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(54) **Sheet-holding apparatus.**

(57) Apparatus for temporarily holding flexible sheets and conveying them progressively through an image transfer station, e.g. in a xerographic printer comprising a rotatable sheet holder (30) having two segmental peripheral portions (34, 35) which have inter-meshing teeth and can be relatively angularly displaced for varying the arcuate length of the sheet supporting surface (39) formed by such portions. For gripping the leading and trailing margins of a sheet (38) and holding it taut against the surface (39) there are leading and trailing clamps (58, 48) which are likewise relatively angularly displaceable so that they can operate at the leading and trailing ends of the arcuate support surface (39) whatever be its adjusted size.

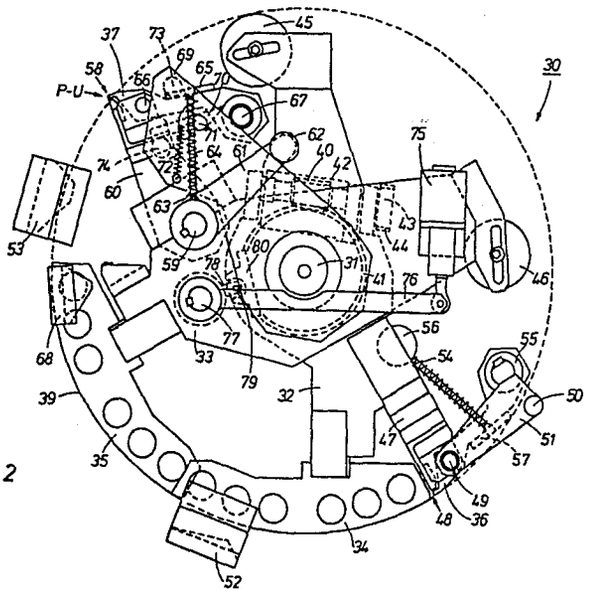

FIG. 2

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Sheet-holding apparatus.

This invention relates to sheet-holding apparatus comprising a rotatable sheet holder having a cylindrically curved surface for supporting a sheet of flexible material concentric with the axis of rotation of the holder and comprising mechanical fastening devices for engaging the leading and trailing margins of the sheet and holding it taut against said curved supporting surface.

Rotatable sheet holders are used in various kinds of reprographic processes in which it is necessary for successive zones along a sheet of flexible material to be brought successively to a site where a step in the formation of a graphic image on the supported sheet is performed. Examples of such apparatus are described in the specifications of United Kingdom patent application GB 2,003,090 A, European patent application publication No 0 007 756 A, and United States patent 3,734,015 - 3,071,070 - 3,212,889 and 4,268,158. These examples include sheet-supporting apparatus for use in offset duplicating machines and xerographic printers.

In the prior art apparatus the sheet holder comprises a rotatable cylinder to which the sheet is held by adhesive tape or mechanical means associated with the cylinder. In some of the apparatus having sheet-fastening means associated with the cylinder such fastening means is provided only for the leading margin of the sheet and the remainder of the sheet is progressively rolled against the cylinder by an extraneous roller at the site where the image formation on the sheet occurs (see e.g. the specifications of the aforesaid United Kingdom patent application GB 2,003,090 A and European Patent Application 0 007 756). In others of the known apparatus the cylinder is provided with fastening means for both the leading and trailing margins of the sheet (see e.g. the specifications of the aforesaid United States patent 3,071,070 - 3,212,689 and 4,268,138).

The provision of mechanical fastening means for the leading and trailing margins of a sheet is necessary or desirable in many kinds of reprographic process for ensuring that the sheet to be processed is held taut against its support before entering the image-forming zone which, in a xerographic printer for example, may be the zone where a toner image is transferred to the supported sheet from a photoconductive element.

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It is a disadvantage of known apparatus wherein the sheet support carries both leading and trailing fastening devices that the apparatus will only properly support sheets having a length or breadth dimension substantially corresponding with the circumferential distance between said leading and trailing fasteners. Any attempt to provide for adjustment of the angular spacing of the leading and trailing fasteners would obviously face problems if at the same time the sheet, whatever its size, must be adequately supported over its entire distance between the fasteners and the fasteners cannot be mounted above the surface of the support.

It is an object of the present invention to provide an apparatus which permits the angular spacing of leading and trailing fasteners to be substantially varied to suit different sheet dimensions while maintaining adequate sheet support.

