United States Patent [19]

Nelson

[11] **3,872,239**

[45] **Mar. 18, 1975**

[54] **FACSIMILE APPARATUS AND METHOD OF OPERATION**

[75] Inventor: **Richard L. Nelson,** New York, N.Y.

[73] Assignee: **Exxon Research and Engineering Company,** Linden, N.J.

[22] Filed: **Feb. 20, 1973**

[21] Appl. No.: **333,616**

[52] **U.S. Cl.** ..... **178/6,** 178/6.6 R, 346/24, 346/138

[51] **Int. Cl.** **H04n 1/08**

[58] **Field of Search** ..... 178/6, 6.6 R, 7.6; 346/24, 346/138

[56] **References Cited**

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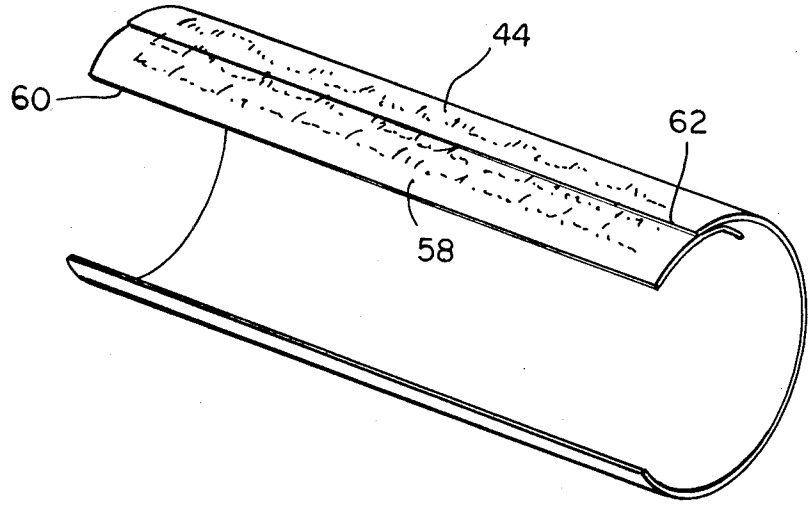
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Primary Examiner—Howard W. Britton
Attorney, Agent, or Firm—N. Norris

[57] **ABSTRACT**

A facsimile transceiver comprising a document/copy receiving drum, a motor for rotation of the drum about the drum axis and a read/write head mounted for linear movement in a direction parallel with the drum axis. When the transceiver is operating in the receive mode, the copy medium having adhesive along at least one edge circumscribes the drum in a closed loop so as to eliminate the necessity for transmitter-receiver angular synchronizing signals which would otherwise be required for locating the copy margin adjacent the edge of the copy paper. After completion of a transmission, the copy medium is severed along a line so as to provide an appropriate margin for the copied information content. In one embodiment of the invention, the closed loop is formed from a single sheet having adhesive along one edge for purposes of forming a bond between opposite edges of the sheet when the sheet is applied to the drum. The read/write head includes a cutting wheel which is adapted to sever the sheet along the appropriate line when the head is moved in a cutting stroke along the length of the drum with the cutter wheel in contact with the sheet. In another embodiment, the copy paper includes tear strings displaced along its back surface running parallel to the axis of the drum and of sufficient number so that a tear string for shearing the copy paper loop is likely to be near the margin of the copy.

27 Claims, 28 Drawing Figures



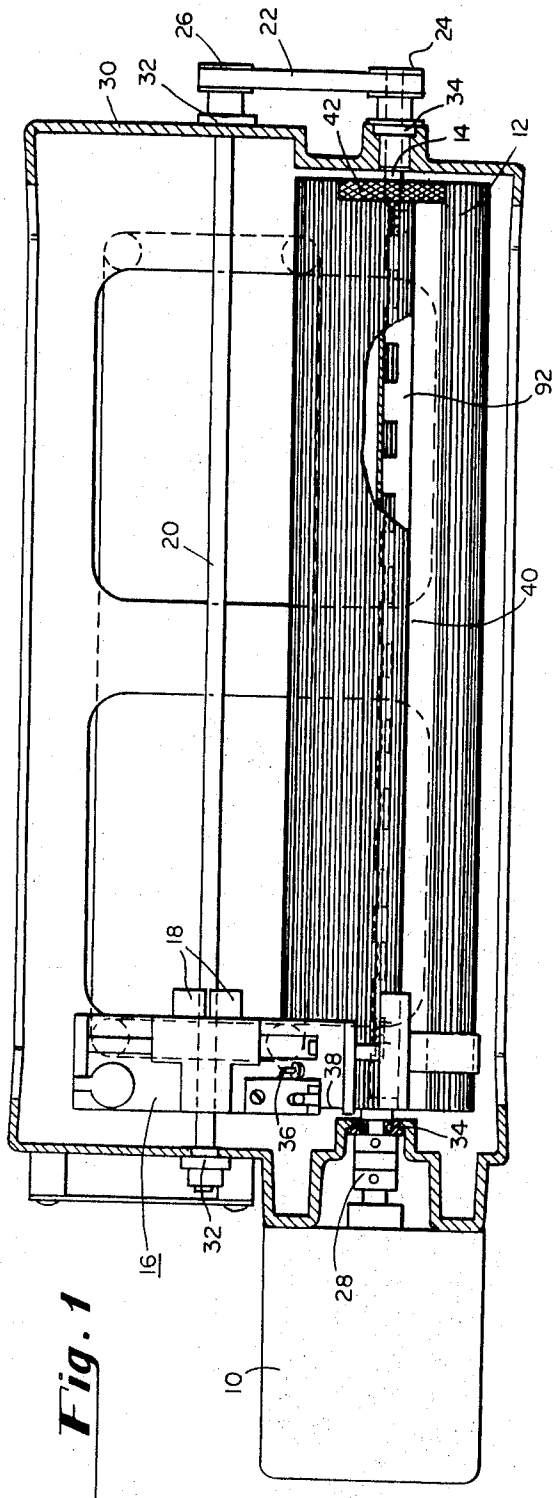

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Fig. 1

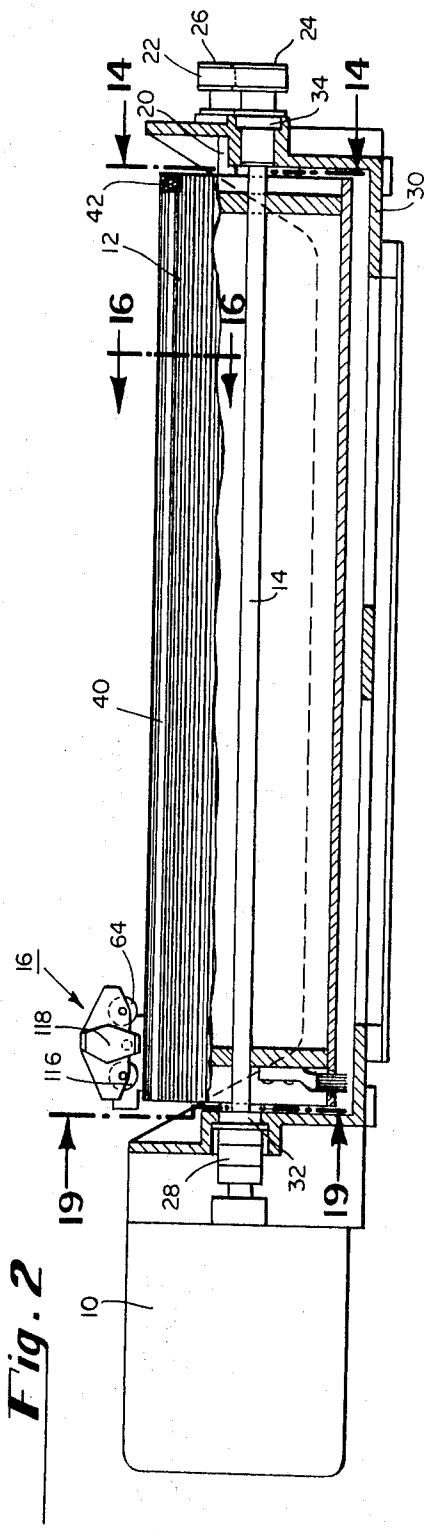
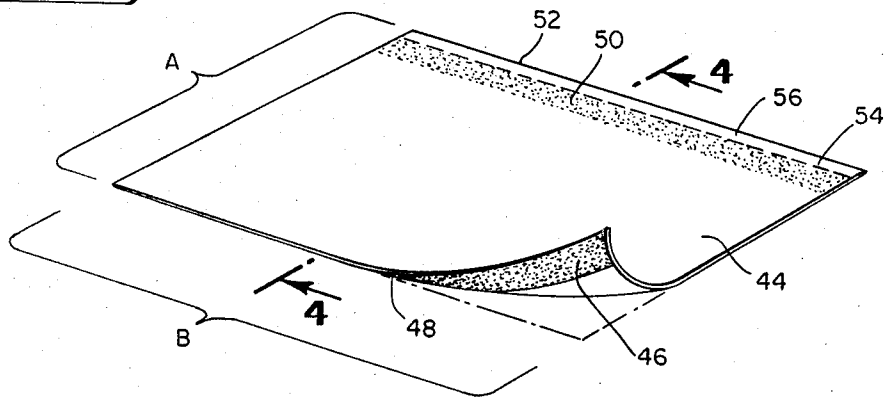

