United States Patent

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[72] Inventor **Nandor Mihalik**
Walton-on-Thames, England

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[73] Assignee **Sperry Rand Corporation**
N.Y, N.Y.
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[33] **Great Britain**
[31] **51123/67 and 42384/68**

[54] **ELECTROSTATOGRAPHIC APPARATUS**
19 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **355/16,**
355/11, 355/17, 355/72
[51] **Int. Cl.** **G03g 15/04**
[50] **Field of Search** 355/3, 11,
16, 17, 72

[56] **References Cited**
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—M. L. Gellner
Attorney—Malcolm W. Fraser

ABSTRACT: One or more flexible plates, which either constitute, or are arranged to receive and support, electrostatographic sheets on which an electrostatic latent image can be formed and developed, are held by mountings in curved condition on a suitably shaped support member and moved round a circular path past each in sequence of a plurality of processing stations, of an electrostatographic apparatus. The plate mountings, preferably constituted by linkage mechanisms, are actuated to lift each flexible plate from the support member into a flat condition and to present each flexible plate in such flat condition at the exposure station before wrapping it again round the support member for continued movement round said circular path.

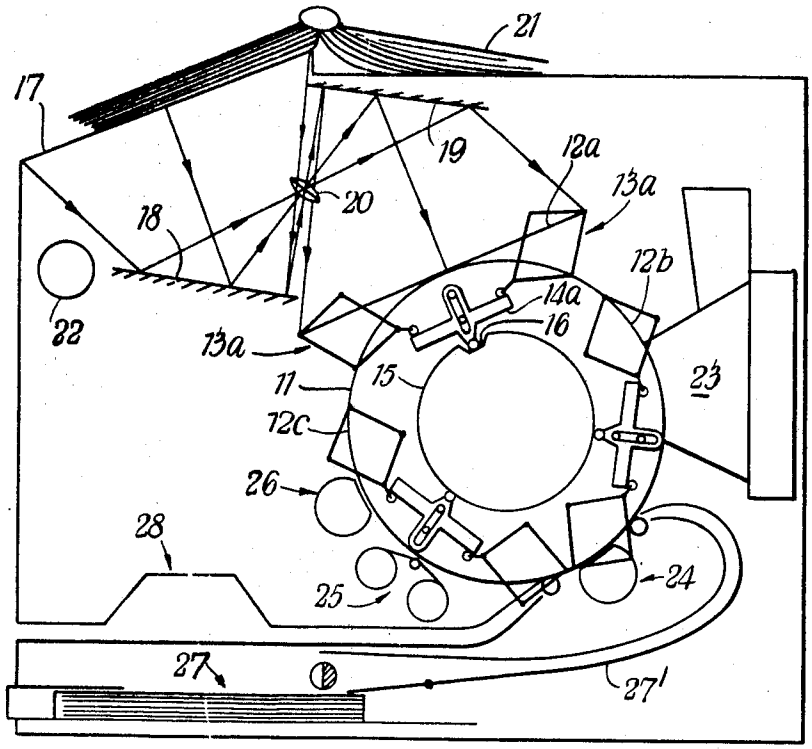


FIG.1.

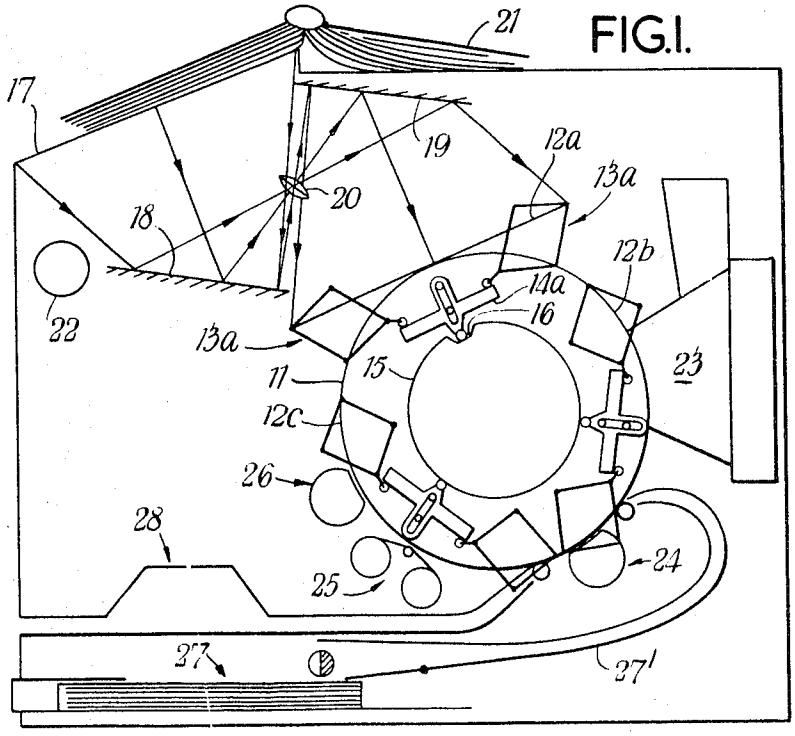
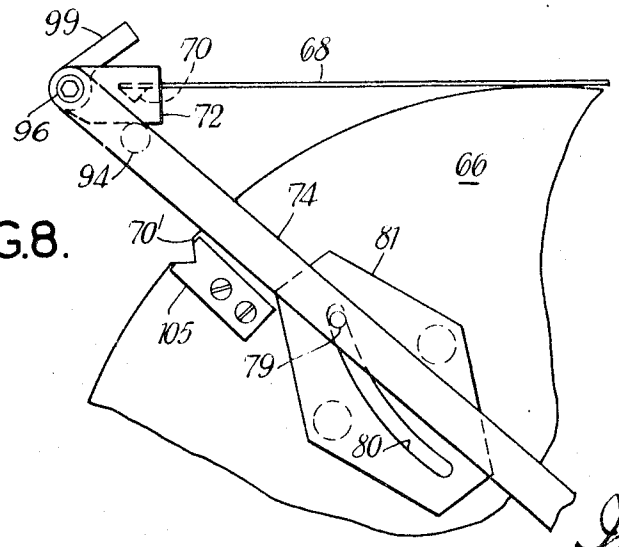


FIG.8.