Apparatus according to the present invention is defined in claim 1 hereof. As specified therein, the invention is characterised in that the holder comprises two parts having peripheral portions of comb-like structure with intermeshing teeth, which portions together form a said cylindrically curved sheet supporting surface which subtends an angle of less than 360°, the said holder parts are relatively angularly displaceable about their common axis of rotation to enable the angle subtended by the said sheet-supporting surface to be adjusted to suit different sheet dimensions and the leading and trailing fastening devices are likewise relatively angularly displaceable to permit them to hold leading and trailing sheet margins in the vicinity of the leading and trailing ends of said supporting surface in any said adjusted setting of said holder parts.

The invention departs from the established practice of using a sheet support in the form of a complete cylinder.

In an apparatus according to the present invention, the leading and trailing fastening devices can operate at different angular spacings suited to different sheet dimensions and whatever be the selected sheet size, within the handling capabilities of the apparatus, the sheet can be afforded good support over substantially the entire distance between said devices. The number of teeth in the comb-like structures and the width and spacing of the teeth can be selected so that the "open" areas within the overall dimensions of

the support surface are sufficiently small to ensure that the supported sheet will not be locally deformed into these areas under the conditions of use, even when the parts of the holder are in their most extended setting giving the maximum possible supporting surface length measured along the line of curvature.

Apparatus according to the invention can be used in various kinds of printing machines including offset and xerographic printers.

A particularly important field of use for the invention is in printing plate-making machines, for holding the metal plates during transfer thereto of an image to be printed.

The sheet holder can for example easily be made to a size and with an adjustment range suitable for holding sheets ranging in size from A4 to A1. The holder can be infinitely adjustable within a given range for holding a sheet of any dimension within that range or the holder can be adjustable to suit two or more specific sheet dimensions in a given range.

In preferred embodiments of the invention there is mechanism which causes the angular spacing of the leading and trailing fastening devices to increase slightly at a stage in the operating cycle such as to cause tensioning of a sheet held by such devices. In this manner tautness of a sheet on the cylindrically curved supporting surface can be ensured automatically and without need for a sheet to be rolled or otherwise progressively pressed against the supporting surface after the leading margin of the sheet has been secured to the holder and before its trailing margin is secured.

Advantageously, the leading and trailing fastening devices are in the form of clamps and the apparatus includes means which automatically opens and closes the leading clamp at a predetermined region along the path followed by the periphery of the holder during its rotation so that such clamp can take hold of a margin of a sheet if this is held ready for pick-up at that region, and includes means which automatically subsequently opens and closes the trailing clamp to permit it to take hold of the trailing margin of such sheet. Apparatus having these features is suitable for use in printing machines with a high throughput capacity.

In particularly favoured apparatus having the said automatic sheet pick-up facility there is means which controls the movement of

the leading clamp so that for a period of time during part of a revolution of the cylindrically curved support surface said leading clamp is angularly spaced from and is held (against rotation with said surface) at said sheet pick-up region, and means which during said period of time opens and closes said leading clamp for taking hold of a sheet before said leading clamp is caused to accompany the rotation of said surface and thereby draw said sheet onto such surface.

It is preferable to employ leading and trailing clamps each of which comprises a series of jaws distributed in spaced relation along the transverse dimension of the holder (the dimension parallel with its axis of rotation). This feature is conducive to firm holding of a sheet across its entire width. In certain apparatus according to the invention the means for closing the jaws operates to close the inner jaws onto a sheet margin before the outer ones. By this means risk of any lateral displacement of a sheet margin during application of the clamping forces thereto, and the unsatisfactory clamping of sheets the leading and/or trailing margin of which is buckled in the transverse direction, is avoided or reduced.

The invention includes printing apparatus comprising sheet-holding apparatus with an automatic sheet pick-up facility as above referred to, means for supporting flexible sheets in a position near the path followed by the periphery of the sheet holder for take-up by the leading clamp of the holder and means for image-wise transferring material to a said sheet while it is held by and rotates with said sheet holder.

Reference will now be made to the accompanying drawings in which a particular sheet-holding apparatus according to the invention, selected by way of example, is shown incorporated in a xerographic platemaker.

In the drawings :

Fig. 1 is a perspective view of a multiple-size offset platemaker,

Fig. 2 is a side view of the sheet-holding apparatus according to the invention adjusted for holding large sheets,

Fig. 3 is a side view of the sheet-holding apparatus adjusted for holding smaller sheets,

Fig. 4 shows a detail of the rotatable holder,

Fig. 5 shows a detail of the cam mechanism for operating the sheet clamps and

Fig. 6 is a section, in various planes of the sheet-holding apparatus.