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Fig. 2

Fig. 3



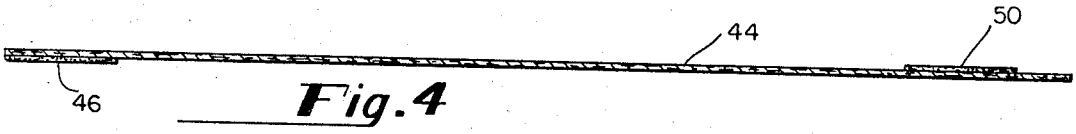


Fig. 4

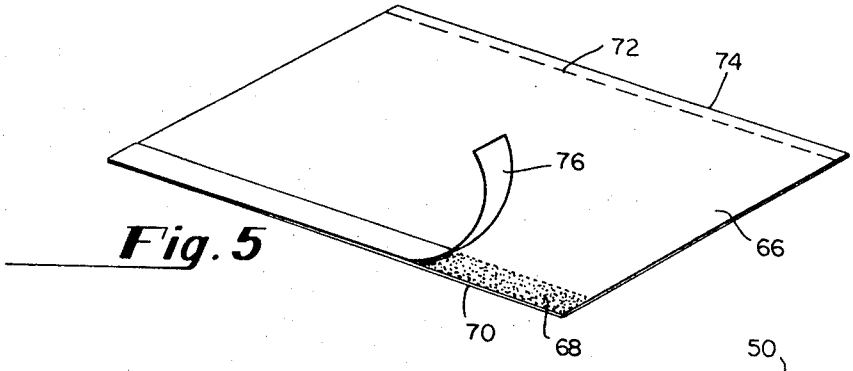


Fig. 5

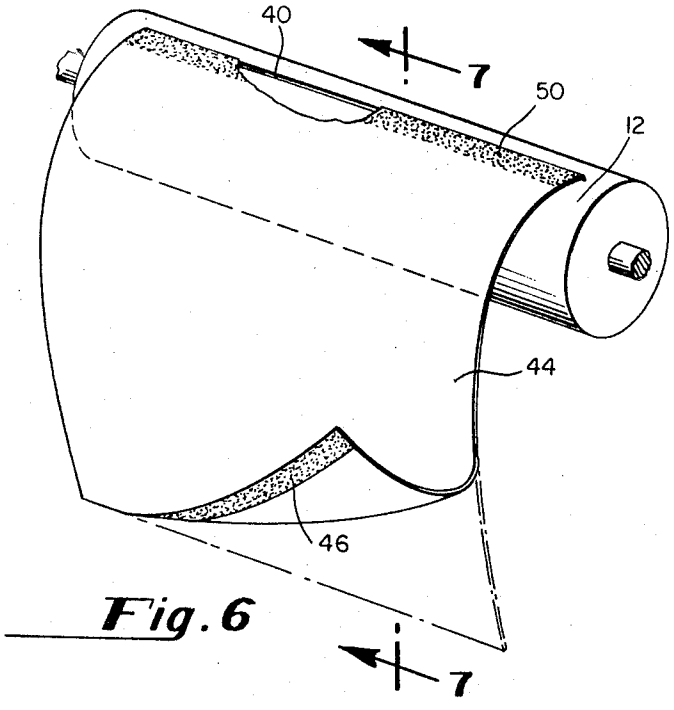


Fig. 6

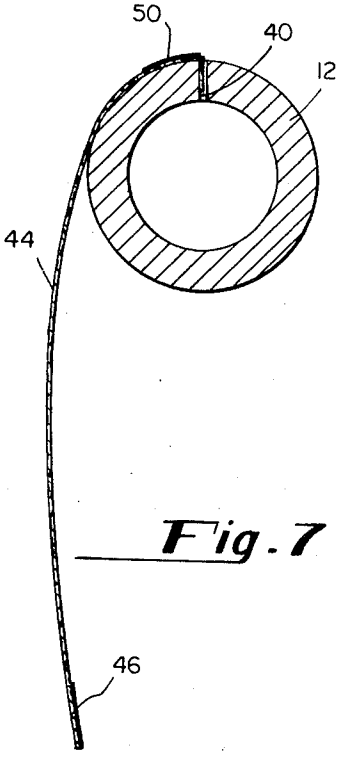


Fig. 7

Fig. 8

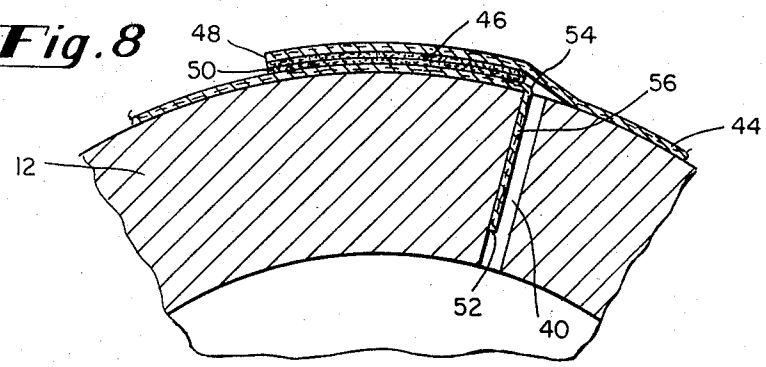
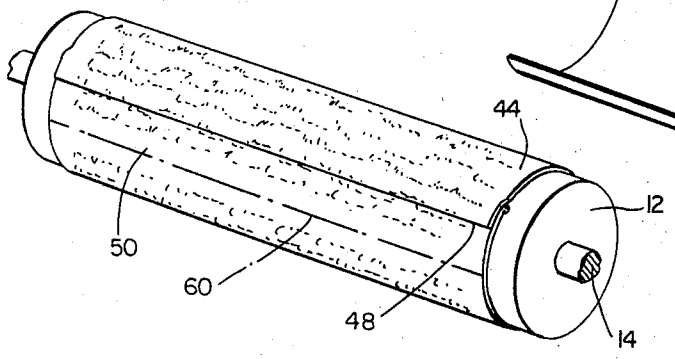


Fig. 9



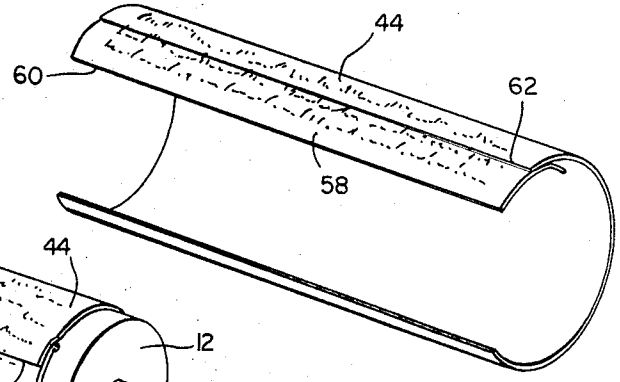


Fig. 10

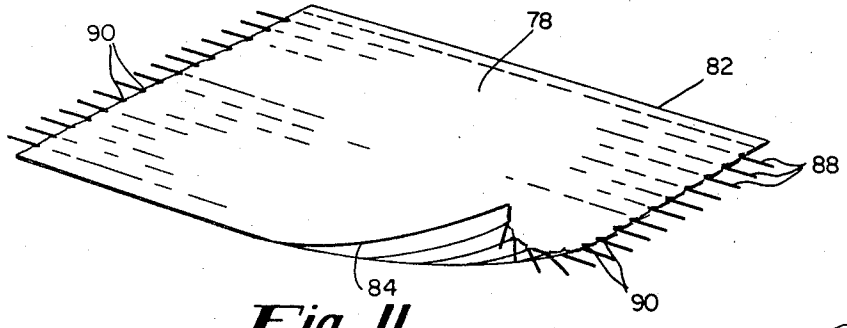


Fig. 11

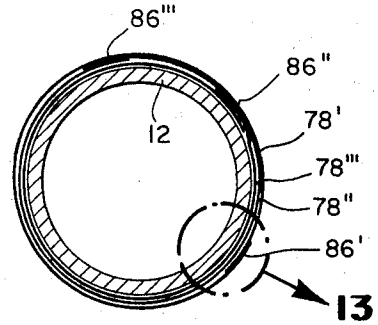


Fig. 12

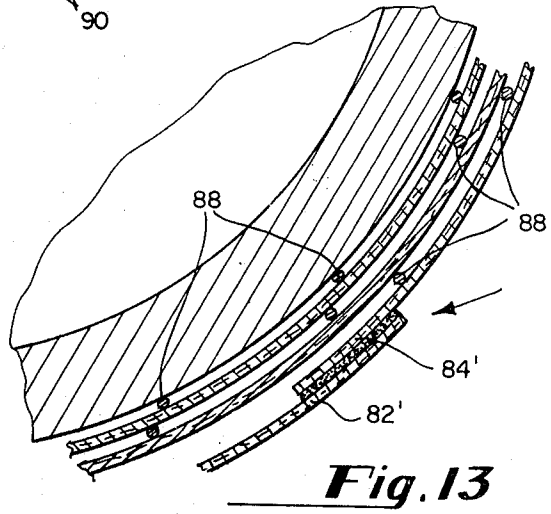


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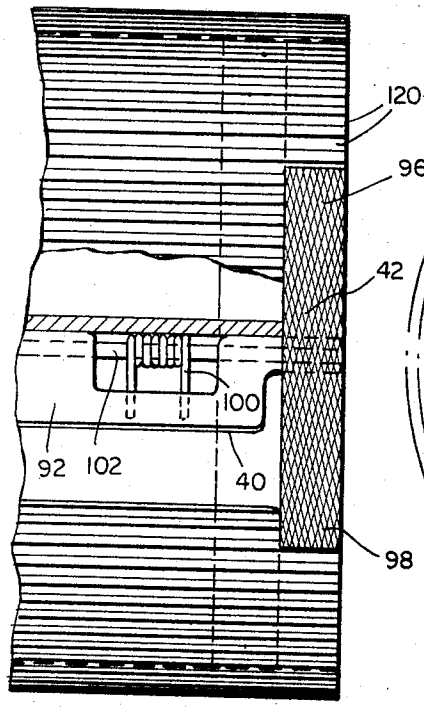


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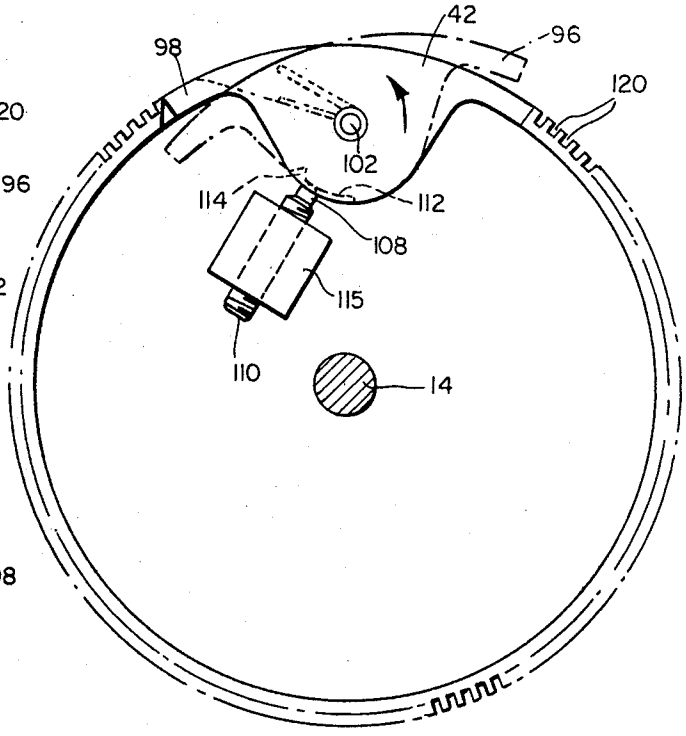


Fig. 14

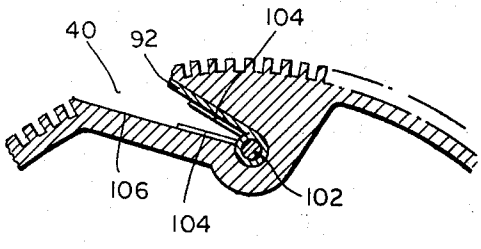


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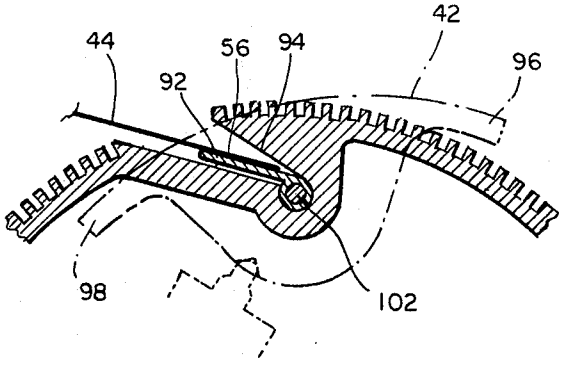


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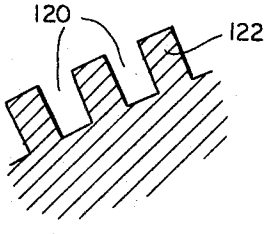


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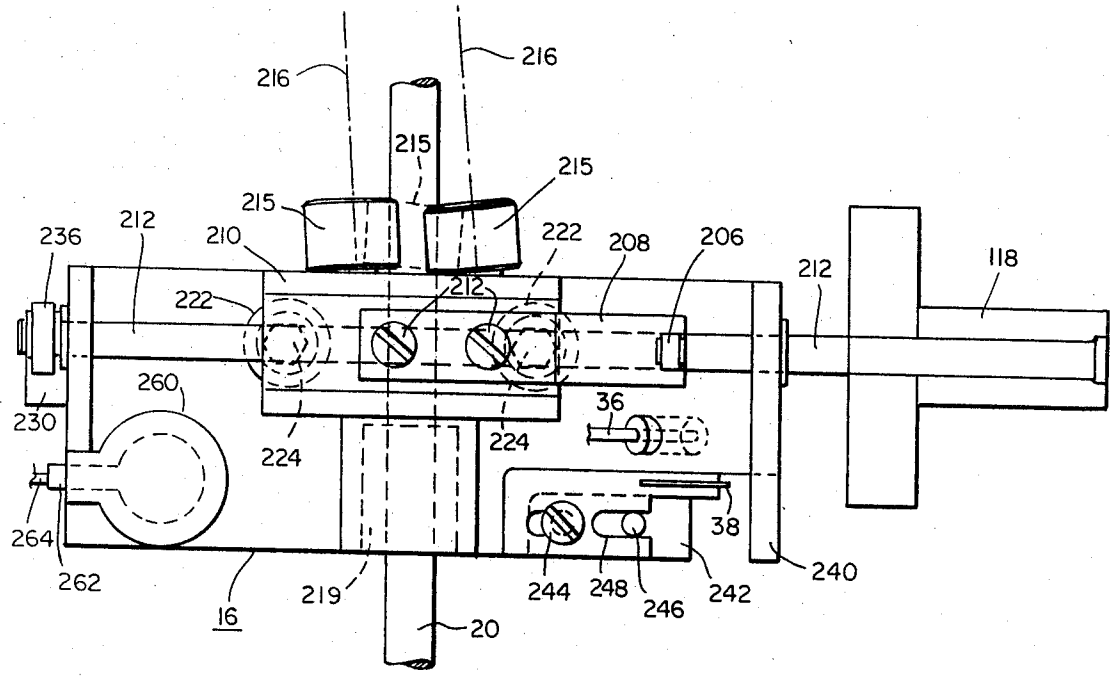