Inventor
Nandor Mihalik
by Dalcalmo W. Fraser
Attorney

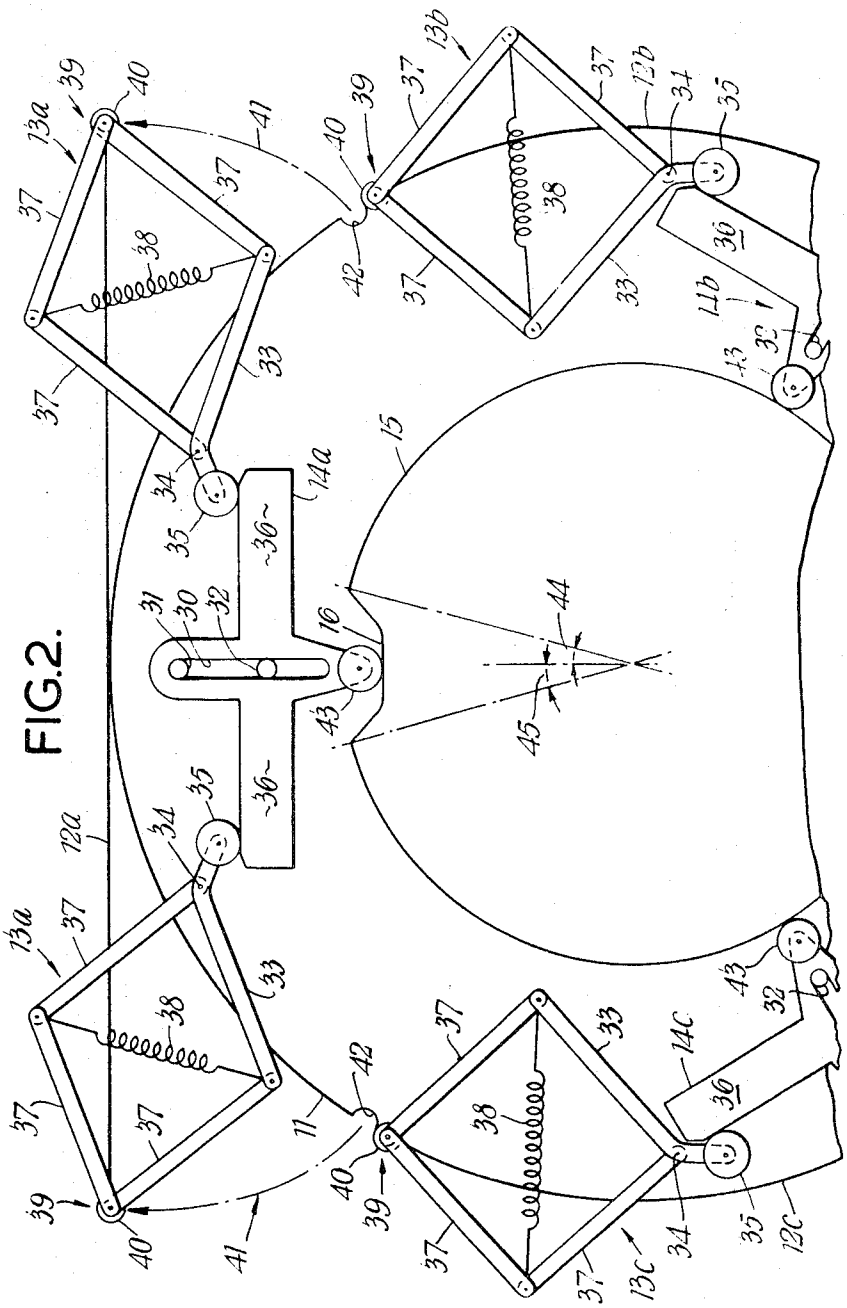


FIG.2.

Inventor:
Nandor Mihalik
by Richard W. Visser
Attorney

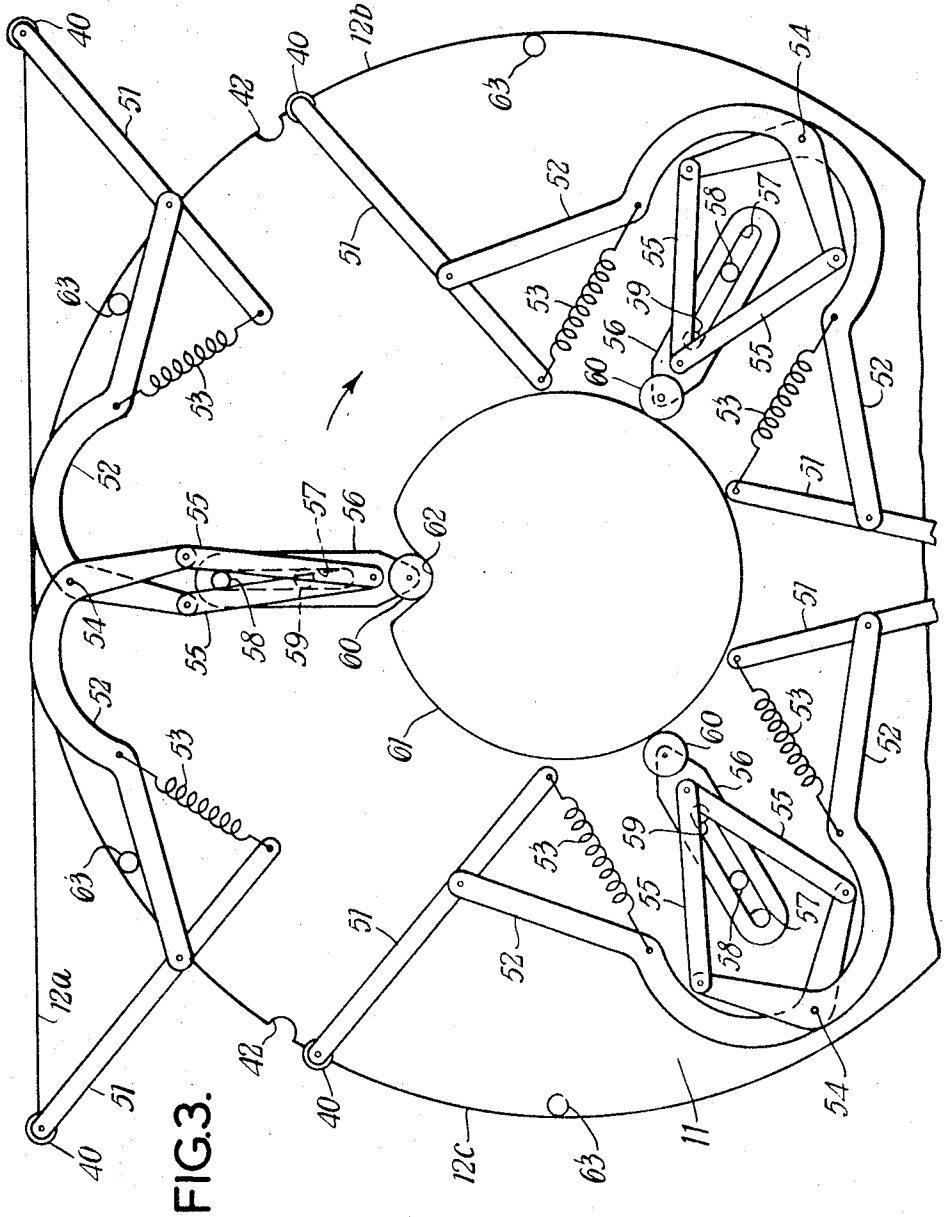


FIG.3.

Inventor.
Nandor Mihalik
by Deboelmeister Hanes
attorney

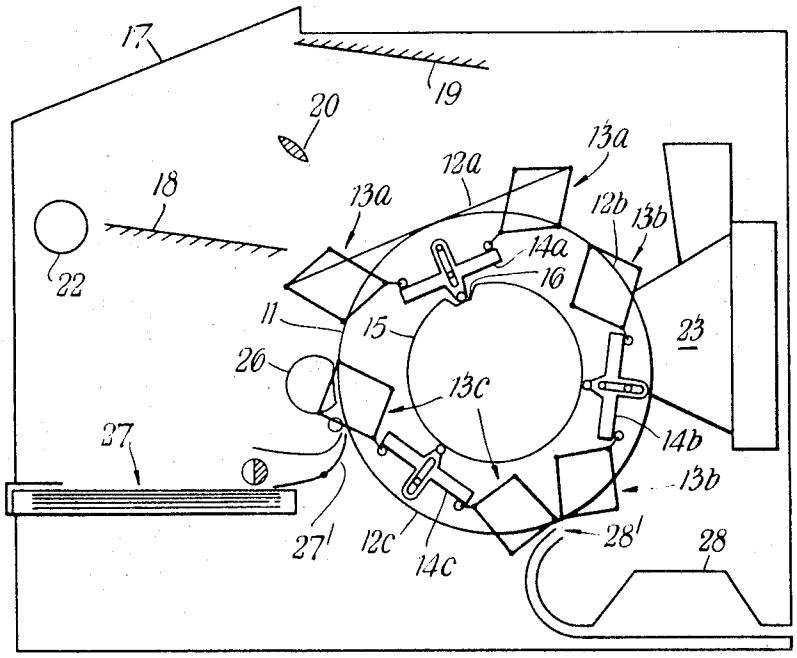


FIG.4.

