **750** in response to rotation of the motor **751**. Whenever no picture is being sent at all, then the member **793** will engage the clutch **754** so as to prevent rotation of the drum.

As soon as impulses are received, whether picture or synchronizing impulses, then the

member 793 is disengaged from the clutch 754 and the drum 750 rotates continuously. In order to ensure that the inception of the rotation of the drum 750 will be at the beginning of the picture, a pawl and ratchet system such as that described in connection with Figure 4 may be utilized or a similar system may be utilized for the purpose of ensuring that the inception of rotation occurs at the beginning of the recording sheet.

Once in approximately five minutes during the sending of the picture where there is a possibility that synchronizing impulses may have been so arranged that the cam 787 has been moved slightly out of position, the transmitter may stop sending for an instant such as, for instance, a period of one scanning line and upon resumption of transmission, the entire recording apparatus will be rephased in the manner previously described in connection with Figure 4 for the modified form; and also phasing will be automatically established in the inception of each picture signal.

A suitable cam switch such as that described in connection with Figure 14 or 21 may also be utilized for the purpose of switching the incoming signal from the light beam scanner to the synchronizing magnet. Such a switch may well be mounted upon the cam follower 795 or preferably may be actuated by a cam on the shaft of the drum 750 which will operate in the manner shown in Figure 14 and described in connection therewith.

This system which permits reduction of the masses which must be stopped in order to obtain synchronization and virtually reduces the elements to be stopped to the actual scanning stylus or light beam, itself, may be utilized in each of the other systems of recording; and hence in Figures 34 to 37 inclusive, I have illustrated the use of this same system in connection with an oscillating arm type of recording scanner. In the construction shown in Figure 34, I have shown an oscillating arm type of scanner of the type generally set forth in my Patent No. 2,212,969 wherein an oscillating arm 800 is caused to move back and forth across the face of a recording sheet 801 by a suitable motor (not shown). The motor drives the gear 802 which in turn drives the gear 803 which drives the heart shaped cam 804 which engages a roller 805 at one end of the oscillating arm 800 and causes the roller 805 to move back and forth in a predetermined path so as to cause the oscillating arm 800 to pivot about the fulcrum 806.

A suitable spring may be arranged to continuously bias the roller 805 against the edge of the cam 804 to exactly guide the movement.

The arm 800 carries a stylus assembly 807 at one end thereof, the said stylus assembly consisting of a mounting member 809 having rails 810 and 811 within which the stylus carrier 812 may ride, the stylus carrier having corresponding rails for registry with the rails 810 and 811 of the member 809.

Springs 812' and 813 of the mounting 809 press one of the rails 810 inwardly so as to ensure a proper frictional relationship between the stylus carrier 812 and the mounting 809.

The stylus carrier 812 has a post 813 to which is secured an arm 814 for carrying a rotatable stylus 815. The frictional engagement of the stylus carrier 812 in the mounting 809 is such that positive stopping forces will cause a movement of the carrier 812 with respect to the mounting 809 but that ordinary scanning operation during the scanning excursion will not produce such results.

A synchronizing lever 817 is pivotally supported at 818 upon a pin mounted on the bracket 819. The synchronizing lever arm 817 is part of a bell crank lever, the opposite arm 820 of which is captured in the notch 821 of the armature 822, the said armature being biased by the tension spring 823 into engaging position.

The synchronizing lever arm 817 has an engagement head 824 which is arranged to engage only the stylus carriage 812 and the mounting 809. At the inception of the scanning excursion, the scanner arm 800 moves in the direction indicated by the arrow of Figure 34. The engagement head 824 however, of the lever arm 817 engages the stylus carriage 812 and hence holds the stylus stationary with respect to the sheet even though the arm 800 and the mounting 809 continue their movement. Upon receipt of the synchronizing impulse, the armature 822 is attracted by the magnet 825 which has been energized by the synchronizing impulse and there is no further support for the lever arm 817 and now the stylus carriage 812 in pushing against the engagement head 824 of the lever arm may rotate the lever 817 about the pivot 818 and may thus begin to move with the scanning arm 800.