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Fig. 20

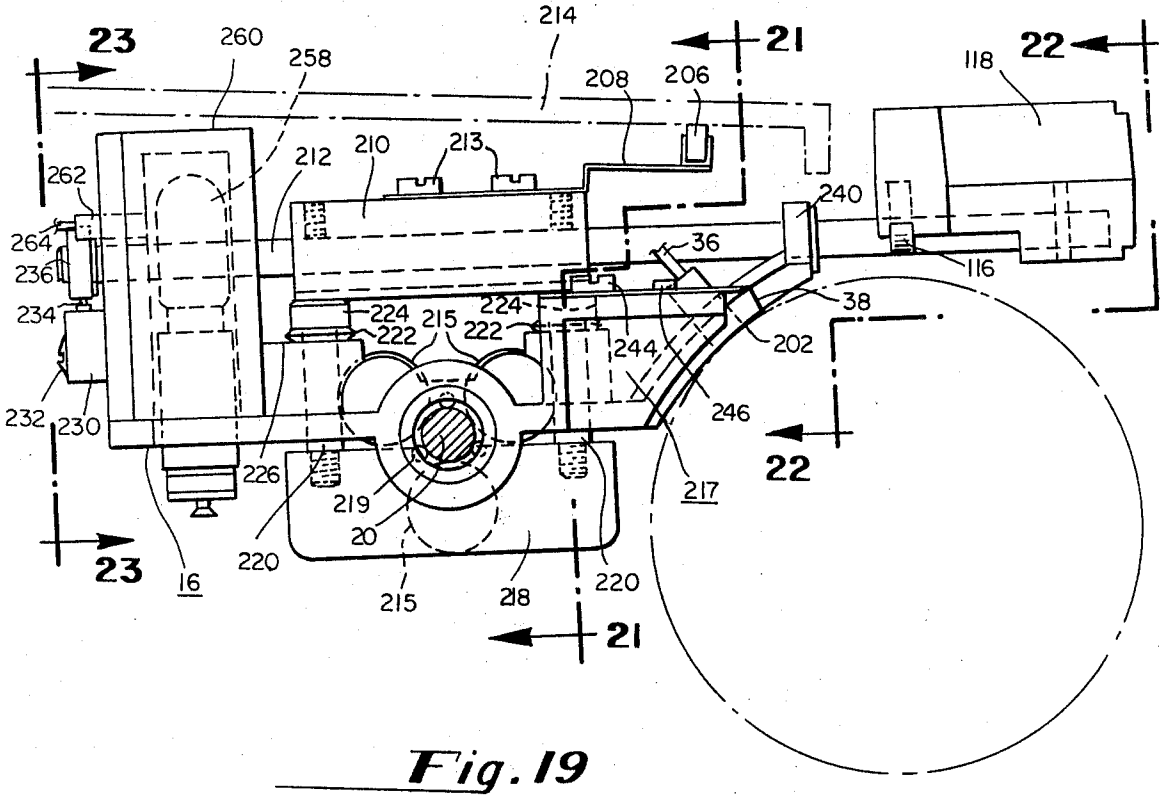
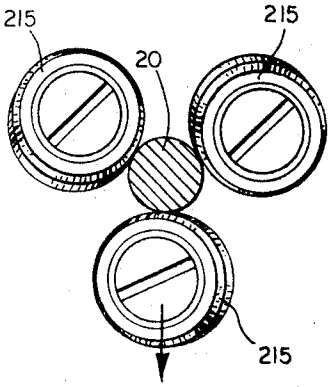

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Fig. 19

Fig. 24



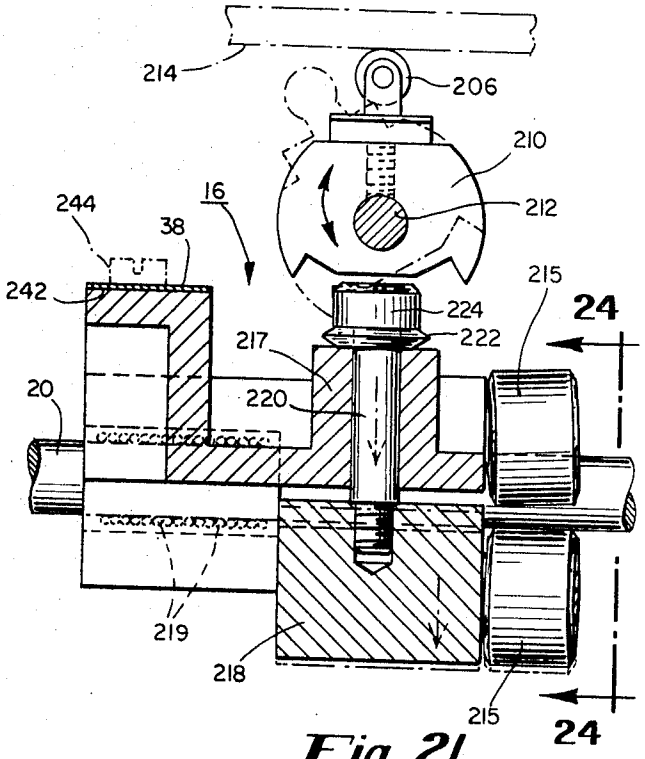


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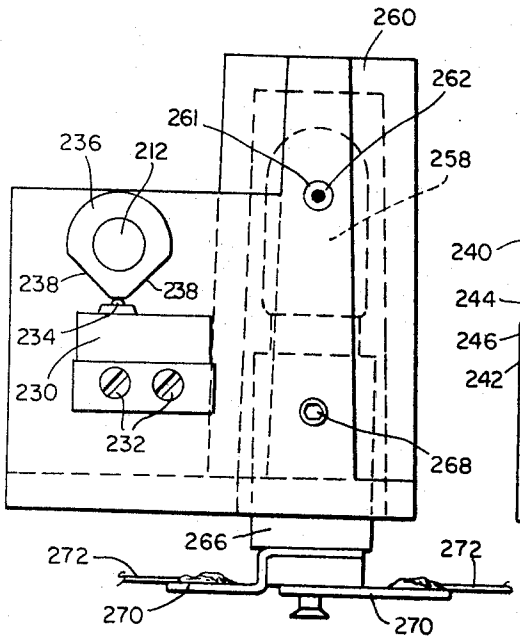


Fig. 23

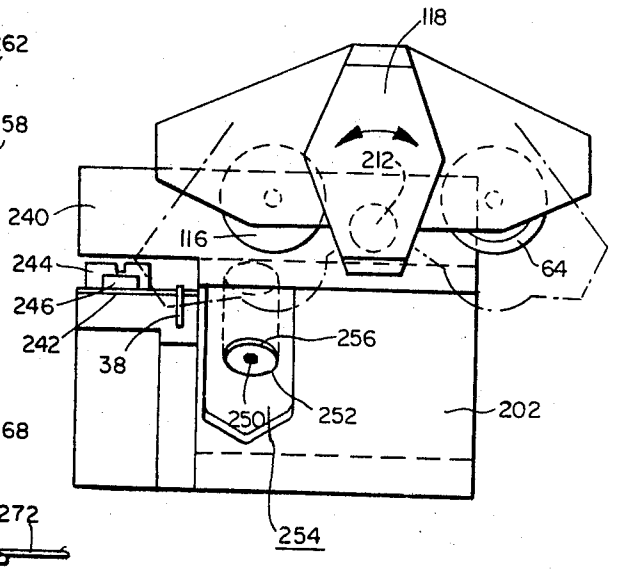


Fig. 22

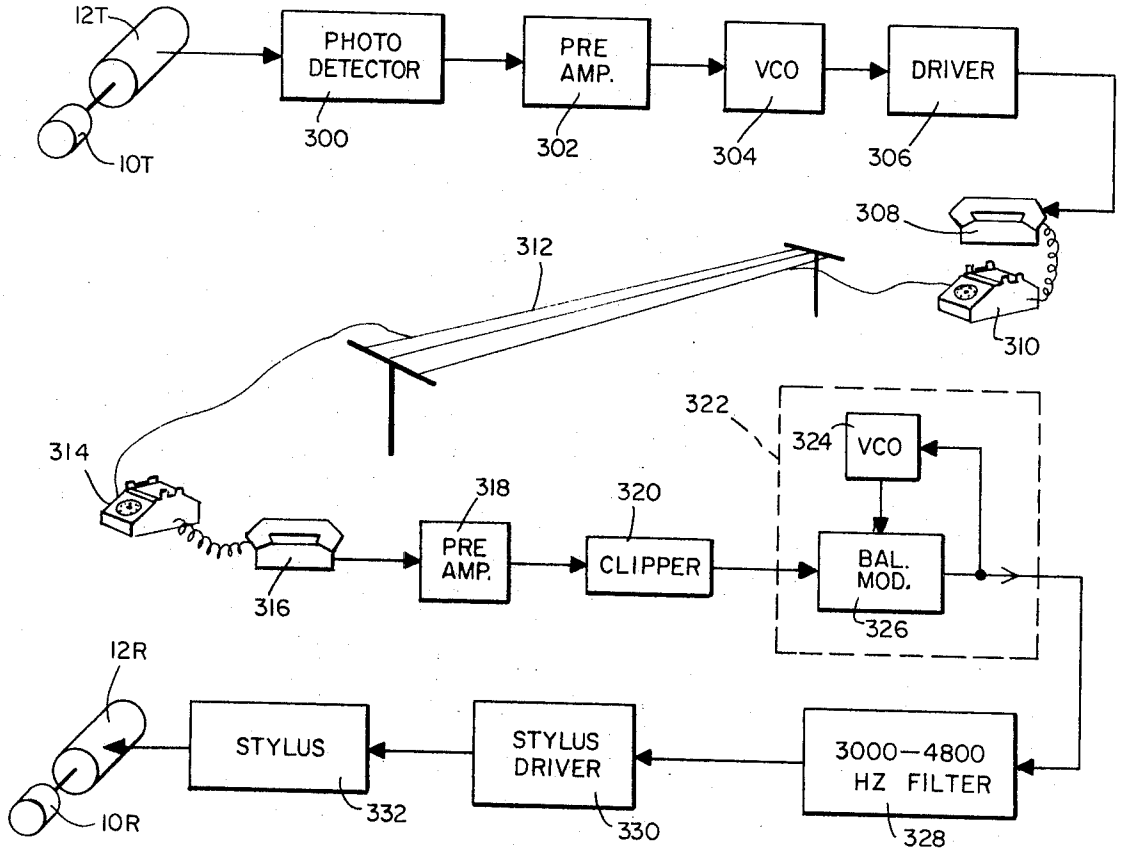

12T
10T
PHOTO DETECTOR
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PRE AMP.
302
VCO
304
DRIVER
306
308
310
312
314
316
318
PRE AMP.
320
CLIPPER
322
324
VCO
BAL. MOD.
326
12R
10R
STYLUS
332
STYLUS DRIVER
330
3000—4800 HZ FILTER
328