FIG.7.

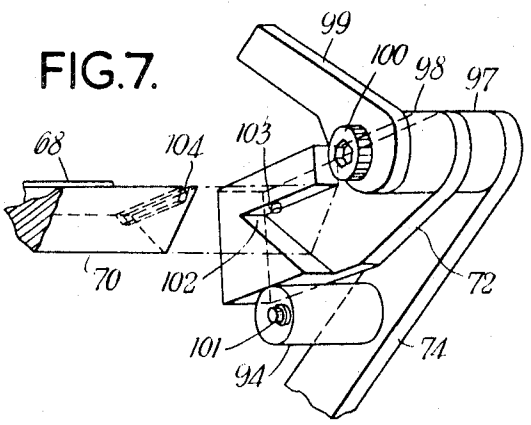
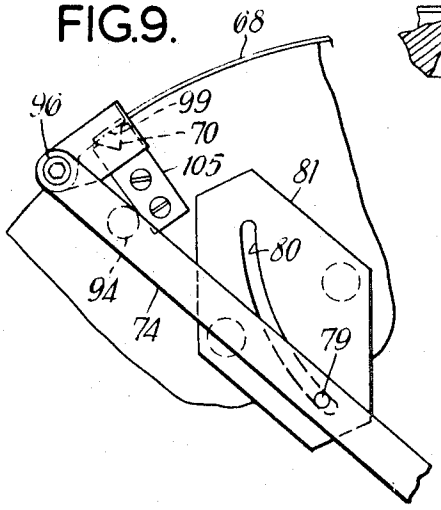
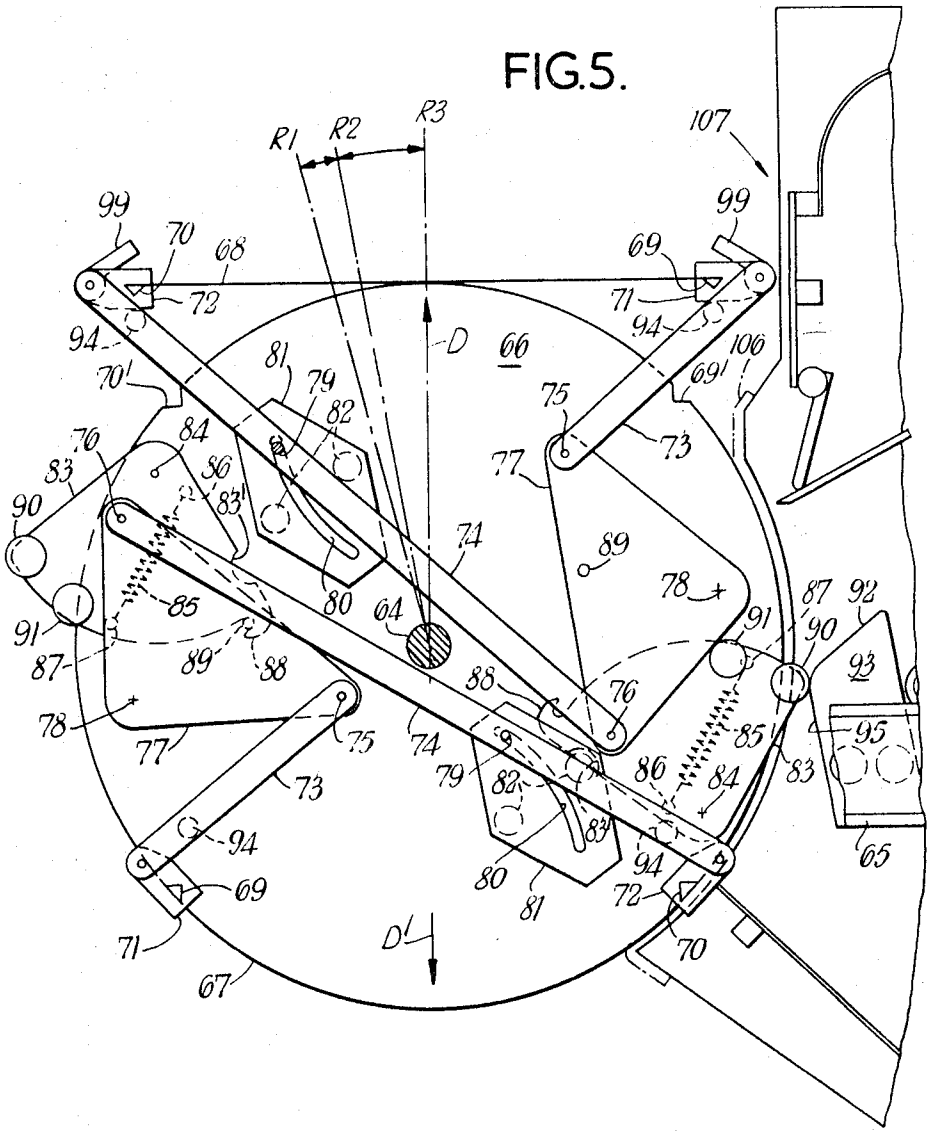


FIG.9.



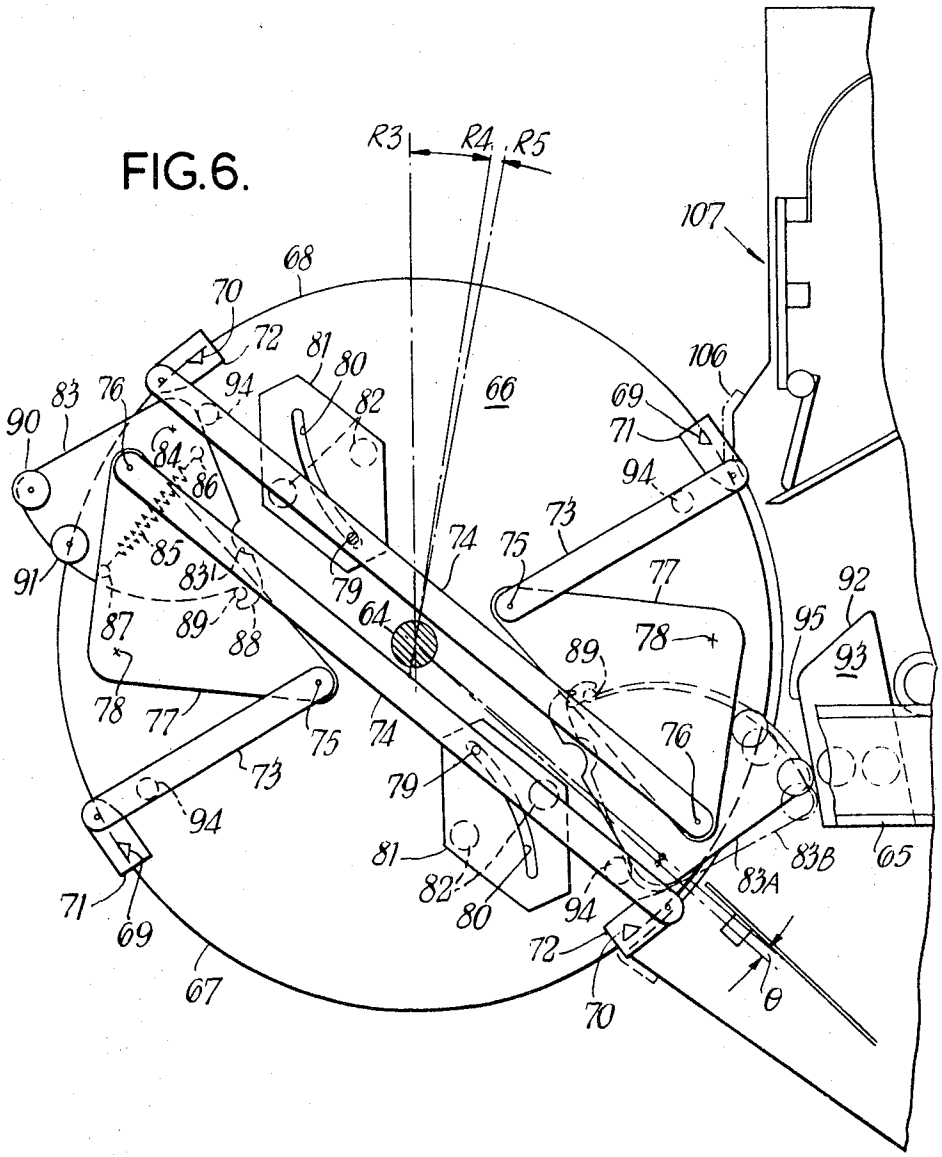
Inventor.
Nandor Mikolik
by Malcolm C. Fraser
attorney