During the return movement, it is essential that the stylus carriage 812 again reach a position where it may be stopped by the engagement head 824 of the lever arm 817. Since the engagement head 824 is pivoted at 826 upon the lever arm 817 and spring biased into such position that it is yieldingly pressed against the pin 827, the head therefore resists movement of the stylus carriage with respect to the arm 817 in the scanning direction. But the spring 828 is so arranged that during the return, the carriage 812 may depress the chamfered surface 829 of the engagement head 824 and pass thereover into the original position to be once more engaged for synchronizing purposes during the scanning excursion.

A safety lever 830 is also provided and is also pivoted on the pin 818 in order to prevent the stylus carriage 812 from being removed from the mounting 809 in the event that a synchronizing impulse should be delayed.

The engagement head 831 of the lever 830 is arranged to engage the mounting 809 and not the stylus carriage 812. In the event that the mounting 809 should have been moved to a position where the stylus carriage might be moved off the mounting without the receipt of a synchronizing impulse, then the pressure of the mounting 809 against the engagement head 831 of the lever 830 will permit disengagement of the lever arm 817 in order to obviate such removal.

For this purpose, the lever arm 830 is slidably connected at 832 to the armature 822 and is therefore so arranged that pressure of the mounting 809 thereon in the direction indicated by the arrow of Figure 35 will result in rotation of lever arm 830 and a pushing of the armature 822 towards the magnet 825 and hence result in a disengagement of the notch of the armature 821 from the arm 820 of the lever arm 817.

The engagement head 831 of the arm 830 is arranged in the same manner as the engagement head 824 of the arm 817 in order to permit a return movement of the mounting. In this manner, exactly the same type of stylus arresting action

is provided for as was described in connection with the first modification set forth in Figures 1–21*a* of this specification. No element except the stylus carriage itself is brought to a stop.

The scanning arm may continue to oscillate continously without any change in its motion and it is only the scanning stylus and its relatively small carriage which are brought to a stop for the purpose of synchronization. Where it is desired to bring the stylus carriage **812** back into its original position with respect to the mounting **809**, the screw **840**, Figures 34 and 35, may be adjusted so that the carriage **812** will press against the portion **841** of the screw and thus be pushed back into its original relationship with its mounting **809**.

Upon the inception of the next scanning excursion, the same synchronizing action will occur and the lever **817** will cause the stylus carriage **812** to remain stationary until receipt of the synchronizing impulse. Phasing may be accomplished in the same manner as has heretofore been described in connection with Figure 4 and the same operations may be performed with this type of receiver as with the receivers of the two prior modifications.

Likewise, synchronizing switching may take place from the main drive shaft in the manner described in connection with Figure 14 or the switching for synchronizing purposes may be accomplished by mounting the switch on the synchronizing lever itself in the manner described in connection with Figure 21*a*.

In Figures 38–42 inclusive, I have shown a slightly modified form of the structure of Figure 34 wherein the same type of oscillating arm scanning mechanism is utilized and wherein the same type of synchronizing mechanism is also utilized but wherein the movable stylus is a pivotally mounted one instead of a slidably mounted one.

For this purpose, the stylus **915** is mounted on the spring member **914** which is secured in any suitable manner as by the screws **913** to the pivotally mounted bar **907**, the said bar **907** being pivoted on the pin **908** which is carried by the oscillating arm **900** which operates about the pivot **806** in the manner previously described.

The pivotal securement of the bar **907** to the oscillating arm **900** is frictionally tight at the pivot **908** and this frictional securement is obtained by means of the spring **920**. (See for instance Figure 39.) The pin **908** has a washer **921** on one side thereof which bears against the pivotally mounted bar **907** and a washer **922** at the opposite end. The compression spring **920** is captured between the washer **922** and the bushing **923** of the oscillating arm **900** thus ensuring that the washer **921** is pressed tightly against the pivotally mounted bar **907** pressing the bar in turn frictionally tightly against the bushing **923**.