Fig. 25

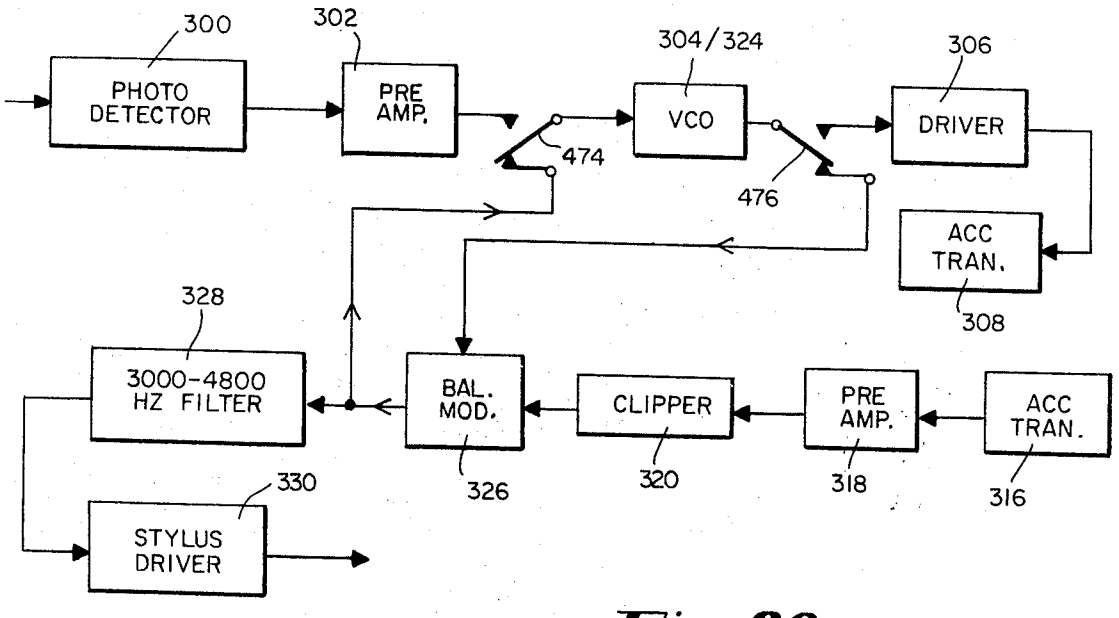

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PHOTO DETECTOR
302
PRE AMP.
304/324
VCO
306
DRIVER
474
476
ACC TRAN.
308
328
3000-4800 HZ FILTER
BAL. MOD.
326
CLIPPER
320
PRE AMP.
318
ACC TRAN.
316
330
STYLUS DRIVER

Fig. 26

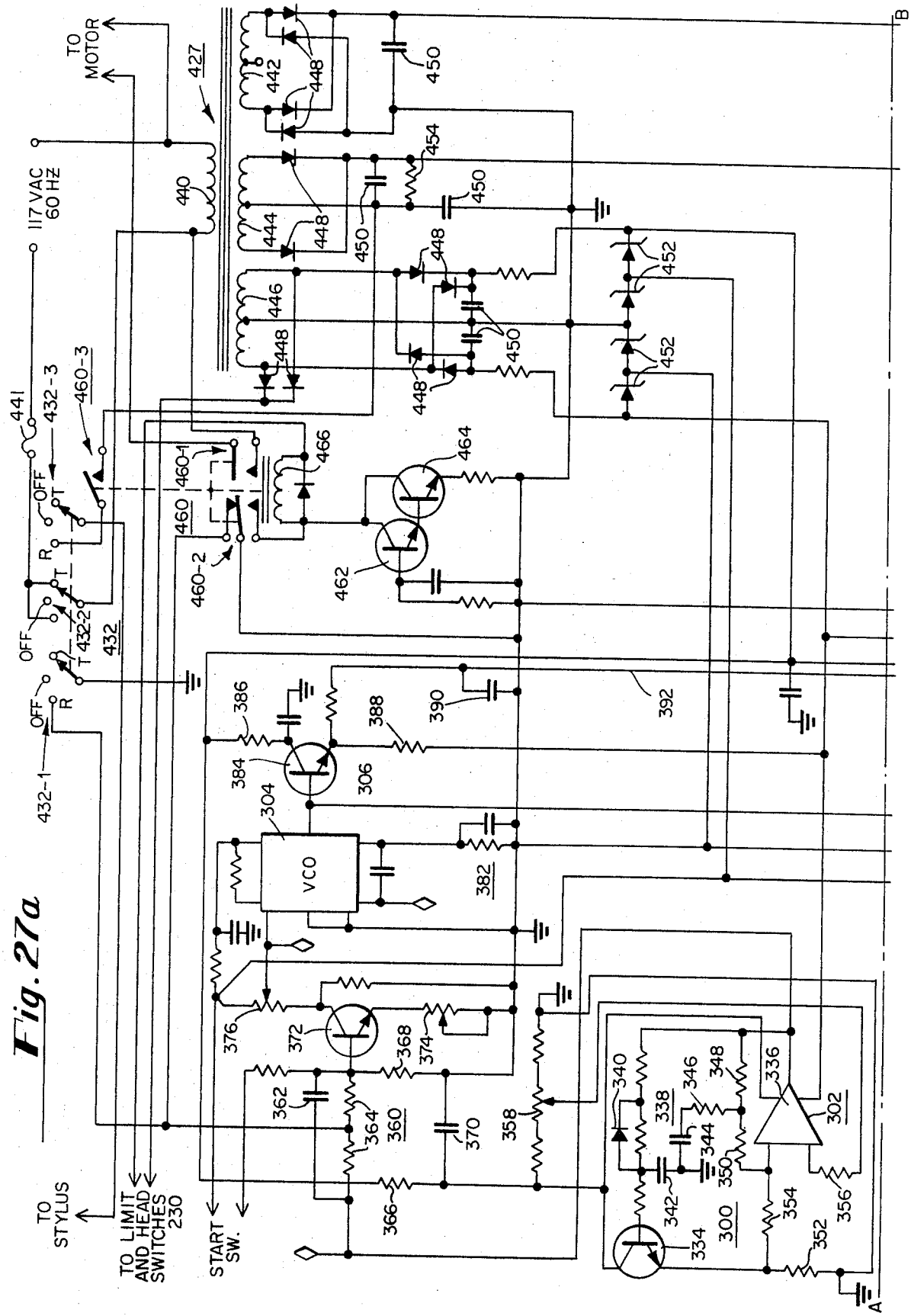

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TO STYLUS
TO LIMIT AND HEAD SWITCHES 230
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Fig. 27a

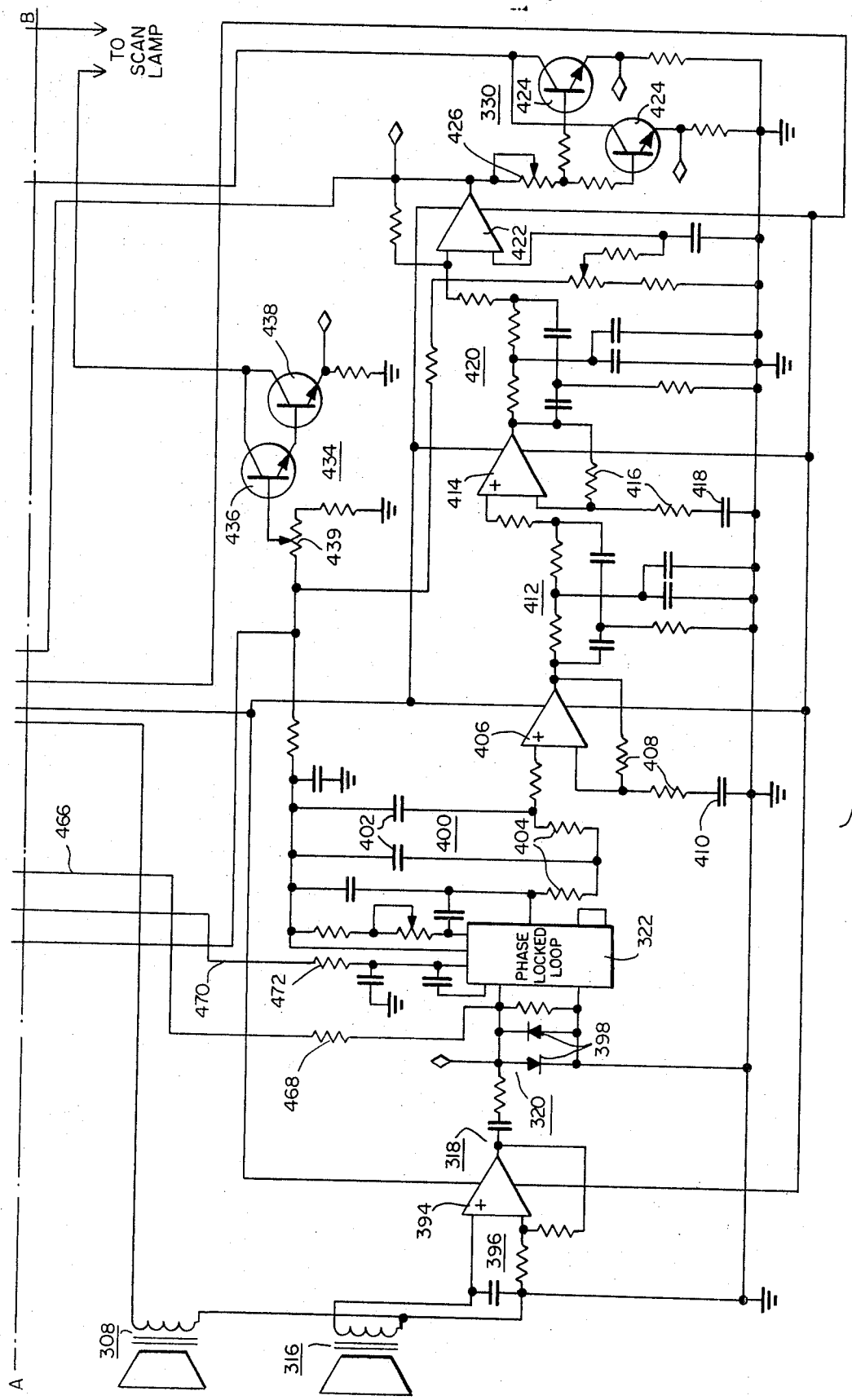

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TO SCAN LAMP
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400
404
466
PHASE LOCKED LOOP
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A

Fig. 27b

FACSIMILE APPARATUS AND METHOD OF OPERATION

RELATED APPLICATIONS

Certain aspects of the facsimile apparatus disclosed herein are also disclosed in my copending application Ser. No. 333,615 filed Feb. 20, 1973 now abandoned in favor of continuation-in-part application Ser. No. 412,989 filed Nov. 5, 1973, a copending application of Luther R. Winters, Jr. Ser. No. 332,927 filed Feb. 16, 1973 and a copending application of Herbert P. Ford, Jr. Ser. No. 332,925 filed Feb. 16, 1973, assigned to the assignee of this invention.

BACKGROUND OF THE INVENTION

This invention relates to facsimile systems comprising a transmitter, a receiver and a communications network such as telephone lines therebetween. The transmitter employs a scanning or reading element which reads the information content of an original document. The original document is moved relative to the reading means such that successive paths are scanned whereupon the output of the scanning element is fed to a device such as a photodetector which converts the variations in light intensity received by the scanning element due to variations in the reflectivity of the scanned document to electrical signals. These electrical signls then convey information concerning the radiation absorption, emission or reflection of the scanned document. The electrical information-bearing signals are then transmitted to a receiving unit over suitable means such as a telephone network where the receiving unit converts the electrical information-bearing signals from the transmitting unit to marks or images on a receiving copy medium so that the received copy is a reasonable facsimile of the original scanned document.

In one type of conventional facsimile system, the copy medium comprises a sheet of paper which is applied to the receiving drum with opposite edges of the paper abutting or overlapping so as to form an open loop having a discontinuous copy medium surface. In order to assure that the margin of the copy is appropriately located with respect to the edge of the sheet, angular synchronizing signals are utilized. These signals assure that the position of the document edge passes the reding head of the transmitter at the same time that the copy edge passes the writing head of the receiver, and this in turn assures the proper location of the copy margin with respect to the edge of the copy sheet. In other words, the copied matter is placed on the copy sheet in substantial conformance with its location on the document being copied.

U.S. Pat. No. 3,582,550 — Latanzi is illustrative of the complexity which is involved in maintaining synchronization between transmitter and receiver drums in prior art systems. In this particular prior art system, a variable frequency generator drives the drum motor at the receiver in resonse to an error signal indicative of the relative positions and speeds of the transmitter and receiver drums. An elaborate clutch mechanism is shown in U.S. Pat. No. 3,569,628 — Okleshen which is utilized in effecting synchronous phase operations between a transmitter and a receiver. These synchronizing arrangements add expense to a facsimile system as well as making it difficult to increase the rate of transmission.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a relatively low cost facsimile system.

It is a more specific object of this invention to provide a relatively low cost facsimile system by eliminating the necessity for synchronizing signals.