The platemaker 10 (Fig. 1) comprises a housing 11 in which the components of the apparatus are located. Inside the housing 11 is provided a holder 12 for an original to be copied. Through an objective 13 an image of the original is projected onto a charged photoconductor 14 which is held by a support 15a. The support 15a as illustrated stands upright in the image plane of the objective 13.

After exposure, the support 15a is swung into a horizontal position around axis 16 and when horizontally oriented, the support is held and fixed in a frame 17 by known means.

Frame 17 is supported by a plurality of air bearings 18 that move over and along slides 19 to have the photoconductor 14 submitted to a wet processing and image transfer.

Liquid toner development of the photoconductor 14 is carried out at processing station 20 comprising a plurality of slotted processing chambers 21. A rinsing chamber 22 is used to remove toner particles and other hydrophobic material which were not attracted by the electrostatic charge on the photoconductor but deposited on the non image-areas of the photoconductor 14. The processing station 20 comprises in addition a supply station 23 for processing liquid and rinsing solution and associated pump means (not shown).

Slidingly arranged upon slides 19 is a second support 15b which is analogous in structure to support 15a, in that it is likewise used to support a photoconductor (not shown) which is supplied by a photoconductor supply station 24. The supply is represented as being in the form of a roll, but a supply of photoconductors in sheet form may of course be used.

In order to permit both supports 15a and 15b to perform a to-and-fro motion on slides 19 without obstructing the passage to one another, a support lifting mechanism in the form of hooks 25, linked via rods 26 to eccentrics 27 is provided. This mechanism causes support 15b, carrying a photoconductor, to pass over support 15a carrying the exposed photoconductor 14 which is in the course of being processed.

After processing of photoconductor 14 on support 15a, support 15b is lowered and passed over a charging station 28 in order to charge the photoconductor on that support prior to its image-wise exposure.

The developed photoconductor 14 is subsequently transported through a transfer station which is in the region of the machine indicated by arrow 29. At this region there is a receptor sheet holding apparatus according to the present invention, including a rotatable sheet holder 30. Also at that region there are a number of aluminium plate storage racks 29a, and a plate take-up station 29b. A transfer mechanism comprising a set of sucker cups 29c operates in dependence on a plate size selector mechanism (not shown) to remove an aluminium plate of selected size from the corresponding storage racke and to transfer that plate to the take-up station 29b where the sheet is held with one edge at a predetermined position (P-U in Fig. 2) ready for gripping and withdrawal by the sheet holder 30.

After an aluminium plate has become transferred to the holder 30 as hereafter described, transfer of toner image from the developed photoconductor 14 takes place. For this purpose the said photoconductor is transported through the transfer station along a path such that the surface bearing the liquid toner travels very close to but just out of contact with the surface of the receptor sheet on the sheet holder 30, the latter being rotated in synchronism with the advance of photoconductor 14 on support 15a. Actually, the surface of the receptor sheet just makes contact with the liquid toner on the photoconductor, but not with the photoconductor surface. The liquid toner image transfers to the aluminium plate held by the sheet holder 30. An electrical potential gradient is applied by a voltage source and electrical conductors (not shown) between the conductive backing of the photoconductor and the receptor sheet holder 30 in order to effect this transfer. Toner transfer in an electric field is well known in electrophotography and needs no further description. After transfer and fixing of the toner, the aluminium plate is released from the holder 30 and it can be received e.g. in a collecting tray. A further aluminium plate can then be taken up by the folder 30 ready for receiving a toner transfer image from a photoconductor, which may be another photoconductor transported to the transfer station or it can be the photoconductor

14 after it has been conditioned for re-use.

The sheet-holding apparatus according to the invention will now be described with reference to Figs. 2 to 6.

Referring particularly to Figs. 2 and 3 : the rotatable sheet holder 30 comprises a shaft 31 which is rotated by a motor (not shown) and which carries two relatively angularly displaceable holder parts 32,33 having segmental peripheral portions 34,35. The parts 32,33 have counter-weights 45,46 to balance the weights of the segmental portions 34,35.

As shown in Fig. 4, which is a diagrammatic plan view of the sheet supporting surface of the sheet holder 30, the said peripheral portions 34 and 35 of the sheet holder are of comb-like form with inter-meshing teeth 96,97 respectively and said portions together provide a cylindrically curved sheet-supporting surface 39 for supporting one of the aluminium plates indicated by the rectangle 99 in broken lines in Fig. 4. During rotation of the shaft 31 this surface 39 follows the circular path represented in broken line.