The pivotally mounted bar **907** also carries a projection **925** for engagement with the head **824** of the stylus synchronizing lever **817**. The levers **817** and **830** in this embodiment operate in exactly the same manner as in the case of Figures 34 to 37. That is, the lever **817** engages the projections **925** of the bar **907** as seen in Figure 38 thus holding the stylus **915** stationary with respect to the paper while the oscillating arm **900** continues in its movement. The placement of the synchronizing lever **817** in the path of the stylus for the purpose of holding the stylus stationary results in a rotation of the bar **907** about the pivot **908**. Upon the removal of the lever **817** by the synchronizing impulse, then any force which heretofore has been exerted upon the bar **907** to rotate the same is removed and the bar **907** now immediately continues its movement with the arm **900** in the position in which it was left at the time the synchronizing impulse was received.

The lever **830** is used in the same manner as has heretofore been described in connection with Figures 34 to 37 to prevent too great a rotation of the bar **907**.

The spring **914** ensures that the stylus **915** will always be in engagement with the paper **891** no matter what the radial position of the bar **907** about its pivot may be, provided it is not displaced to too great a distance (which latter possibility is obviated by the lever **830** in the manner previously described). By the use of the mechanism of Figure 38 it is thus possible, instead of using a slidable frictionally held stylus as shown in Figure 34 to use a pivotal frictionally held stylus which may thus be held stationary with respect to the paper until the synchronizing impulse is received.

In other respects the operation is the same although in the present instance, there is no possibility that the stylus can be slidably removed from the oscillating arm.

Resetting of the stylus may be accomplished by a member such as the member **840** of Figure 34 or the member **940** of Figure 38 may be utilized, the same member **940** being supported in any suitable manner, as for instance, by the screws **941** from the stationary bracket **942**. The said member **940** may also be placed on that side of the scanning apparatus where the oscillating arm will engage it upon the completion of the scanning excursion instead of waiting for the completion of the return excursion. A pin **945** on the bottom of the arm **907** may strike against the abutment **940** and owing to the continued movement of the arm **900**, and the pivot arm **907** may thus be rotated back to its initial position.

Obviously, of course, the member **940** may abut against any portion of the lower part of the pivoted arm or against any other member besides the pin which may be mounted thereon.

Various phasing and synchronizing elements such as those previously described may also be used in this embodiment and the pawl and ratchet clutch of Figure 4, the cam switches of Figures 14 or 21*a* may also be used for this purpose.

In the foregoing descriptions I have set forth my invention in its various possible embodiments, that is, in connection with its utilization for multiple stylus continuous recording apparatus, in its adaptation for revolving drum light beam recording apparatus, and in its adaptation to oscillating arm scanning apparatus.

In each of these modifications, the essential element was to obtain continuous regular movement of virtually the entire movable mass of the recording equipment and to halt for synchronizing purposes only the recording element itself whether it be the stylus or the light beam. The recording element itself is relatively of so little mass that the momentary halt thereof can have no effect upon the steadiness of the recording apparatus. Thus in the case of stylus recording, the stylus and the slidable carriage upon which it is mounted may actually weigh no more than a gram while the rotating and moving masses including the drive shafts, the sprockets or cam and the chains or oscillating arms are not impeded in any way in their continuous operation.

In the case where a light beam is utilized as

the recording element, the revolving drum and the light beam carrier are able to move regularly and continuously without any cessation of movement whatever during the entire recording and the only element that need be moved for synchronizing purposes is a small rotatable mirror which for synchronizing purposes need be rotated through an extremely small arc, the rotation thereof not affecting the regular movement of the recording apparatus by deflecting the light beam in a desired manner.

The simplification of the recording apparatus made possible, therefore, by my invention and the improved results achieved thereby further enhance the value of facsimile equipment for home use by non-technical unskilled persons.