In accordance with this invention, a facsimile system comprises a transmitter, a receiver and a communications network coupling the transmitter to the receiver. The transmitter includes reading means for detecting the information content of an original document, transmitter scanning means for moving the original document relative to the reading means along successive scanning paths and signal transmission means responsive to the reading means for generating signals representative of the information content of the original document. The receiver includes means for writing on a copy medium, receiver scanning means for moving the copy medium relative to the writing means along successive scanning paths and signal receiving means responsive to the signals generated by the signal transmission means for activating the writing means to reproduce the information content of the original document on the copy medium. In order to eliminate the necessity for synchronizing the initial position of the original document with respect to the reading means and the initial position of the copy medium with respect to the writing means, the copy medium comprises a closed or endless loop of material moving relative to the writing means such that a continuous writing surface is juxtaposed to the writing means. In accordance with one important aspect of the invention, the receiver scanning means may comprise a substantially cylindrical drum rotatable about the axis thereof with the copy medium forming the closed loop around the cylindrical surface of the drum. A similar drum may be utilized for the transmitter scanning means where the original document forms an open loop around the cylindrical surface of that drum. By utilizing synchronous motors to drive the drums, sufficient speed synchronism between the drums of the transmitter and receiver may be maintained during scanning.

In accordance with another important aspect of the invention, the receiver may comprise means for severing the copy medium along a line parallel to the axis of the drum so as to appropriately locate the margin of the copy with respect to the edge of the paper. In other words, the severing of the copy medium permits the information on the copy medium to be appropriately positioned or centered on the severed copy sheet. In one preferred embodiment of the invention, the scanning means comprises a head which moved along a linear path parallel to the axis of the drum. The head includes cutting means which may be moved into cutting engagement with the copy medium and then moved along the copy medium with the head. In order to permit the head to be moved through a cutting stroke, means are provided which permit the head to slide along the linear path independent of the drive mechanism. The surface of the drum is provided with a plurality of linear grooves extending parallel with the axis of the drum so as to provide a guide for the cutting roller carried by the head. By providing a sufficient number of grooves, the cutting means can be aligned with one of the grooves so that the copy medium is severed along a line to assure the proper location of the copy margin with

respect to the edge of the paper. The drum may also comprise a pliable or soft surface providing means to allow the cutter to penetrate and sever the copy medium.

In accordance with still another important aspect of the invention, the copy medium comprises a sheet of material adapted to be marked by the writing means of the receiver. The sheet includes adhesive means carried adjacent one edge thereof so as to permit the formation of an adhesive bond between areas adjacent opposite edges of the sheet when the areas are overlapped to form a closed loop. A line of weakness may be provided along one edge of the sheet to facilitate folding thereof and thereby permit the portion of the sheet located between the line of weakness and its adjacent edge to be inserted into a clamp or slot of the receiver drum.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of a facsimile transceiver constructed in accordance with the invention;

FIG. **2** is a front view of the transceiver shown in FIG. **1**;

FIG. **3** is a perspective view of a sheet of copy paper having self-bonding adhesive on both sides which may be utilized in the transceiver of FIGS. **1** and **2**;

FIG. **4** is a sectional view taken along line **4—4** of FIG. **3**;

FIG. **5** is a perspective view of another embodiment of the sheet of copy paper wherein an adhesive strip is provided on only one side of the copy paper;

FIG. **6** is a perspective view of the copy paper of FIG. **3** being applied to the cylindrical drum of the transceiver shown in FIGS. **1** and **2**;

FIG. **7** is a cross-sectional view taken along line **7—7** of FIG. **6**;

FIG. **8** is an enlarged partial cross-sectional view of the paper and clamping slot shown in FIG. **6**;

FIG. **9** is a perspective view of the copy medium secured in a closed loop around the drum shown in FIGS. **1** and **2** with copied information thereon;

FIG. **10** is a perspective view of the copy medium shown in FIG. **9** after severing and removal from the drum;

FIG. **11** is a perspective view of another type of closed loop copy medium which may be utilized in accordance with this invention;

FIG. **12** is a cross-sectional view of the copy medium of FIG. **11** secured in a closed loop around the drum shown in FIGS. **1** and **2**;

FIG. **13** is an enlarged view of a portion of FIG. **12**;

FIG. **14** is a sectional view of the facsimile transceiver shown in FIG. **2** taken along section line **14—14**;

FIG. **15** is an enlarged view of the grooves in the surface of the drum shown in FIG. **14**;

FIG. **16** is a sectional view of the drum shown in FIG. **1** taken along section line **16—16** with the copy clamp closed;

FIG. **17** is a sectional view of the transceiver drum shown in FIG. **2** taken along section line **16—16** with the copy clamp open;

FIG. **18** is an enlarged fragmentary view of the end of the transceiver drum with the copy clamp in the closed position;

FIG. **19** is a side view of the scanning head for the transceiver shown in FIG. **2** taken along line **19—19**;

FIG. **20** is a top view of the scanning head shown in FIG. **19**;

FIG. **21** is a sectional view taken along section line **21—21** of FIG. **19**;

FIG. **22** is an end view of the scanning head of FIG. **19** taken along line **22—22**;

FIG. **23** is an end view of the scanning head of FIG. **19** taken along line **23—23**;

FIG. **24** is a view of the scanning head drive mechanism taken along line **24—24** of FIG. **21**;

FIG. **25** is a block diagram of a facsimile system including block diagrams of the transmitter and receiver circuitry which may be utilized in a preferred embodiment of the invention;

FIG. **26** is a block diagram of transceiver circuitry which is capable of operating in a transmit or receive mode; and

FIGS. **27** (A & B) are detailed schematic circuit diagrams for the circuitry shown in FIG. **26** where the circuitry is interconnected along line A–B.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. **1** & **2**, a facsimile transceiver comprises a synchronous motor **10** which drives a document/copy receiving drum **12** rotatably about a drum shaft **14** which extends along the drum axis while also driving a scanning head **16** along a substantially linear path parallel to the drum axis. The head is advanced along the linear path by the cooperation between a head drive mechanism **18** and a shaft **20** which is located rearwardly of and parallel to the drumshaft and is also driven by the motor **10** via a belt **22** which couples the shaft **20** to the shaft **14.** Pullies **24** and **26** secured to the shafts **14** and **20** respectively are provided for the belt **22,** while a flexible coupling **28** connects the motor drive shaft of the motor **10** to the shaft **14.** The motor **10,** the drum **12** and the head **16** are supported for rotation on a molded U-shaped frame **30** wherein the head shaft **20** and the drum shaft **14** are journaled in bearings **32** and **34** respectively.

In accordance with an important aspect of the invention shown and described in the aforesaid copending application Ser. No. 333,615, the head **16** shown in FIGS. **1** and **2** is a read/write head giving the transceiver the dual capability of transmitting information scanned by the head on an original document applied to the drum **12** while also having the capability of receiving and then writing on a copy medium secured on the drum **12** as the head **16** scans in a direction parallel with the axis of drum rotation. More particularly, the head **16** comprises an optical scanner including a bundle of fiber optics **36** which extends through an opening into close proximity with the surface of the drum **12.** The fiber optics serve to detect light-dark variations in the original document applied to the drum when the transceiver is operating in the transmitting mode. The head **16** also includes a stylus **38** which extends into contact with an electrosensitive copy medium carried by the drum so as to mark the copy medium in accordance with a received information-bearing signal applied to the transceiver when operating in the receiving mode.

In accordance with this invention, the copy medium applied to the drum **12** forms a closed or endless loop thereabout so as to eliminate the necessity for synchronizing the initial relative angular position of the original

document on a transmitting transceiver drum with respect to the initial relative angular position of the copy medium on a receiving transceiver drum **12.** In this connection, the drum **12** includes an axial slot **40** which extends for the entire length of the drum **12** at the periphery thereof. The slot **40** has a clamping mechanism associated therewith which will be described in somewhat greater detail subsequently, which clamping mechanism is opened and closed by a finger engagable member **42.** The nature of the copy medium which is inserted into the slot **40** with the capability of forming a closed loop of continuous copy medium will now be described in substantial detail.

Referring to FIGS. **3** and **4,** the copy medium applied to the drum comprises a sheet of paper **44** having a width A slightly larger than the circumference of the drum **12** and a length B slightly smaller than the length of the drum **12.** The paper **44** includes on one face a strip of adhesive material **46** which is located immediately adjacent a first edge **48** which extends along the length of the paper **44.** This adhesive material may be a contact adhesive which bonds when brought into contact with the opposite side and edge of the paper or itself. Preferably, it is characterized by bonding only to a like material. Another adhesive strip **50,** slightly narrower than the strip **46,** is located adjacent the opposite edge **52.** Adhesive strip **50** is located on the opposite face of the paper **44** and spaced slightly back from the edge **52** behind a perforated line of weakness **54.** The adhesive strip **50** comprises the same material as the strip **46** and therefore will only stick to the adhesive strip **46.**

The paper **44** may be easily applied to the drum **12** as depicted in FIGS. **6, 7** & **8** by inserting the strip **56** between the perforated line **54** and the edge **52** into the slot **40** so that the line **54** aligns with the near edge of the slot **40** and wrapping the paper **44** around the drum **12** until the adhesive strip **46** is brought into overlapping contact with the adhesive strip **50.** As shown in FIG. **8,** when the paper is placed in circumscribing relationship around the drum **12,** the strips **46** and **50** will be disposed in overlapping relationship and the extra width of the strip **46** will insure that none of the adhesive **50** is exposed and permit clamping in the slot **40** to assure that the paper is secured in proper place on the drum **12.** The perforations **54** not only provide means of conveniently bending the strip **56** so as to allow for easy insertion into the slot **40,** but also provide a means for aligning paper **44** by aligning the perforations **54** with the near or forward edge of the slot **40.** Of course, the perforations may be replaced by a score line, printed line or other suitable means or marking or weakening the paper **44** along that line so as to facilitate clamping and proper alignment of the paper on the drum **12.**

Once the paper has been applied to the drum **12** and the strip **46** has been bonded to the strip **50** as best shown in FIG. **8,** the transceiver of FIGS. **1** and **2** may be placed in the receive mode and the message received from the transmitting transceiver. When the transmission of the information is complete as depicted in FIG. **9,** the sheet **44** may be cut along an appropriate line **60** so as to properly center the information content on the sheet **44,** i.e., locate the edge of the paper so as to provide a suitable margin **58** shown in FIG. **10** at the resulting edge **60** of the sheet **44** as shown in FIG. **10.** The sheet **44** will have a seam **62** where the adhesive strips **50** and **46** overlap, which corresponds to the original paper edge **62.** However, this seam is not considered objectionable since the copy medium may be written on adjacent and even over the seam **62.** The strip **56** may be removed by tearing along the perforations **54.**

In another embodiment shown in FIG. **5,** the copy medium comprises a sheet **66** having a single strip of adhesive material **68** located immediately adjacent edge **70** while the perforated line of weakness **72** is located adjacent the opposite edge **74.** In this particular embodiment, the adhesive strip **68** is capable of forming a bond with different materials. Accordingly, in order to prevent the strip **68** from sticking inadvertently to another surface, a protective covering **76** which may comprise plastic or some other readily removable material such as wax paper is provided. The covering **76** may then be removed just prior to applying the sheet **66** to the drum **12.**

In FIGS. **11–13,** another type of copy medium is shown comprising a plurality of sheets **78** which are wrapped around the drum **12** so as to provide a magazine or cassette and avoid the need for separate sheets of copy paper being applied to the drum each time the transceiver is utilized in the receiving mode. The sheets **78** of the copy medium (three sheets being shown in FIGS. **12** and **13** for purposes of illustration) are secured about the drum **12.** Each sheet is provided with adhesive material which may be arranged as described in either of the embodiments heretofore discussed. Thus, as shown in FIG. **13,** the first sheet **78'** is wrapped around the drum **12** with the opposite edges **82'** and **84'** overlapping and at least one surface of the sheet **78'** carrying adhesive forming a bond at a location generally designated as **86'.** An edge of the next sheet **78''** is then wrapped around the shet **78'** with the opposite edges **82''** and **84''** overlapping to form an adhesive bond generally designated as **86''** which is angularly displaced with respect to the adhesive bond **86'.** The same is true with respect to the third sheet **78'''** and any subsequent sheets which are applied to the magazine or cassette. To prevent slippage between the sheets **78', 78'',** and **78''',** adhesive may be utilized between the sheets.