FIG.5.



Inventor
Nandor Mihalik
by Nicholas W. Fraser
attorney

FIG.6.



Inventor.
Nandor Mihalik
by Malcolm G. Fraser
attorney

ELECTROSTATOGRAPHIC APPARATUS

This invention relates to electrostatographic apparatus.

Electrostatographic apparatus is known in which an electrostatographic surface, in the form of a cylindrical wall of a rotating drum, successively passes charging, exposing, developing, image-transferring and cleaning stations in order to produce on a sheet of copy paper or the like, which is brought into contact with the electrostatographic surface at the image-transferring station, a reproduction of an original document or the like to an image of which the electrostatographic surface is exposed at the exposing station. Provision of the electrostatographic surface in the form of a cylinder, in such known apparatus, has the advantage of ease of disposition of the processing stations, round the cylindrical surface; but it has two notable disadvantages. Firstly, the drum on whose cylindrical wall the electrostatographic surface is provided is expensive to manufacture and thus, as is occasionally necessary, to replace. Secondly, because the electrostatographic surface is not flat it is necessary to expose it progressively at the exposing station, and it is correspondingly necessary to provide means by which the original which is to be copied is scanned rather than an image of the whole of it being formed simultaneously; and whatever means of scanning may be employed, it necessarily contributes substantially to the cost of manufacture of the reprographic apparatus.

With these disadvantages of the drum-type apparatus in mind, it has been proposed to provide the electrostatographic surface in the form of a flexible endless belt; but this also has disadvantages. If a portion of such an endless belt is to be flat so that a complete image can be projected on to it simultaneously, then either other parts of the belt must be bent to undesirably small radii of curvature or the length of the belt, and the size of the apparatus which incorporates it, must be larger.

It is an object of the present invention to provide reprographic apparatus which incorporates an electrostatographic surface which is presented in flat condition at an exposing station but which, without ever being subjected to excessive curvature, is presented in cylindrical form to the other stations which it has to pass.

According to the invention, there is provided electrostatographic apparatus comprising a flexible plate, plate-mounting means including a support member and plate holding means, the support member having a part-cylindrical support surface defining an axis and the plate-holding means being arranged to hold the plate wrapped on the part-cylindrical surface, drive means arranged to rotate the plate-holding means about the said axis thereby to move the wrapped plate in a circular path concentric with said axis, and a plurality of processing stations, including an exposure station and a developer station, disposed round said circular path for passage of the plate sequentially therepast during movement of the plate round said circular path, wherein the plate-holding means is actuable to unwrap the plate from the support surface and hold it in flat condition and the apparatus further comprises actuating means arranged to actuate the plate-holding means and thereby to unwrap the plate and present it in a flat condition to the exposure station.

In one embodiment of the invention, the flexible plate is not itself an electrostatographic plate, provided with a photosensitive layer, but serves as a supporting plate for sheets of material, such as paper, which are fed one at a time on to the flexible plate in the wrapped condition thereof and which are stripped therefrom after passage thereof past the exposure and developer stations, each sheet being provided with a photosensitive surface layer and constituting an electrostatographic sheet on whose surface an electrostatographic image can be formed and developed.

In a presently preferred embodiment of the invention, however, the flexible plate is itself an electrostatographic plate, provided with a photosensitive layer on which an electrostatic image can be formed and developed before, usually, being

transferred at a transfer station of the apparatus to a sheet of material, such as uncoated paper, on which it can be fused or otherwise rendered permanent.

Embodiments of electrostatographic apparatus according to the invention are illustrated in the accompanying drawings, in which:

FIG. 1 is a schematic side view showing the general arrangement of various components of a first embodiment of apparatus according to the invention;

FIG. 2 shows on a larger scale three flexible plates, each provided with an electrostatographic surface, and plate mounting means for supporting and moving them, as indicated only generally in FIG. 1, of the embodiment shown in FIG. 1;

FIG. 3 shows, also on a larger scale, another arrangement of plate mounting means for supporting and moving the flexible plates shown in FIGS. 1 and 2;

FIG. 4 is a schematic side view of a second embodiment of apparatus according to the invention, this second embodiment being generally similar to that shown in FIG. 1 but having flexible plates which are not themselves electrostatographic plates and means for feeding onto and subsequently stripping from these flexible plates sheets of paper which constitute electrostatographic sheets;

FIG. 5 shows in end elevation a rotatable supporting drum having mounted thereon, by means of cam-and-linkage mechanisms, two flexible plates of which one is shown extended in flat condition and the other is shown wrapped round the supporting drum, this drum and its cam-and-linkage mechanisms constituting plate-mounting means of a further embodiment of the invention;

FIG. 6 is another view of the arrangement shown in FIG. 5, showing the drum in a different rotational position and with both flexible plates wrapped round the drum;

FIG. 7 is a perspective view, on a larger scale, of part of one of the linkage mechanisms of FIGS. 5 and 6, shown in FIG. 7 in a position to hold an associated flexible plate extended in flat condition;

FIG. 8 is a partial end elevation, corresponding to FIG. 5 but on a larger scale and showing, with additional detail, part of a linkage mechanism in the position corresponding to FIG. 7, and

FIG. 9 is a partial end elevation, on the same scale as FIG. 8 showing the same part of the linkage mechanism in position, as in FIG. 6, to hold the associated flexible plate wrapped on the supporting drum.

Referring to FIGS. 1 and 2, the apparatus there shown comprises a rotatably mounted drum 11 which constitutes a support member for supporting each of three flexible plates 12*a*, 12*b* and 12*c* when these are wrapped round respective parts of the cylindrical surface of the drum. As described in more detail below, the ends of the plate 12*a* are secured to respective linkage mechanisms 13*a* which are pivotally mounted on the drum ends and which cooperate with radially slidable cam followers 14*a*, 14*b* and 14*c* (one at each end of the drum) which in turn each follow a respective stationary cam 15 formed with a low portion 16. Each cam follower has a roller 43 which rides on the stationary cam 15. The flexible plates 12*b* and 12*c* are similarly supported by linkage mechanisms 13*b* and 13*c* respectively, cooperating with cam followers 14*b* and 14*c* respectively which also follow the cam 15. As will be explained, the arrangement is such that each of the three plates 12*a*, 12*b*, and 12*c* is normally wrapped round a respective part of the cylindrical surface of the drum 11, and is thus itself in a part-cylindrical disposition, but that as each pair of cam followers, for example the roller 43 of the cam follower 14*a* as illustrated in FIG. 1, moves on to the low portions 16 of the cam 15, the corresponding linkage-mechanisms (13*a* in FIG. 1) unwrap the ends of the corresponding plate (12*a* in FIG. 1) and hold the plate in tension and thus flat. Thus, as the drum 11 rotates each in turn of the three plates takes up the flat position in which the plate 12*a* is illustrated in FIG. 1, and in that position it lies in the image plane of an object placed on a flat transparent screen 17 and imaged by an optical system

which comprises plane mirrors **18** and **19** and a lens system **20**. Thus FIG. **1** shows a book **21** of which one page is flat on the screen **17** and of which the optical system provides a sharply focused image on the plate **12***a* in its illustrated flat condition.