The teeth 96,97 on each of the portions 34,35 have a width of about 8 mm and are spaced by gaps 12 mm wide. Each of said portions has fortytwo teeth. The overall width of the support surface formed by the two segmental portions is about 1.24 metres and its radius of curvature is about 30 cm. In its setting providing the longest arc of sheet-supporting surface (Fig. 2) such surface is large enough to support a plate having the dimensions of e.g. a large opened newspaper.

In order to permit the relative angular displacement of the holder parts required for changing the sheet size setting of the apparatus, holder part 32 is rotatably mounted relative to the shaft 31 while part 33 is fixed relative to that shaft. The mechanism for bringing about such relative angular displacements of the holder parts will now be described.

The holder part 33 which is positively connected to the driving shaft 31 supports a motor 42 and the output shaft of this motor is connected by a chain and sprocket coupling 44 with the shaft 43 of a worm 40 which is rotatably supported in bearings which are also carried by the said holder part 33. The worm 40 is in meshing engagement with a worm gear 41 connected to the holder part 32. The

worm gear 41 is capable of being immobilised relative to shaft 31 by a locking mechanism which will presently be described. Operation of the motor 40 while the worm gear 41 is locked to the shaft 31 causes the motor 40, the worm and the associated coupling to move bodily around the periphery of the worm gear 41, and the holder part 33 moves as a unit with such motor-worm assembly. Consequently the segmental comb-like portions receive a relative movement of recession or approach, according to the direction of rotation of motor 40, thereby lengthening or shortening the arcuate extent of the sheet supporting surface 39. Such size adjustments can be effected while the sheet holder is stationary, i.e. when the shaft 31 is not being driven, or while the holder is rotating.

For gripping opposed end margins of a sheet and holding it against the curved sheet supporting surface 39 the sheet holder is provided with leading and trailing clamps 58,48 respectively. The trailing clamp 48 will be described first.

The trailing clamp comprises a series of jaws distributed in spaced relationship across the sheet holder. Each of these jaws comprises a fixed jaw member and a pivoted jaw member. A description of one of the jaws will suffice, the others being similar. Referring to Figs. 2 and 3, the fixed jaw member is a bar 47 which is secured to the holder part 32 and has a tapered outer end portion 102 for contacting the trailing margin of a sheet to be held. The pivoted jaw member is an arm 36 which is rotatable about shaft 49 supported by the bar 47 and which is shaped at one end to co-operate with the tapered end portion of the fixed jaw member 47. Arms such as 51 are secured to the shaft 49 and carry rollers 50 which at certain positions in the course of one revolution of the sheet holder are contacted and depressed by fixed cams 52 and 53. The arms 51 are connected to a transverse bar 55 which covers all of the pivoted jaw members 36 so that the said displacements of the arms 51 by the cams 52 and 53 causes contacting of the trailing ends of each of the jaws 36 by the bar 55 and thereby simultaneous pivotal movement of all of the pivoted jaws 36 into their open positions. This opening movement takes place against the biasing force of springs such as 54. These springs are located by pins carried by a transverse bar 56 and the springs bear at one end against that bar and at their other ends

against plates such as 57 connected to the pivoted jaw members.

The leading clamp 58 likewise comprises a series of jaws distributed in spaced relation across the sheet holder. One of these jaws will be described with reference to Figs. 2 and 3. The other jaws are similar. The jaw comprises co-operating jaw members 37 and 100. The jaw member 100 is a bar supported between two arms 60a, 60b which are secured to a shaft 59 pivotally mounted in part 33 of the sheet holder. The outer end of shaft 59 carries an arm 61 with a roller 62 which is permanently engaged in a cam groove 91 (Figs. 5 and 6) in a cam plate 90 secured to the mounting frame (not shown) of the rotatable sheet holder. The jaw members 37 are pivotally connected to jaw member 60 by a shaft 66 fitted between the arms 60a and 60b. The ends of jaw members 37 remote from the jaw mouth extend below a transverse bar 67 which is fixedly connected to the outer pivoted jaw members of the leading clamp. The several pivoted jaw members are biased towards closed position by springs such as 63 guided on pins 64 which are secured to shaft 59. The springs bear against plates such as 65 connected to the pivoted jaw members.