To faciliate the proper location of the margin for each sheet **78,** each sheet is provided with a plurality of tear strings **8** on one side thereof as best shown in FIG. **13.** The strings extend in the direction which corresponds to the drum axis when the sheet is secured to the drum. After a copy medium is filled with information content at the completion of a transmission, an appropriate tear string **88** may be pulled so as to center the information content on the sheet **78.** These tear strings may be bonded to the paper by suitable adhesive means. To facilitate tearing of each sheet of paper, opposing edges of each sheet may include a plurality of spaced V-shaped grooves or notches **90** corresponding to the location of the tear strings **88.** Thus, the initial pulling on the tear string to form the desired margin will be facilitated since the initial pulling of the string will be aligned with the apex of the notch and thus avoid inadvertent tearing of the paper. A cylindrical support (not shown) may be provided between the drum **12** and the sheets **78,** in order to form a complete magazine for insertion on the drum. Note also that a hybrid copy medium utilizing adhesive along at least one edge and tear strings may be provided. Such a

sheet could be applied to a drum individually or with others so as to form a magazine.

In another embodiment of the invention, the magazine of paper may comprise a continuous sheet of paper wrapped in spiral fashion about the cylindrical magazine support member. In this embodiment, the single sheet of paper would be rolled on the support member or the like in a continuous spiral to form as many standard sheets of copy paper as may be desired on a single magazine. The initial edge of the paper might be bonded to the drum by adhesive or the like, and a similar bond might be used between each layer of paper circumscribing the drum. Tear strings or perforations or the like may be provided along the one side of the paper at intervals corresponding to a sheet and extending in the direction of the drum axis to facilitate removal of each sheet of paper at its margin once the imprinted matter is disposed thereon. In this particular embodiment, angular synchronizing would be required to insure that the margin of the received copy corresponds to the margin of the transmitted matter at the position of the tear string.

As mentioned previously, the drum **12** comprises a slot **40** having a clamping mechanism for receiving an edge of a copy medium sheet so as to hold it in the proper position on the drum **12.** Reference will now be made to FIGS. **14** and **16–18** for a more cetailed description of the clamping mechanism. As shown in FIG. **17,** a movable clamping member **92** which extends axially in the slot **40** along a substantial portion of the drum so as to receive an edge of a copy medium sheet when in the open position, e.g., portion **56** of the sheet **44.** The clamping member **92** is pivotally mounted on a shaft **102** at the base of the slot **40** and is movable between open and closed positions. In the open position, the finger engagable member **42** assumes the position shown in broken lines in FIGS. **14** and **17.** Once the portion **56** is in place between the movable clamping member **92** and the upper clamping surface **94** of the drum slot **40,** the member **42** may be depressed at the end **96** to urge the movable clamping member **92** upward against the clamping surface **94** to hold the strip **56** of the sheet **44** therebetween. The closed position of the clamp is depicted in FIG. **16** absent the sheet **44.** In order to release the sheet **44** from the clamping mechanism, the other end **98** of the finger engageable member **42** may be depressed so that the clamping mechanism assumes the open position shown in FIG. **17.**

In order to maintain the clamping mechanism in its closed position, the clamp **92** is biased upward by a conventional spring member **100** which is carried by the shaft **102.** One arm **104** of the spring **100** presses upward against the under side of the movable clamping member **92** and the other arm **104** presses downward against the bottom or lower slot surface **106** thereby forcing the clamping member **92** up against the slot surface **94.** However, by pushing on the end **98,** detent **108** carried at the end of an adjustable screw **110** slidably engages a groove **112** on the lower or interior side of the clamping member **92** and, as the end **98** is depressed further, it will lock in place in a depression **114.** This depression **114** is of sufficient depth to hold detent **108** in place so that the clamping mechanism is held open even though the spring **100** tends to urge it closed. Only when pressure is applied to the end **96** of the clamping member **42** will the member **42** move in a manner so that the detent **108** disengages from the depression **114.** The detent **108** is adjustable in relation to the depression **114** by adjusting the position of the screw **110** in a mounting block **115** carried by the frame. In this manner, an edge of the copy medium may be clamped into place in the slot along an edge thereof. It will of course be appreciated that other clamping mechanisms may be used.

In accordance with another important aspect of this invention, cutting means comprising a cutting roller **64** (a blade might also be utilized) is rotatably carried by the head **16.** As best shown in FIG. **2,** the head includes the cutting roller **64** as well as an opposite relatively soft roller **116.** In the receiving or transmitting mode, the head **16** will advance in an axial direction with neither the cutting roller **64** nor the soft roller **116** in contact with the copy medium or original document carried by the drum. By manually twisting a head knob **118** which projects forward from the head **16,** the cutting roller **64** or the roller **116** may be selectively brought into contact with the copy medium. By twisting in a clockwise direction, the cutting surface of the roller **64** is brought into contact with the copy medium to allow the roller **64** to engage and sever the copy medium as the head **16** is moved manually or automatically in an axial direction along the shaft **102.** Prior to severing the copy medium, the drum must be rotated to a position so that the cutting roller **64** will engage the copy medium along a line which will establish an appropriate margin for the information content on the copy medium. If the knob **118** is rotated in a counterclockwise direction, the roller **116** will be brought into contact with the copy medium. As shown in FIG. **19,** the roller **116** is rather broad so as to ride easily along the surface of the copy medium on the drum **12.**

In order to assist in guiding the cutting roller **64** along a straight line so as to provide a suitable edge for the copy medium after severing, the drum **12** comprises a plurality of peripheral surface grooves **120** which extend axially along the drum. By providing a close and frequent spacing between the grooves **120,** it is possible to sever the copy medium along any one of the number of closely spaced lines. This assures that the copy medium may be severed along a line so as to establish a suitable margin for the information on the copy medium.

As shown in FIG. **15,** the grooves **120** are separated by blunt projections **122.** It will of course be appreciated that the projections **122** as well as the relatively flat bases of the grooves **120** may have a different configuration, e.g., V-shaped, although this particular configuration is deemed to be desirable since it does provide good shearing action for the cutter wheel when the wheel is pushed along the drum axis in grooves **120** by maximizing the surface area supporting the copy medium.

To permit the cutting roller **64** to advance freely across and thereby sever the copy medium, a novel head drive mechanism is utilized which is the invention of Luther R. Winters, Jr. and the subject matter of the aforementioned copending application Ser. No. 332,927 . This drive mechanism and other novel aspects of the head fully disclosed in the aforesaid copending application will now be discussed in detail with reference to FIGS. **19–24.**

In accordance with the invention of the aforesaid application, the head **16** is driven by and mounted on the

single drive shaft **20.** The head is then rotatably biased to a position of engagement between arcuate surface **202** of the head member which also carries the bundle **36** of fiber optics. Since the arcuate surface **202** is maintained in contact with the document carried by the drum **12,** the spacing between that surface **202** and the document is fixed and consequently the distance between the ends of the fiber optics **36** and the surface **202** is thereby fixed. The critical distance between the ends of the fiber optics and the document being scanned is thereby maintained so as to optimize the scanning of the document in accordance with my invention described in aforementioned copending application Ser. No. 333,615.

In order to rotatably bias the arcuate surface **202** into contact with the document carried on the drum **12,** a roller **206** is carried by a resilient arm **208** which is attached to a cam member **210** coupled to a head control shaft **212** which extends generally perpendicularly to the axis of the drum **12** and the drive shaft **20.** The resilience of the arm **208** which is attached to the cam **210** by threaded fasteners **213,** causes the roller **206** to ride along the interior surface of an upper transceiver casing member **214** shown in broken lines. The casing member **214** pushes against the roller **206** tending to rotate the head **16** clockwise, forward and down toward the drum **12** to force the surface **202** against the document carried by the drum **12,** thereby assuring the proper spacing between the fiber optics **36** and the document.

The drive mechanism for the head **16** which advances the head as the shaft **20** rotates comprises a plurality of skewed rollers or cam followers **215** which engage the shaft **20** at different angular positions, as shown in FIG. **24.** By skewing the axis **216** of each of the rollers **215** with respect to the shaft **20** as best shown in FIG. **20,** rotation of the smooth rollers **215** by shaft **20** in turn advances the head **16** along the shaft **20.** In order to provide for this advancement, each of the axes **216** is skewed a very small angle in a plane parallel to the plane of tangency between the roller **215** and the shaft **20.** In order to optimize the resolution of the facsimile system, the head **16** must be advanced very slowly and this calls for a very small angle of skewing, preferably less than one degree. In this manner, a single shaft **20** is able to drive as well as support the head **16** without the need for an additional drive shaft. Bearings **219** are also provided in the head **16** at the end opposite the rollers **215** to journably mount the shaft **20** in the head.

In order to permit the head **16** to be easily, manually advanced axially along the drum **12,** the rollers **215** are mounted so as to permit them to disengage the shaft **20.** In this connection, two of the rollers **215** are supported by a head member **217** which forms the upper and principal portion of the head **16** above the shaft **20,** and a third roller **215** is supported by a relatively movable head member **218** which forms the lower portion of the head below the shaft **20.** Fasteners **220** extend through holes in the upper head member **217** and thread into engagement with the lower head member **218.** In order to bias the rollers **215** into contact with the shaft **20,** compressible rings **222** are provided between the head **224** of the fasteners **220** and adjacent surfaces of the upper head member **217.** The rings **222** then serve to urge the member **217** downward and the member **218** upward thereby forcing the upper rollers **215** toward the lower roller **215** which in turn results in engagement between the rollers **215** and the shaft **20.**

When it becomes desirable to move the head **16** along the drum **12,** the knob **118** is twisted in a clockwise or counterclockwise direction. This will rotate the shaft **212** to which the knob **118** is secured and in turn causes rotation of the cam **210** secured to the control shaft **212** to a position of engagement with the tops of the heads **224** as shown in broken lines in FIG. **21.** This in turn will compress the rings **222** as the threaded fastener **220** is forced downwardly thereby separating the upper rollers **215** from the lower roller **215** to disengage the shaft **20.** Once the rollers have been disengaged from the shaft **20,** the head **16** may move more freely along the shaft to permit the copy medium to be severed by the roller **64.** However, it is possible to move the head **16** without twisting the knob **118** since the rollers **215** will slide on the shaft **20.** In the alternative, the knob **118** may be twisted in a counter clockwise direction which also serves to disengage the rollers from the shaft **20** to allow the head **16** to be repositioned with the soft roller **116** disposed as shown in FIGS. **19** and **22** for movement axially along the drum. Twisting of the knob **118** also releases the bias on the head which forces the surface **202** toward the drum by rotating the roller **206** away from the surface **214** thereby allowing the head to slide more easily along the shaft **20** with the stylus separated from copy medium.

Another important aspect of the head **16** involves the use of the shaft **212** to open and close a switch which controls the application of power to the stylus **38.** In this connection, FIGS. **19** and **23** show a pressure-actuated switch **230** secured to the rear of the head **16** by screws **230.** The switch **232** includes an actuatable member **234** which projects into contact with a cam **236** attached to the end of the control shaft **212.** Whenever the control shaft **212** is rotated by twisting the knob **118** corresponding to manual movement of the head **16,** the actuable projection **234** will be allowed to rise as cam surfaces **238** of cam **236** move into contact therewith (see FIG. **23**) and this interrupts the application of power to the stylus **38.** Thus, when the head must be handled by an operator to adjust its position, the power to the stylus is interrupted so that any contact between the operator's fingers and the stylus would not be injurious to the operator. In addition, the stylus **38** is recessed behind a member **240** as best shown in FIGS. **19** and **20.** As also shown in these figures, the stylus **38** is mounted on a shelf **242** of the upper head member **217.** However, to properly position the stylus **38** on the shelf **242,** a screw **244** extends down into the shelf and an integral projection **246** extends into a slot **248** of the stylus **38** which permits adjustment of the stylus relative to the roller.