In the apparatus shown in FIGS. **1** and **2**, each of the flexible plates **12***a*, **12***b* and **12***c* is provided with a photosensitive surface layer and constitutes an electrostatographic plate. Because the whole object of the optical system is imaged simultaneously on the flat flexible plate which has been unwrapped, the whole image may be registered simultaneously by the plate. For example, an electronic flash light **22** may be triggered to give an intense illumination of the object at the moment when the flat plate is accurately in the image plane, the exposure time being sufficiently brief to "freeze" the image which the plate registers even though the motion of the drum **11**, and of the exposed plate is continuous. Alternatively the drum **11** and the plates could be stopped briefly with the flat plate in the image plane.

As illustrated in FIG. **1**, the drum **11** rotates clockwise. Almost immediately after passing the illustrated position, the cam followers **14***a* are forced radially outwardly by movement of the roller **43** in the low portion **16** of the cam to actuate the linkage mechanisms **13***a* and wrap the ends of the plate **12***a* once more round the drum, in which condition they remain until the cam followers **14***a* once more return to the low portions **16** of the cams. Thus the plate **12***a* is already fully wrapped on the drum before its leading edge reaches a developer station at which it passes a developer unit **23**, and it remains fully wrapped while passing an image-transfer station **24**, a cleaning station at which it passes a cleaning unit **25** and a charging station at which it passes a charging unit **26**.

The developer unit **23**, cleaning unit **25** and charging unit **26** are all of known kind and may be as described, for example, in U.S. Pat. No. 3,471,882, granted Oct. 14, 1969. At the image-transfer station **24**, a sheet of copy paper (from a copy-paper store and feed unit **27**, via transport means **27***'* which is only schematically indicated) is brought into contact with one of the flexible plates which is wrapped round the drum and has on it a developed image, and the image is transferred in known manner to the copy paper which is then stripped from the plate in known manner and led separately to a fuser unit **28** which is also of known kind and may be as described in said patent.

As shown in FIG. **2**, the cam follower **14***a* has a slot **30** which accommodates two pins **31** and **32** which are mounted on the end of the drum **11** and project axially therefrom and which constrain the cam followers to radial movement relative to the drum. Each linkage mechanism **13***a* comprises a two-armed lever **33** pivotally mounted on the drum end at a respective pivot **34**. Each lever **33** carries on one of its arms a roller **35** which rides on a respective arm **36** of the cam follower **14***a*, the other arm of each lever **33** forming, with three pivotally connected struts **37**, a collapsible quadrilateral on one diagonal of which a spring **38** is provided in tension. At the quadrilateral vertex **39** which is diagonally opposite the pivot **34**, one end of the plate **12***a* is secured. For example, the end of the plate may be secured in any convenient manner to a rigid rod **40** which extends, parallel to the drum axis, from one illustrated linkage mechanism **13***a* to a similar and corresponding linkage mechanism at the other end of the drum.

It will be appreciated that the tensioned springs **38** act to urge the rods **40** away from one another and thus the plate **12***a* is held in tension and flat. Furthermore, the paths **41** which the rods **40** follow if the plate **12***a* is wrapped round the drum while held taut are such that, with the geometry as illustrated, the springs **38** become progressively more stretched as the rods **40** move towards and into longitudinal grooves **42** provided for them in the surface of the drum **11**. Thus the springs **38** bias the plate **12***a* to its unwrapped, flat condition; and the unwrapping is limited, by engagement of the rollers **35** on the arms **36**, and by engagement of the pin **31** in the end of the slot **30**, to stop when the plate **12***a* is flat and its central part is either just tangent to the drum **11** or is just clear of the drum.

This "unwrapped" condition of the plate **12***a* is only possible when the low portion **16** of the cam **15** allows a follower **14***a* to move radially inward to the maximum extent permitted by the pin **31**. As already stated, the cam **15** is stationary; and as the drum rotates through an angle **44** (which as illustrated is about 15°) from its illustrated position in FIG. **2**, the cam follower **14***a* is pushed radially outward and, by means of the linkage mechanisms **13***a*, the ends of the plate **12***a* are fully wrapped on to the drum with their rods **40** seated in the recesses **42**. FIG. **2** shows the trailing edge of the plate **12***b* (with its linkage mechanism **13***b* and cam follower **14***b*) and the leading edge of the plate **12***c* (with its linkage mechanism **13***c* and cam follower **14***c*) in the fully wrapped condition. Once fully wrapped, a plate remains fully wrapped until its cam follower is only an angle **45** (also about 15°in FIG. **2**) short of the illustrated position of the cam follower **14***a;* and in this last angle **45** it once again unwraps to its flat condition. Each plate extends round almost 120° of the drum periphery, and an extra 15° each must be left clear for unwrapping of the trailing edges of the plates and rewrapping of their leading edges. This leaves, however, about 210° of the drum periphery round which the processing stations other than the exposing station can be disposed to act on the plates while they are in cylindrical condition.

It will be understood that the illustrated means of supporting the flexible plates and moving them between their flat and unwrapped conditions is given merely by way of example and may be modified. For example, the levers **33** may be acted on by additional springs which directly bias them to pivot about the pivots **34**; by this means a more rapid unwrapping to the flat condition may be achieved without increasing the tension in the plate due to the springs **38**. Or the cam followers **14***a*, *b* and *c*, may act positively in both directions, so that both unwrapping and rewrapping of the plates are effected positively and without resort to biassing return springs. Equally, the illustrated arrangement may within the scope of the invention be replaced by other arrangements for achieving the same object, namely to unwrap the plates and present them flat at one station and to rewrap them and present them in cylindrical form at the other succeeding stations.

One other possible arrangement is shown in FIG. **3**. As there shown, the plate **12***a* and its end rods **40** are pivotally secured to levers **51** which in turn are pivotally mounted on levers **52** relative to which they are biased by springs **53** which are in tension. The levers **52** are pivotally mounted on the end of the drum **11** at **54**, and have inner ends which are pivotally linked by arms **55** to a cam follower **56**. The cam follower **56** has a slot **57** and is constrained to radial movement, relative to the drum, by two pins **58** and **59** which project from the drum end surface into the slot **57**. The cam follower **56** has a follower roller **60** which, as the drum **11** rotates, rolls on a stationary cam **61** with a low portion **62** (corresponding to the cam **15** and its low portion **16** in the arrangement shown in FIGS. **1** and **2**). With the follower roller **60** on the low portion **62** of the cam **61**, the springs **53** act to spread the levers **51** and **52** and hold the plate **12***a* taut and flat. Preferably, the drum end is provided with stops **63** which limit the movement of the levers **52** when the flat plate is just tangent to or just clear of the drum surface. As the drum rotates (clockwise in FIG. **3**), the follower roller rides up on to the high part of the cam **61**, pushing the cam follower **56** radially outwards. This causes the arms **55** to splay apart and the levers **52** to swing inwardly, away from the stops **63**; and simultaneously the plate **12***a* is wrapped on to the drum until, with the follower roller on the high part of the cam **61**, the rods **40** at the ends of the plate **12***a* are seated in the corresponding grooves **42** on the cylindrical surface of the drum. FIG. **3** shows the plates **12***b* and **12***c* in this wrapped condition, and also shows the corresponding position of their linkage mechanisms.