In each of the various constructions herein set forth, I have illustrated only preferred embodiments thereof in connection with the specific structures used.

Obviously, my invention may readily be adapted to other types of facsimile recording structures and in each of those structures my invention may have a form appropriate to those structures.

Many modifications of the specific form of my invention in each structure will now be obvious to those skilled in the art. I prefer therefore to be bound not by the specific disclosures herein, but only by the appended claims.

I claim:

1. A telepicture receiver for line by line scanning of a sensitive sheet comprising a sensitive sheet carrier and a stylus mounting, said mounting being carried by an oscillating arm, a source of power and a positive drive connection between said source of power and said arm, means for regularly uninterruptedly moving said stylus mounting with respect to said sheet, a stylus carrier carried by and movable with said stylus mounting, a stylus on said carrier and engageable with said sheet, and a synchronizing lever arm engageable with said carrier and holding said carrier stationary at the inception of a scanning line while said mounting continues said regular movement; said lever arm being positioned in engaging position by an armature of a synchronizing magnet; means for energizing said synchronizing magnet to move said armature to release said lever arm from engaging position.

2. A telepicture receiver for line by line scanning of a sensitive sheet comprising a sensitive sheet carrier and a stylus mounting, said mounting comprising an oscillating arm, a source of power and a positive drive connection between said source of power and said arm, means for regularly uninterruptedly moving said stylus mounting with respect to said sheet, a stylus carrier pivotally mounted on said oscillating arm mounting, frictionally positioned with respect thereto and movable with said stylus mounting, a stylus on said carrier and engageable with said sheet, means engaging said stylus carrier and holding said carrier stationary at the inception of a scanning line while said mounting continues said regular movement, and means for releasing said engagement means upon receipt of a selected signal.

3. A telepicture receiver for line by line scanning of a sensitive sheet comprising a sensitive sheet carrier and a stylus mounting, said mounting being carried by an oscillating arm, a source of power and a positive drive connection between said source of power and said arm, means for regularly uninterruptedly moving said stylus mounting with respect to said sheet, a stylus carrier carried by and movable with said stylus mounting, a stylus on said carrier and engageable with said sheet, and a synchronizing lever arm engageable with said carrier and holding said carrier stationary at the inception of a scanning line while said mounting continues said regular movement; said lever arm being positioned in engaging position by an armature of a synchronizing magnet; means for energizing said synchronizing magnet to move said armature to release said lever arm from engaging position, and means for restoring said stylus carrier to original position in its mounting after the termination of the scanning excursion.

4. A telepicture receiver for line by line scanning of a sensitive sheet comprising a sensitive sheet carrier and a stylus mounting, said mounting comprising an oscillating arm, a source of power and a positive drive connection between said source of power and said arm, means for regularly uninterruptedly moving said stylus mounting with respect to said sheet, a stylus carrier pivotally mounted on said oscillating arm mounting, frictionally positioned with respect thereto and movable with said stylus mounting, a stylus on said carrier and engageable with said sheet, means engaging said stylus carrier and holding said carrier stationary at the inception of a scanning line while said mounting continues said regular movement, and means for releasing said engagement means upon receipt of a selected signal, and means for restoring said stylus carrier to original position in its mounting after the termination of the scanning excursion.

5. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, and means operable at the termination of a scanning line to cause said recording element to move to a position at the beginning of a scanning line, means for causing said recording element to move with said drum to remain at the beginning of said scanning line and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element.

6. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a light beam emanating from said recording carriage and reflected upon said drum, means for varying said light beam in accordance with facsimile impulses, and means operable at the termination of a scanning line to deflect said light beam to a position in which it impinges upon the beginning of the next scanning line, means for causing said light beam to move so that it continues to impinge upon said drum at

the beginning of said next scanning line, and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said light beam.

7. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, said recording element comprising a light source and means guiding said light source to said sensitive sheet carrier; and adjustment means operable at the termination of a scanning line to cause said guiding means to move to impinge said light at the beginning of a scanning line, said adjustment means causing said guiding means thereafter to move with said drum to cause said light to continue to impinge thereon at the beginning of said scanning line; and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element.

8. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, said recording element comprising a light source and means guiding said light source to said sensitive sheet carrier; and adjustment means operable at the termination of a scanning line to cause said guiding means to move to impinge said light at the beginning of a scanning line, said adjustment means causing said guiding means thereafter to move with said drum to cause said light to continue to impinge thereon at the beginning of said scanning line; and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element, said guiding means comprising a mirror and a pivotal mounting for said mirror.

9. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, said recording element comprising a light source and means guiding said light source to said sensitive sheet carrier; and adjustment means operable at the termination of a scanning line to cause said guiding means to move to impinge said light at the beginning of a scanning line, said adjustment means causing said guiding means thereafter to move with said drum to cause said light to continue to impinge thereon at the beginning of said scanning line; and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element, said guiding means comprising a shaft mounted parallel to the path of movement of said recorder carriage; a mirror carried by said shaft.

10. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, said recording element comprising a light source and means guiding said light source to said sensitive sheet carrier; and adjustment means operable at the termination of a scanning line to cause said guiding means to move to impinge said light at the beginning of a scanning line, said adjustment means causing said guiding means thereafter to move with said drum to cause said light to continue to impinge thereon at the beginning of said scanning line; and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element, said guiding means comprising a shaft mounted parallel to the path of movement of said recorder carriage; a mirror carried by said shaft; said adjustment means comprising a lever operatively connected to said shaft; a pawl at the end of said lever and a cam carried by said drum.

11. A telepicture receiver for line by line scanning of a sensitive sheet along a helical path in response to telepicture facsimile and synchronizing signals received from a transmitting station, said receiver comprising a sensitive sheet carrier drum and a recorder carriage, a source of power, a positive drive connection between said source of power and said drum for continuously rotating said drum and a positive drive connection between said source of power and said carriage for continuously moving said carriage longitudinally of said drum, a recording element carried by and moving with said carriage and responsive to facsimile impulses, said recording element comprising a light source and means guiding said light source to said sensitive sheet carrier; and adjustment means operable at the termination of a scanning line to cause said guiding means to move to impinge said light at the beginning of a scanning line, said adjustment means causing said guiding means thereafter to move with said drum to cause said light to continue to impinge thereon at the beginning of said scanning line; and additional means responsive to a synchronizing impulse for arresting said last mentioned movement of said recording element, said guiding means comprising a shaft mounted parallel to the path of movement of said recorder carriage; a mirror carried by said shaft; said adjustment means comprising a lever operatively connected to said shaft; a pawl at the end of said lever and a cam carried by said drum; and

means for disconnecting said lever from said shaft on receipt of a synchronizing signal.

12. In a facsimile receiver for receiving and translating facsimile and synchronizing signals, a recording drum and a recorder therefor; means for moving said recorder with respect to said drum; said means comprising a power source, drive shaft and additional driving mechanism; and means for phasing said recorder comprising a power connection between said power source and said drive shaft; said power connection being normally inoperative; and magnetic means responsive to the continuous reception of said signals for rendering said power connection operative; and separate synchronizing means for said recorder.

13. In a facsimile receiver for receiving and translating facsimile and synchronizing signals; a recording drum and a recorder therefor; means for moving said recorder with respect to said drum; said means comprising a power source, drive shaft and additional driving mechanism; and means for phasing said recorder comprising a power connection between said power source and said drive shaft; said power connection being normally inoperative; and magnetic means responsive to the continuous reception of said signals for rendering said power connection operative; said power connection comprising a pawl and ratchet; means biasing said pawl out of engagement with said ratchet; said magnetic means comprising an electro-magnet connected to said pawl; said magnet, when energized, urging said pawl into engagement with said ratchet; means for energizing said magnet while signals are being received.

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