Referring now to FIG. **22,** the surface **202** rides on the document carried by the drum **12** so as to maintain the appropriate spacing between the end **250** of the fiber optics **204** and the document carried by the drum **12.** In accordance with the invention disclosed in my aforementioned copending application Ser. No. 333,615, the ends **250** of the fiber optics **36** extend slightly beyond the base **252** of the recess **254** in the surface **202.** This prevents the collection of dirt on the ends **250** of the fiber optics **36** since the dirt tends to collect around a fiber optic protective jacket **256** which surrounds the fiber optics **36** rather than on the ends **250** of the fiber optics themselves. Note that the fiber

optic spacing from the document carried by the drum **12** is maintained since the recess **254** is deeper in the surface **202** than the overall protrusion of the ends **250** of the fiber optics from the base **252** of the recess **254.**

In order to illuminate the area of the document being scanned, the bundle of fiber optics **36** is optically coupled to a light source **258** enclosed within a housing **260** located at the rear of the head **16.** As shown in FIGS. **19** and **23,** a jacket **262** extends through an opening **261** in the housing **260** which receives a bundle of illuminating fiber optics **264.** At least one additional fiber optic extending into the recess **254** is provided for detecting the way in which the light from the illuminating fiber optics is absorbed, emitted or reflected from the document being scanned by the head **16.** This detecting fiber optic is then coupled to a suitable photodetector such as a photodiode or phototransistor. The illuminating fiber optics which extend between the light source **258** and the recess **254** have not been shown nor has the detecting fiber optic which extends from the recess **254** to the photodetector, since this forms the subject matter of my aforementioned copending application.

As shown in FIG. **23,** the light source **258** comprises a bulb mounted in a socket **266** which is secured to the housing **260** by a fastener **268.** The socket **266** includes terminals **270** which are connected to a suitable power source by leads **272.**

In the foregoing specification, a mechanical structure has been described which permits the transceiver to operate in both a transmitting mode and a receiving mode. The circuitry of the transceiver which permits operation in both modes will now be described with reference to FIG. **25.** As shown there, a drum **12T** is rotated by a motor **10T** at a transceiver unit constructed in accordance with this invention while the document carried by the drum **12T** is being scanned. As the head (not shown in FIG. **25**) is advanced axially along the rotating drum **12T,** successive paths on the document are illuminated by the illuminating fiber optics and the variations in light intensity due to the reflectivity and transmissivity of the document are sensed by the fiber optic detection or reading bundle and coupled to the photodetector **300.** The photodetector **300** converts these variations in light intensity which are a function of the reflectivity or transmissivity of the scanned document into electrical signals. These electrical signals are amplified at a preamplifier **302** and utilized to control a VCO (voltage control oscillator) **304** to generate frequency modulated signals representing the information content of the document carried by the drum **12T.** The frequency modulated signals are then amplified by a driver **306** before being applied to an acoustical coupler **308** which is associated with a conventional telephone handset **310.**

The frequency modulated carrier is transmitted by suitable means such as conventional telephone lines **312** to another transceiver which is coupled to another conventional telephone handset **314** and an associated acoustical coupler **316.** This transceiver includes a preamplifier **318** for amplifying the frequency modulated carrier and a clipper **320** which eliminates variations in the amplitude of the frequency modulated signal.

In accordance with the invention of Herbert P. Ford, Jr. which forms the subject matter of the aforementioned copending application Ser. No. 332,925, the clipped, frequency modulated signal is received and applied to a phase locked loop **322** including a voltage controlled oscillator **324** and a balanced detector in the form of a doubly-balanced modulator **326** having a pair of balanced inputs with the frequency modulated signal from the clipper **320** applied to one input and the output of the voltage controlled oscillator which is coupled to the output of the balanced modulator **326** applied to the other input. A notch type filter **328** is coupled to the output of the phase locked loop **322,** which in this embodiment, attenuates frequencies at the 3,000–4,800 Hz. range. Since, in this embodiment, the maximum fundamental frequency of the frequency modulated signal is 1,500 Hz. due to the limitations of conventional telephone lines **312** and the phase locked loop including the balanced modulator **326** inherently doubles that frequency, the notch filter **328** is effective to remove the fundamental frequency of the frequency modulated signal from the demodulated DC signal which is applied to a stylus driver **330.** However, the filter **328** does not attenuate those frequencies approaching 1,500 Hz., frequencies which correspond to rapid fluctuations in the demodulated DC signal as required for rapid transmission of and high resolution in the copy which is formed by marking on a copy medium with a stylus **332** as the copy medium is moved by rotating a drum **12R** by motor **10R** while the head moves to scan successive paths on the copy medium.

Referring now to FIGS. **27***a* and **27***b*, the circuitry disclosed in block diagram form in FIG. **25** will now be described in somewhat more detail. The photodetector **300** comprises a phototransistor **334** having its emitter connected to the inverting terminal of an operational amplifier **336** in the preamplifier **302.** The base of the transistor **334** is connected to the output of the operational amplifier **336** through a soft clamp circuit **338** which includes a diode **340** and a capacitor **342.** When white is detected at the document causing the phototransistor **334** to conduct, the capacitor **342** is charged. When black is detected, the phototransistor **334** does not conduct and the diode **340** prevents the feedback from the operational amplifier **336** from discharging the capacitor **342** thus causing a generalization of white peaks. A high frequency peaking circuit comprising a capacitor **344** and a resistor **346** is also provided. The resistor **346** is connected to feedback resistors **348** and **350** which, along with resistors **352, 354** and **356** determine the DC level corresponding to white. This DC level may be adjusted by a preamplifier bias control comprising a potentiometer **358.**

The DC signal representing black or white (or the various levels of gray in between) is then applied to a high frequency peaking circuit **360** comprising a capacitor **362** connected in parallel with resistors **364.** The high frequency peaking circuit also comprises resistors **366, 368** and a capacitor **370.** The output of the high frequency peaking circuit is applied to the base of a transistor **372** which is on when a black signal of +1.5 volts is applied to its base and is off when a white signal of 0.5 volts is applied to its base. Black limit and white limit potentiometers **374** and **376** are provided in the emitter and collector circuits respectively of the transistor **372.**

When the transistor **372** is off corresponding to a white signal, the VCO **304** is appropriately biased so as to run at a frequency of 1,500 Hz. When black is detected at the photodetector **300** and the transistor **372** is on, the VCO is appropriately biased to run at a fre-

quency of 2,400 Hz. When various levels of gray are detected, the frequency lies between 1,500 and 2,400 Hz. The VCO has been shown in block diagram form since the circuitry of an appropriate VCO is well known and may be purchased in integrated circuit form. In this connection, the VCO of the NE **565** integrated circuit phase locked loop manufactured by Signetics Corp. has been found to be particularly suitable. As shown in FIG. **27***a*, a power supply filter **382** is utilized in conjunction with the VCO **304.**

The output of the VCO **304** is applied to the base of a transistor **384** of the driver **306** which is connected in an emitter follower configuration. The collector and emitter of the transistor **384** are appropriately biased by resistors **387** and **388** with a capacitor **390** being provided to equalize the response at the high and low frequencies provided by the VCO **304.** The output from the driver transistor **384** is applied over line **392** to the acoustical coupler **308** for transmission over the line **312** shown in FIG. **25.** When the transceiver is operated in a receiving mode, the acoustical coupler **316** will convert the acoustical signal to an electrical signal which is applied to an operational amplifier **394** of the preamplifier **318** which includes an RC network **396** for equalizing the response for frequencies from 1,500 to 2,400 Hz. Variations in the amplitude of the signal at the output of the operational amplifier **394** are eliminated by diodes **398** of the clipper circuit **320.** After clipping, the 1,500 – 2,400 Hz. signals are applied to the phase locked loop **322** which is shown in block diagram form. Once again, the phase locked loop may be in integrated circuit form and the NE 565 chip manufactured by Signetics Corp. has been found to be particularly well suited for this purpose.

In order to eliminate the sharp edges on the double frequency square wave signals at the output of the phase locked loop **322,** a ladder filter **400** is provided. The filter **400** which includes capacitors **402** and resistors **404** is connected to the input of the notch filter **328** which removes high frequency, 3,000 – 4,800 Hz. components which correspond to doubling the harmonic frequency of the 1,500 – 2,400 Hz. signals applied to the phase locked loop **322.**

The filter **328** comprises a first operational amplifier **406** having its non-inverting terminal connected to the output of the ladder filter **400.** A 1,000 Hz. peaking circuit comprising resistors **408** and a capacitor **410** are connected to the inverting terminal of the operational amplifier **406.** The output of operational amplifier **406** is connected to a filter network **412** which is effective to substantially attenuate frequencies in the range of 4,800 Hz. The output from the network **412** is applied to another operational amplifier **414** having a 1,000 Hz. peaking circuit comprising resistors **416** and a capacitor **418.** Another filter network **420** is provided at the output of the operational amplifier **414** for substantially attenuating frequencies in the range of 3,000 Hz. The output of this network is applied to the inverting terminal of another operational amplifier **422** which has a DC gain of approximately **10.**

The signal is then applied to the driver **330** which is a current generator comprising transistors **424** having their bases coupled to the output of the operational amplifier **422** through a base current limiting potentiometer **426.** Preferably, the potentiometer **426** is set so that **0** volts corresponds to white and **4** volts corresponds to black. The output at the collectors of the transistors **424** is connected in series with the stylus power supply. The stylus current is then applied to the stylus through contacts **432–3** of function switch **432** when the switch is in the receive or R position.

The transceiver also includes a constant current supply **434** which is utilized to drive the lamp or light source **258** for illuminating the document being scanned when the transceiver is operating in the transmitting mode. The constant current supply comprises transistors **436** and **438** connected in a Darlington configuration with the base of the transistor **436** connected to the potentiometer **439** to permit the adjustment of the lamp current. The use of a constant current source permits the illumination of a document to be maintained substantially constant without regulating the voltage of the lamp.

The power supply **427** is substantially conventional. A primary **440** is connected to a 117 volt AC, 60 Hz. power supply through a fuse **441** and a function switch contacts **432–2** when the switch is in the receive (R) or transmit (T) mode. The power supply **427** comprises three secondaries **442, 444** and **446.** Each of these secondaries **442, 444** and **446** are connected to diodes **448** for obtaining DC supply voltages. The power supply **427** includes filter capacitors **450** and a series of Zener diodes **452** for regulating the bias levels for the circuitry of the transceiver. A resistor **454** is connected in parallel with the filter capacitor **450** which is in turn connected in series with the stylus driver **330** and the stylus.

In order to control the application of power to the transceiver motor, a switch **460** is provided comprising switch contacts **460–1, 460–2** and **460–3.** When the transceiver is not operating, the contacts of the switch **460** assume the position shown in FIG. **27***a* where the function switch **432** is shown in the transmit position. In order to start the motor, a surge of current is generated by transistors **462** and **464** in response to the output of the operational amplifier **422.** This energizes a switch coil **466** which closes contacts **460–1** and **460–3** and moves the blade of switch **460–2** to the other position. The switch contacts **460–1** close the circuit to the motor while the switch contacts **460–2** close the circuit through the coil **466** to permit the motor to continue to run even though no surge of current is provided by the transistors **462** and **464.** When the transceiver is acting as a receiver, the function switch is in the R position and the contacts **460–3** are closed to apply current to the stylus. Note that the head switch **230** is connected in series with the coil **466** to interrupt the power to the stylus by opening the switch contacts **460–3** whenever the knob **118** is turned or whenever an end-of-travel limit switch (not shown) is triggered.

The operation of the transceiver circuitry will now be described both in respect to a transmitting transceiver as well as a receiving transceiver. At the transmitter, the function switch **432** is placed in a transmitting mode shown in FIG. **27***a* and a start switch is momentarily closed which applies a signal to the base of the transistor **372** which corresponds to a black signal from the preamplifier **302.** As a result, the output from the VCO **304** increases to a frequency of 2,400 Hz. and this signal is applied to the input of the phase locked loop **322** over a line **470** and a resistor **472** in the receiving portion of the transmitting transceiver. The phase locked loop converts the 2,400 Hz. signal to a DC level corresponding to black. This in turn is applied to opera-

tional amplifier **422** to trigger the transistors **462** and **464** of the current generator associated with the coil **466** and thereby close switch **460-1** to apply power to the motor of the transmitting transceiver.