It will be seen that, in use of the apparatus, the alternating flat and cylindrical conditions of the plates are achieved without the flexible plates ever being subjected to a curvature greater than that of the drum surface. Also the plates are fully supported by the drum whenever they are subject to contact

with anything else (whether during image transfer or during cleaning) and may therefore be of thin construction. They may, for example, be plates of metal or of metal-coated plastics material, with a surface coating of an electrostatographic material which would, in principle, be suitable for use as a coating of a flexible endless belt. It will be noted, however, that the flexible plates used in apparatus according to the invention may be much less robust than an endless belt-type of apparatus would require if it were practicable.

Coated plates of metal or of metal-coated plastic, which can be manufactured in the flat state, are much easier and cheaper to produce than either a coated drum surface or a coated endless belt would be, and are, moreover, much more convenient to dispatch and handle as replacements.

In the embodiment of the invention which is schematically represented in FIG. 4 (which may conveniently be compared with FIG. 1 and in which the same reference numerals are used to denote corresponding parts), the flexible plates 12*a*, *b* and *c* are not themselves provided with a photosensitive layer and do not constitute electrostatographic plates. Instead, the paper store and paper feed unit 27 and its transport means 27′ are provided with sheets (of paper, for example) which are provided with a photosensitive layer and which constitute electrostatographic sheets, and are arranged to feed these sheets individually on to the plates 12*a*, *b* and *c* while these are in their wrapped condition. By this means, each plate carries such a sheet as it passes the charging unit 26, and the sheet may be held on the respective plate either exclusively by means of the electrostatic charge which it receives from the unit 26 or additionally by releasable gripping means (not shown). In this case, accordingly, it is not the plates 12*a*, *b* and *c*, but the sheets of sensitive paper which they carry, which are charged and exposed and on which the resulting electrostatic image is then developed by means of the developer unit 23. Since the image is formed and developed directly on the sheet, the apparatus of FIG. 4 requires no transfer corona device like the device 24 in FIG. 1; but, as in FIG. 1, the image bearing sheet is stripped from the plate 12*a*, 12*b* or 12*c* at a stripping station 28′ (not illustrated in detail) and is fed therefrom through a fuser 28 which fuses the image to render it permanent before the sheet which bears it is ejected from the apparatus.

Referring now to FIGS. 5 to 9, these illustrate an alternative embodiment of flexible plates and plate mounting means, including a support drum and plate-holding means in the form of cam-actuated linkage mechanisms, which may replace the plates, drums and linkage mechanisms shown in the embodiment of the invention shown in FIGS. 1 to 4.

As shown in FIGS. 5 and 6, a rotatable shaft 64, mounted in bearings (not shown) which are fixedly mounted on a main frame 65 (of which only a fragment is shown) of an electrostatographic machine, has a cylindrical drum 66 mounted on it for rotation therewith. The drum 66, which may conveniently be constructed generally as disclosed in our copending British Pat. Application No. 7581/68, has a cylindrical outer surface of which parts provide support for two flexible plates 67 and 68 when these are wrapped round the drum, and the ends of the drum have mounted on them cam-and-linkage mechanisms by means of which the plates 67 and 68 are mounted and moved as described below.

The flexible plate 67 has its two ends secured on bars 69 and 70, respectively, which extend parallel with the shaft 64 and which project beyond the ends of drum 66. At each end of the drum the corresponding two ends of the bars 69 and 70 respectively are secured to a respective one of two similar linkage mechanisms. Thus, at the end of the drum viewed in FIG. 5, the ends of the bars 69 and 70 are secured to anchor links 71 and 72, respectively, which are pivotally mounted on ends of respective arms 73 and 74. The respective other ends of the arms 73 and 74 are pivotally mounted at 75 and 76 on a plate 77 which is itself pivotally mounted at 78 on the said end of the drum 66. Intermediate its ends, the arm 74 carries a pin 79 which extends parallel with the shaft 64 and projects into a cam slot 80 formed in a cam plate 81 which is mounted on the said end of the drum 66 and spaced therefrom by means of spacing pillars 82.

The plate 77 is spaced away from the end of the drum 66 on which it is pivoted at 78 and between the drum end and the plate 77 is disposed a cam-follower plate 83 which is also pivotally mounted on the drum end, at 84. The plate 83 is spring-urged clockwise (as illustrated), by means of a spring 85 in tension between an anchor pin 86 mounted on the plate 83 and a further anchor pin 87 mounted on the drum end, and is formed with a hook 88 which is thus normally held in engagement with a locking pin 89 provided on the plate 77 and projecting therefrom towards the drum 66. By this means the plate 77 is normally prevented from rotating about its pivot point 78. The cam-follower plate 83 also carries rollers 90 and 91.

The flexible plate 68 is mounted in identical manner by means of a further pair of bars 69 and 70 and a further identical pair of linkage mechanisms (one at each end of the drum 66) of which the components are therefore indicated by the same reference numerals. It is to be observed that the two linkage mechanisms at each end of the drum 66 are independent of each other, and the cam-follower plate 83 of each is recessed at 83′ to give clearance to one of the pillars 82 of the other.

The drum 66 and its shaft 64 are rotated clockwise (as seen in the drawings) by drive means (not shown) of the apparatus of which they are part. For convenience in the description which follows, the radius of the drum 66 at which, in FIG. 5, the extended plate 68 is shown tangent is indicated by an arrow or drum datum line D. Suppose now that the drum 66 is rotating and that the plate 68 is wrapped round it in the position in which, in FIG. 5, the plate 67 is shown; i.e. the rotational position of the drum is such that the drum datum line D is at the position shown by a broken arrows D′.

During continued rotation of the drum 66, with the plate 68 wrapped on it, the drum datum line D reaches the radial direction R1, and at that point the rollers 90 comprised by the two linkage mechanisms associated with the plate 68 make contact with the rising cam surfaces 92 of two identical fixed cam blocks 93 secured on the frame 65 adjacent opposite ends of the drum 66. As the drum 66 continues to rotate, the drum datum line D moves from the radial direction R1 to the radial direction R2; and during this movement the rollers 90 begin to ride up the cam surfaces 92 and in doing so rotate clockwise the cam-follower plates 83 on which they are mounted to such an extent that the rollers 91 engage against edges of the corresponding plates 77. This amount of movement of the plates 83 is sufficient to move (against the action of the spring 85) the hooks 88 clear of the pins 89, so that the plates 77 are freed for pivotal movement. Further rotation of the drum 66 beings the rollers 90 to the peaks of the cam plates 93 and the drum datum line D to the radial direction R3 (as shown in FIG. 5). During this further movement from R2 to R3, the plates 83 continue to pivot anticlockwise and the freed plates 77, urged by the rollers 91, pivot clockwise and, in so doing, displace the arms 73 and 74. Movement of the arms 74 is determined by the slots 80 in which their pins 79 engage, and these slots are so shaped that the end of the plate 68 which is secured to the bar 70 is smoothly unwrapped from the drum 66, i.e. points of the plate 68, and also the pivot points at which the anchor links 72 are pivoted to the arms 74, trace out involute curves with respect to the drum 66 (though not in space, since the drum is itself rotating). Simultaneously, the displacement of the arms 73 causes the other end of the plate 68, secured to the bar 69, to unwrap in similar manner. In these two unwrapping movements, the bars 69 and 70 are raised out of respective longitudinal grooves 69′ and 70′, with which the surface of the drum 66 is provided and in which they are normally accommodated. The motion of the arms 74 is such that the unwrapping action which they occasion is not accompanied by any circumferential slip of the plate 68 relative to the drum 66; and slight tension is maintained in the

plate 68 either (as illustrated) simply due to the weight of the arms 73 or, if desired, by means of light springs (not shown) stretched from the arms 73 to the plates 77 and urging the arms 73 clockwise.

The linkage mechanisms are so arranged that as the drum datum line D reaches the radial direction R3, with the rollers 90 on the peaks of the cam blocks 93, the plate 68 has been unwrapped to the flat condition in which it is just tangent to the drum 66 at the datum line R3. This residual contact with the drum prevents any sag or vibration of the central part of the plate. To prevent any sag in this flat condition, due to the weight of the bars 69 and 70, the arms 73 and 74 are each provided with a respective cylindrical stop member 94 which is eccentrically and adjustably mounted and is positioned to engage the underside of the respective anchor link 71 or 72 when the flat condition of the plate 68 is reached.

On continued clockwise rotation of the drum 66, the datum line D moves (see FIG. 6) from radial direction R3 to R4. During this movement, falling cam surfaces 95 of the cam blocks 93 allow the plates 83 and 77 to pivot clockwise and anticlockwise respectively, and the plate 68 to wrap on to the drum surface again until the bars 69 and 70 are once more nested in the grooves 69' and 70'. The final operative movement of the linkage mechanism occurs during movement of the datum line D from radial direction R4 and R5, during which the plates 83, urged by their springs 85, continue their clockwise pivotal movements, from a position indicated as 83A to a position indicated as 83B, so that their hooks 88 once more engage the pins 89 and lock the plates 77 with the mechanisms in their "down" position. During the following revolution of the drum 66, the plate 68 will again be unwrapped and wrapped again as above described: but before that occurs the plate 67 will also have been unwrapped and wrapped again as the rollers 90 of its operating linkage mechanism also, in due course, ride over the fixed cam blocks 93.

In the foregoing description, it has been assumed that the plate 67 or 68, once wrapped on the drum, will remain so wrapped so long as the associated plates 77 and their pins 89 are held locked by the associated plates 83 and their hooks 88; but more positive additional locking means is also provided, as will be described below with reference more particularly to FIGS. 7, 8 and 9.

As shown in FIGS. 7 and 8 in respect of one of the arms 74, each arm 73 or 74 has mounted at its outer end, by means of a screw 96 (see FIG. 9) passing through an aperture in the arm, a spacer 97 which is axially bored and threaded to receive the screw. The spacer 97, at its end remote from the arm 73 or 74, has a reduced diameter portion (not shown) which extends through an aperture in the anchor link 71 or 72 (which is thereby freely pivotable thereon) and is of slightly greater axial length than the thickness of the link. A further spacer 98 abuts the end of the reduced-diameter portion of the spacer 97 (which maintains a slight clearance for the anchor link 71 or 72) and the spacer 98 and a locking arm 99 are secured to the spacer 97 by means of a screw 100 which they are bored to receive and which is screwed into the central bore of the spacer 97. Thus the locking arm 99 is held in fixed angular position relative to the arm 73 or 74 on which it is mounted, even though the anchor link 71 or 72 is free to pivot.

As shown in FIGS. 7 and 8 the arm 74 and the anchor link 72 pivotally mounted thereon are in their relative position shown at the upper left of FIG. 5, with the link 72 being supported by the cylindrical stop member 94 (eccentrically mounted on the arm 74 by means of a screw 101 which can be slackened off to permit adjustment of the stop member 94) is position to hold the flexible plate 68 extended in flat condition. With the plate 68 thus extended, it can be easily removed and replaced by another similar plate if desired. To that end, each anchor link 71 or 72 has a thickened end which is shaped to provide an angular notch 102 shaped to receive snugly an end of a bar 69 or 70 as the case may be. Each such notch has a pin 103 extending into it, and each bar is formed at each end with a transverse slot 104 to accommodate a respective one of such pins. To remove the plate 68 when in its position shown in FIG. 5, the arms 73 of its associated linkage mechanism are raised anticlockwise (as viewed in FIG. 5) thus allowing the ends of the bar 69 to which the plate 68 is secured to slide out of the notches 102 of the anchor links 71 in which they are engaged. With the bar 69 disengaged, the plate 68 is no longer under tension and its bar 70 can be similarly disengaged from the anchor links 72. Fitting of a new plate 68, provided with its own bars 69 and 70, is accomplished by reversing the above procedure. As the ends of the bars 70 and 69 of the new plate are engaged in the notches 102 of the anchor links 72 and 71 respectively, each slot 104 engages a respective pin 103, thereby to prevent any endwise movement of a bar 69 or 70 (i.e. movement in the axial direction of the drum 66) which could result in a bar escaping from a notch 102.

As shown in FIGS. 7 and 8, when the plate 68 is extended in a flat condition the locking arms 99 of the associated linkage mechanism are well clear of the bars 69 and 70. The locking arms 99 are so adjusted, however, that as the drum 66 rotates (while the angular direction of the drum datum line D moves from R3 to R4, see FIG. 6) to allow the plate 68 to return once more to its wrapped condition, they close down on the bars 69 and 70 so that, as the bars nest again into the grooves 69' and 70' of the drum 66 (and into notches aligned therewith and formed on bar-end supports 105 secured to the ends of the drum 66) the ends of the bars 69 and 70 are locked firmly between the end supports 105 and the locking arms 99, as shown in FIG. 9 which corresponds to the upper left part of FIG. 6. The locking action provided by the locking arms 99 can only be removed by operating the whole linkage mechanism, and since this is prevented by engagement of the locking hook 88 with the locking pin 89 by the time the drum datum line D has reached the angular direction R5, the plate 68 will remain securely locked in wrapped condition while it rotates below the drum 66. For the same reason, the plate 67 is also firmly locked in wrapped condition when in its position shown in FIGS. 5 and 6 in which, however, for clarity of the drawings, the locking arms 99 associated with the plate 67 are not shown.

In FIG. 6, the drum and the two illustrated linkage mechanisms are shown in the rotational position at which the drum datum line D is in the radial direction R4; and it will be observed that the further small rotation to bring the drum datum line D into the angular direction R5 will already have been completed before the end of the plate 68 (or the plate 67, half a revolution later) comes into contact, at its edges extending round the drum 66, with sealing strips 106 at the edges of a developer unit 107 which is shown in part in FIGS. 5 and 6 but of which no description is here required since it is of known kind.

As described above, the pins 79 are constrained to move along the slot 80 of the plates 81, and the slots 80 are shaped to provide the desired raising and lowering of the plates 67 and 68 without any circumferential slip between them and the supporting surface of the drum 66. With the pins 79 appropriately positioned on the arms 74, the required shape of the slots 80 is very nearly a circular arc; and, if desired, the plates 81 may be omitted and replaced by link arms each having one end pivoted on a respective pin 79 and the other end pivotally mounted on the end of the drum 66 at an appropriate center, chosen to constrain movement of each pin 79 to a strictly circular arc which coincides with the ideal curve (slot 80) at the fully closed and fully extended positions of linkage mechanism and at a chosen intermediate point, say midway between. To the extent that such circular arc diverges from the ideal curve, the plates 67 and 68 will undergo two slight circumferential slippages, equal and opposite, while being extended and again while being rewrapped on the drum; but such slight slippage may be acceptable in practice.