At a receiving transceiver, the function switch **432** is in the receive or R position. The black signal which is generated by the transmitting transceiver is applied to its acoustical coupler **308** and in turn received by the acoustical coupler **316** of the receiving transceiver. After amplification by the preamplifier **318,** the black signal is demodulated at the phase locked loop **322,** filtered and applied to the amplifier **422** of the receiving transceiver to trigger the transistors **462** and **464** associated with its own switch coil **466.** As the result, the switch contacts **460–1** are closed in the receiving transceiver to apply power to the transceiver's motor.

It should therefore be clear that the motors of the transmitting and receiving transceivers will start at approximately the same time but there is no synchronizing of positions of the drums **12T** and **12R** driven by the motors nor is there any necessity for such synchronization in position since the copy medium forms a closed loop on the drum and the margin of the copy can therefore be suitably located before removing the copy medium from the drum regardless of the initial relative positions of the drums **12T** and **12R**. By utilizing synchronous motors **10T** and **10R** which operate at a given frequency, e.g., 60 Hz., the speed of the drums may be maintained sufficiently close to assure a good copy of the original document through stability of frequency of the utility grid.

As the transmission proceeds, dark light variations on the original document will be detected and transmitted from the transmitting transceiver to the receiving transceiver. As indicated in the foregoing, black signals have a predetermined frequency of 2,400 Hz. while white signals have a predetermined frequency of 1,500 Hz. It will of course be appreciated that any document being scanned will have varying degrees of darkness and lightness. The transceiver circuitry shown in FIGS. **27***a* and **27***b* is capable of detecting these varying degrees of lightness and darkness and transmitting frequencies between 1,500 Hz. and 2,400 hz. Thus a gray scale is provided to assure a faithful reproduction of the original document at the copy medium.

As shown in FIGS. **27***a* and **27***b*, the VCO **304** in the transmitting portion of the transceiver and the VCO **324** in the receiving portion of the transceiver, are separate and distinct. In accordance with another important aspect of the invention disclosed in the aforesaid copending application Ser. No. 332,925, the VCO **304** and the VCO **324** may be one in the same as shown in FIG. **26** where the reference characters of FIG. **25** are utilized to identify the same components. By providing suitable switch means **474** and **476,** the combined voltage controlled oscillator **304–324** may be utilized to modulate as well as demodulate the light-dark signals. When the transceiver is operating in the receiving mode, the switches **474** and **476** are in the position shown so as to place the VCO **304**/324 in a feedback loop of the doubly balanced modulator **326** so as to demodulate the frequency modulated signal received. The resulting phase locked loop still serves to double the fundamental frequency of the FM signals to permit the notch filter **328** to substantially attenuate the signals in the 3,000 – 4,800 Hz. range without adversely affecting the high frequency changes in DC level of the signals applied to the stylus driver **330.**

Although the transmitting and receiving transceivers have been described as identical, it will be understood that, a receiving transceiver constructed in acccordance with this invention is capable of operating with a different type of transmitting transceiver such as the Model 400 Telecopier facsimile transceiver manufactured by the Xerox Corporation. Such a facsimile transceiver does require synchronization signals and it is therefore only possible to utilize the transceiver of this invention as disclosed herein to transmit to such a transceiver if a continuous loop of copy medium is utilized at the receiver and/or pseudo synchronization signals are transmitted to the transceiver.

Although the copy medium has been described as electrosensitive and capable of being marked on in resonse to the current applied at the stylus of the writing means, other types of copy medium and writing means may be utilized. For example, the copy medium may be marked on in response to the heat generated by the stylus at the contact point. This is known as thermal printing, or the stylus may be maintained in mechanical contact with the paper, thus printing through a carbon between the stylus and the paper or rupturing dye containing capsules on the paper surface commonly known as NCR paper. Also, a modulated light source, such as a light emitting diode may be utilized which is focused on a photo or thermally or ultra-violet sensitive paper.

Although a specific embodiment of the invention has been shown and described, other embodiments and modifications may occur to those of ordinary skill in the art, and the appended claims are intended to cover any such modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. In a facsimile system comprising a transmitter, a receiver and a communications network therebetween; said transmitter including reading means for detecting the information content of an original document, transmitter scanning means for moving said original document relative to said reading means along successive scanning paths, signal transmission means responsive to said reading means for generating signals representing the information content of said original document; said receiver comprising means for writing on a copy medium juxtaposed to said writing means, receiver scanning means for moving said copy medium relative to said writing means along successive scanning paths, and signal receiving means responsive to said signals generated by said signal transmission means for activating said writing means to reproduce the information content of said original document on said copy medium; the improvement residing in said copy medium comprising:

a closed loop of material moved relative to said writing means by said scanning means such that a continuous writing surface is juxtaposed to said writing means thereby eliminating the necessity for synchronizing the initial relative positions of said original document and said reading means in a scanning path with the initial relative positions of said copy medium and said writing means in a corresponding scanning path.

2. The system of claim **1** wherein said receiver scanning means comprises a cylindrical drum rotatable about the axis of said drum, said copy medium forming

a closed loop around the surface of said cylindrical drum.

3. The system of claim 2 wherein said first cylindrical drum comprises a slot extending substantially axially along the surface thereof and clamp means operably associated with said slot, for receiving a portion of said copy medium to hold said copy medium in place on said cylindrical drum.

4. The system of claim 2 wherein said transmitter scanning means comprises another cylindrical drum rotatable about the axis of said other drum, said original document forming an open loop around the cylindrical surface of said other cylindrical drum.

5. The system of claim 4 wherein said transmitter scanning means and said receiver scanning means comprise synchronous motors for driving both of said cylindrical drums at substantially constant speeds.

6. The system of claim 1 further comprising means for cutting said copy medium so as to break said closed loop after completion of a transmission.

7. The system of claim 6 wherein said cutting means is mounted on said writing means so as to permit movement between a position of engagement with said copy medium for cutting and a position spaced from said copy medium during writing.

8. The system of claim 7 wherein said receiver scanning means comprises a cylindrical drum rotatable about the axis of said drum, said writing means being mounted for generally linear motion along a line parallel with the axis of said drum, said cutting means comprising a cutting surface for severing said closed loop of material along a line generally parallel to the drum axis.

9. The system of claim 8 wherein said drum comprises a surface having a plurality of grooves extending substantially parallel with the axis of said drum and cooperating with said cutting means when engaged so as to guide said cutting means along a line parallel with the axis of said drum.

10. In a facsimile system comprising a transmitter, a receiver and a communications network therebetween; said transmitter including reading means for detecting information content of an original document, transmitter scanning means for moving the original document relative to said reading means along successive scanning paths, and signal transmission means responsive to said reading means for generating signals representing the information content of the original document; said receiver comprising means for writing on a copy medium juxtaposed thereto, receiver scanning means for moving said copy medium relative to said writing means along successive scanning paths, and signal receiving means responsible to said signals generated by said signal transmission means for activating said writing means to reproduce the information content of said original document on said copy medium, the improvement comprising:

a copy medium forming a closed loop of material moved relative to said writing means by said scanning means such that an effectively continuous writing surface is juxtaposed to said writing means;

means for initiating scanning of the original document regardless of the original position of the copy medium relative to said writing means; and

means for scanning the copy medium independently of any periodic position synchronizing control signal from said transmitter.

11. In a facsimile system comprising a transmitter, a receiver and a communications network therebetween; said transmitter including a reading means for detecting information content of an original document, transmitter scanning means including a rotatable drum for moving the original document relative to said reading means along successive scanning lines, and signal transmission means responsive to said reading means for generating signals representing the content of the original document; said receiver comprising means for writing on a copy medium juxtaposed thereto, receiver scanning means including a receiver rotatable drum for moving said copy medium relative to said writing means along successive scanning lines, and signal receiving means responsive to said signals generated by said signal transmission means for activating said writing means to reproduce the information content of said original document on said copy medium, the improvement comprising:

a copy medium comprising a closed loop of material extending along the surface of the receiver rotatable drum; and

means for initiating scanning of said original document independently of the initial relative angular positions of said transmitter scanning drum and said receiver scanning drum.

12. The facsimile system of claim 11 wherein said means for driving said transmitter rotatable drum and said receiver rotatable drum comprises synchronous motors.

13. In a facsimile system comprising a transmitter, a receiver and a communications network therebetween; said transmitter including a reading means for detecting information content of an original document, transmitter scanning means including an angularly rotatable drum for moving the original document relative to said reading means along successive scanning lines, and signal transmission means responsive to said reading means for generating signals representing the original content of the original document; said receiver comprising means for writing on a copy medium juxtaposed thereto, receiver scanning means including an angularly rotatable drum for moving said copy medium relative to said writing means along successive scanning lines, and signal receiving means responsive to said signals generated by said signal transmission means for activating said writing means to reproduce the information content of said original document on the copy medium, the improvement comprising:

a copy medium forming a closed loop of material extending around the surface of the angularly rotatable receiver drum thereby eliminating the necessity for angular synchronization between said reading means of said transmitter and said writing means of said receiver.

14. A method of operating a facsimile system comprising a transmitter, at least one receiver and a communications network therebetween, said method comprising the following steps:

applying an original document to the surface of a transmitter scanning drum so as to form an open loop around the drum;

applying at least one copy medium to the surface of said at least one receiver scanning drum so as to form a closed loop around said receiver scanning drum;

concurrently initiating scanning of the original document carried by said transmitter scanning drum and said at least one copy medium carried by said at least one receiver scanning drum regardless of the initial relative angular positions thereof; and

continuing scanning of said original document and said at least one copy medium while rotating said transmitting scanning drum and said at least one receiver scanning drum in mutually angularly synchronous modes.

15. The method of claim **14** including the step of removing the at least one copy medium of said at least one receiver scanning drum by breaking said closed loop so as to form a suitable margin for the information content of said copy medium.

16. The method of claim **14** wherein the breaking of said closed loop is accomplished by severing said copy medium along a line substantially corresponding with an edge of said original document.

17. The method of claim **14** wherein the step of applying said copy medium to said receiver drum includes the step of forming an adhesive bond betwen two opposing edges of said copy medium so as to form said closed loop.

18. A facsimile receiver for generating a copy in response to received signals representing the information content of an original document, said receiver comprising means for writing on a copy medium juxtaposed to said writing means, scanning means for moving said copy medium relative to said writing means along successive scanning paths, signal receiving means responsive to the signals received by said receiver for activating said writing means to reproduce the information content of the original document on said copy medium, the improvement residing in said copy medium comprising:

a closed loop of material moved relative to said writing means by said scanning means such that a continuous writing surface is juxtaposed to said writing means.

19. The receiver of claim **18** wherein said scanning means comprises a cylindrical drum rotatable about the axis of said drum, said copy medium forming a closed loop around the surface of said cylindrical drum.

20. The receiver of claim **19** wherein said cylindrical drum comprises a slot extending axially along the surface thereof and clamp means operably associated with said slot for receiving a portion of said copy medium to hold said closed loop in place on said cylindrical drum.

21. The system of claim **18** further comprising means for cutting said copy medium so as to break said closed loop after completion of a transmission.

22. The system of claim **21** wherein said cutting means is mounted on said writing means so as to permit movement between a position of engagement with said copy medium for cutting and a position spaced from said copy medium during writing.

23. The system of claim **22** wherein said scanning means comprises a cylindrical drum rotatable about the axis of said drum, said writing means being mounted for generally linear motion along a line parallel with the axis of said drum, said cutting means comprising a cutting surface for severing said closed loop of material along a line generally parallel to the drum axis.

24. The system of claim **23** wherein said drum comprises a surface having a plurality of grooves extending substantially parallel with the axis of said drum and cooperating with said cutting means when engaged so as to guide said cutting means along a line parallel with the axis of said drum.

25. A method of operating a facsimile receiver comprising the following steps:

applying a copy medium to the surface of a scanning drum so as to form a closed loop around said receiver scanning drum;

scanning the copy medium while rotating the scanning drum; and

removing the copy medium from the scanning drum by breaking said closed loop so as to form a suitable margin for the information content on the copy medium.

26. The method of claim **25** wherein the breaking of said closed loop is accomplished by severing the copy medium along a line substantially corresponding with an edge of an original document.

27. The method of claim **26** wherein applying the copy medium to the scanning drum includes the step of forming an adhesive bond between two opposing edges of said copy medium so as to form said closed loop.

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