It will be noted that the arrangement described with reference to FIGS. 5 to 9 is such that the plates 67 and 68 are presented flat in a horizontal plane, and it will be understood

that, if this arrangement were incorporated in machines which were otherwise generally as shown in FIG. 1 or FIG. 4, the optical exposure station and other stations such as the developer station would be correspondingly displaced in the clockwise direction (as viewed in FIGS. 1 and 4) round the axis of rotation of the drum 11. Subject to this, and to necessary modification of the timing of the actuation of the various processing stations (to take account of the fact that the arrangement shown in FIGS. 5 to 9 has only two plates 67 and 68 and thus produces only two copies per revolution of the drum 66), the arrangement shown in FIGS. 5 to 9 constitutes a highly practical embodiment of plates and plate mounting means, according to the invention, which may be incorporated in either of the two types of machines shown in FIGS. 1 and 4 respectively.

What I claim is:

1. Electrostatographic apparatus comprising a flexible plate, plate-mounting means including a support member and plate-holding means, the support member having a part-cylindrical support surface defining an axis and the plate-holding means being arranged to hold the plate wrapped on the part-cylindrical surface, drive means arranged to rotate the plate-holding means about the said axis thereby to move the wrapped plate in a circular path concentric with said axis, a plurality of processing stations, including an exposure station and a developer station, disposed round said circular path for passage of the plate sequentially therepast during movement of the plate round said circular path, wherein the plate-holding means is actuable to unwrap the plate from the support surface and hold it in flat condition and the apparatus further comprises actuating means arranged to actuate the plate-holding means and thereby to unwrap the plate and present it in flat condition to the exposure station

2. Apparatus as claimed in claim 1 and including means for feeding on to the flexible plate, in the wrapped condition thereof, a sheet of material provided with a photosensitive surface layer and constituting an electrostatographic sheet, and means for stripping said sheet from said plate after passage thereof past the said exposure and developer stations.

3. Apparatus as claimed in claim 1, wherein the plate is an electrostatographic plate provided with a photosensitive layer.

4. Apparatus as claimed in claim 1, wherein the support member and the plate holding means are mounted for rotation together about the said axis.

5. Apparatus as claimed in claim 1, wherein the plate has first and second ends disposed parallel to the said axis and the plate-holding means comprises a pair of linkage mechanisms spaced-apart in the axial direction and with the plate disposed between them, each of the said linkage mechanisms being attached to both the first and second ends of the plate and being so arranged that when actuated it unwraps the plate progressively from both ends thereof simultaneously.

6. Apparatus as claimed in claim 5 and comprising first and second mounting means rotatable about the said axis and having mounted on them the respective linkage mechanisms, the drive means being arranged to rotate the first and second mounting means together.

7. Apparatus as claimed in claim 6, wherein the support member is in the form of a drum having the support surface as a peripheral part thereof, and wherein the said first and second mounting means are constituted by a pair of drum-end members each secured to the support surface for rotation therewith and each having mounted upon it a respective one of the linkage mechanisms.

8. Apparatus as claimed in claim 6, wherein each linkage mechanism comprises a linkage member mounted on the respective mounting means for pivotal movement relative thereto, a first linkage arm having a first end pivotally secured to the said one end of the flexible plate for pivotal movement relative thereto and a second end mounted on the said linkage member for pivotal movement relative thereto, a second linkage arm having a first end pivotally secured to the said second end of the flexible plate for pivotal movement relative thereto and a second end mounted on the said linkage member for pivotal movement relative thereto, all said pivotal movements being about axes parallel to the axis defined by the support surface and arrangement being such that reciprocating pivotal movement of the said linkage member causes the said first ends of the first linkage arm and of the second linkage arm respectively to lift the said first end and the said second end respectively of the flexible plate off the support surface whilst simultaneously holding the flexible plate in tension and, respectively, to return the said first and second ends of the plate to the support surface.

9. Apparatus as claimed in claim 8, wherein each said mounting means and the first linkage arm of the respective linkage mechanism mounted thereon are provided with cooperating guiding means which, during pivoting movement of the said linkage member, constrain the said first end of the first linkage arm to move along such a path that the first end of the flexible plate unwraps from and wraps on the support surface without occasioning a difference between the angular rate of movement of the still-wrapped part of the flexible plate round the said circular path and the angular rate of rotation of the first and second mounting means.

10. Apparatus as claimed in claim 9, wherein the said cooperating guiding means comprises a pin projecting from the first linkage arm in the axial direction of the support surface and a cam-slot plate secured on the mounting means and provided with an appropriately contoured slot, the pin being engaged in said slot for sliding movement therein.

11. Apparatus as claimed in claim 8, wherein each linkage mechanism further comprises a locking member mounted on the respective mounting means for pivotal movement relative thereto, said locking member and the said linkage member having cooperating locking means which, in one position of the locking member, locks the linkage member against movement from its position in which the flexible plate is wrapped on the drum, there being further provided resilient means urging the locking member into its said one position.

12. Apparatus as claimed in claim 11, wherein the said locking means comprises a locking pin mounted on the linkage member and a hook provided on the locking member, said hook disengaging said locking pin on pivotal movement of the locking member, against said resilient means, out of its said one position.

13. Apparatus as claimed in claim 11, wherein the said actuating means comprises a respective fixed cam for each linkage mechanism, and each locking member is provided with cam-follower means which, in the said one position of the locking means, is engaged by the respective fixed cam during rotation of the linkage mechanism about the said axis, thereby to pivot the locking member and release the said linkage member, and wherein each locking member is further provided with engaging means which, on further pivotal movement of the locking member due to the cam, engages and pivots the said linkage member and thereby lifts the ends of the flexible plate off the support surface.

14. Apparatus as claimed in claim 5, wherein the linkage mechanisms are so arranged and the actuating means is so positioned that the linkage mechanisms, on continued rotation from their actuated position, return due to gravity to their unactuated condition in which the flexible plate is wrapped on the drum.

15. Apparatus as claimed in claim 8, comprising a first bar and a second bar each extending parallel to the said axis and having secured thereto the said one end and the said second end respectively of the flexible plate, said bars each having two ends which extend beyond the flexible plate in the axial direction, and further comprising a respective anchor link freely pivotally mounted on each said first end of each said first linkage arm and of each said second linkage arm, wherein each end of each said bar is releasably secured to a respective one of said anchor links.

16. Apparatus as claimed in claim 15, wherein the said first and second bars are triangular in cross section and each

anchor link is formed with an angular notch in which an end of one of the bars can be snugly accommodated, and wherein each anchor link has a pin extending into said notch and each end of each of said bars has a slot to accommodate and engage said pin thereby to prevent endwise movement of said bars relative to said anchor links.

17. Apparatus as claimed in claim 15, wherein each said first linkage arm and each said second linkage arm is provided with a respective stop member which, when the linkage mechanisms are in their positions to hold the flexible plate in flat condition, engage and support the respective anchor links mounted on the said arms.

18. Apparatus as claimed in claim 15, wherein each said first linkage arm and each said second linkage arm is provided at its said first end with a respective locking arm mounted on the respective linkage arm in fixed angular relationship therewith, each said locking arm bearing radially inwards against a respective end of one of said first and second bars, when the linkage mechanisms are in their positions to hold the flexible plate in wrapped condition, and moving clear of said bars as the linkage mechanisms are actuated to move the flexible plate into its flat condition.

19. Apparatus as claimed in claim 1 and including, in association with the support member, a plurality of flexible plates and a corresponding plurality of plate-holding means each operatively connected with a respective one of the flexible plates and each being actuable individually by the said actuating means during rotation together of the said plurality of plate-holding means about the said axis.