In addition to the sheet holder parts 32,33 the main shaft 31 carries near one end thereof a radial plate 69 which rotates with such shaft (see Fig. 2). Near its outer end the plate 69 carries a bar cam 70 which is pivotally connected to the plate by a pivot pin 71. The cam 70 is loaded by a spring 72 which urges the cam into its position shown in Fig. 2 in which one end of the cam bears against a stop 74. Cam 70 co-operates with the bar 67 on the pivoted jaw members 37 to cause opening of the leading clamp jaws at the commencement of an operating cycle of the apparatus as hereafter described.

When the shaft 31 commences to rotate (clockwise in the aspect of Figs. 2 and 3 at the commencement of the cycle to carry the sheet-supporting surface 39 towards the pick-up position P-U where the leading clamp 58 is located, the roller 62 on arm 61 is in the most radially inward region of cam groove 91 shown in Fig. 5 and as the shaft 31 rotates the steep portion of the cam groove, which is within the angle marked β in Fig. 5, causes the roller 62 to be pushed radially outwardly away from the main shaft 31. This displacement of roller 62 rotates shaft 59 anticlockwise in the

aspect of Fig. 2. If this were the only movement imparted to that shaft, the leading clamp jaws would be rocked anticlockwise about shaft 59. However, because the shaft 59 is pivotally mounted in the holder part 33, the shaft 59 is being driven bodily clockwise around the axis of the main shaft 31. The result of the combination of this bodily movement of shaft 59 with its anticlockwise rotation about its own axis is that the outer ends of the jaw members 37,60 remain at the pick-up position P-U but move slightly radially outwardly towards the sheet 36 awaiting pick-up at that position.

During the said raidally outward movement of the outer ends of the jaw members 37,60 the cam 70 is being carried clockwise about the axis of shaft 31 by the radial plate 69 to which such cam is pivoted and the tapered end portion of the cam 70 moves into contact with the bar 67 and displaces it towards the shaft 31. The cam accordingly causes clockwise pivotal movement of the jaw members 37 into their open positions. In consequence of the above described radially outward movement of the outer ends of the jaw members 60 and 37 and the pivotal opening movement of jaw members 37 the open jaw mouths pass over the adjacent margin of the sheet 38 at the pick-up position P-U. As the high part of the cam 70, which in the aspect of Fig. 2 coincides with the bottom of the cam pivot pin 71, passes beyond the bar 67, the compression springs 63 cause the pivoted jaw members 37 to close onto the margin of the sheet 38. In this movement the bar 67 which is conneced to such jaw members 37 presses against the cam 70 on what in the aspect of Fig. 2 is the left hand side of the cam pivot and swings this cam into a position in which its lefthand end portion abuts against a stop 73. In the course of this movement the bar 67 rides along the concave portion of the cam 70. Eventually the cam 70 is carried by the plate 69 out of range of the bar 67 and the cam springs back to its original position against stop 74 under the action of the cam return spring 72.

Movement of the bar 67 thereby to set free the jaw members 37 and to permit them to rock into their closed position by their biasing by the prings 63 causes the two outer jaw members to close last, since it is only after said inner jaw members will have been closed, that the bar 67 looses contact with said jaw members and that the outer jaw members, upon further rocking over some angular degrees only,

will close. A further advantageous step consists in extending the described differential operation of the jaw members over all the jaw members, for instance by providing the trailing ends of all but the two outer jaw members 37 with a small set screw that abuts against the bar 67 that withholds the members. Minimum height of a set screw ensures earlier engagement of a jaw member with the sheet on the sheet holder, whereas a greater height of a set screw demands a further displacement of the bar 67 before operative engagement of the jaw member occurs. By suitably increasing the set length of the set screws from the center towards the outer extremities of the bar 67, it may be obtained that engagement of the leading sheet margin occurs progressively from the central region towards the ends of such margin. The described procedure may be advantageous in the gripping of less flat sheet margins. The same arrangement as described hereinbefore may be used for controlling the clamps for gripping the trailing margin of the sheet.

Immediately after closure of the leading lamp 58 on the adjacent margin of sheet 38 at the pick-up position, the leading end of the segmental portion 35 reaches the pick-up position and abuts against the jaw member 100 of the leading clamp 58. As shown in Fig. 3, depicting a situation in which the sheet support has been adjusted to its minimum size and in which the sheet support has reached this point in its cycle, a shock absorber 81 may be provided, e.g. on one of the jaw members 60a or 60b in order to prevent metal to metal impact of the segmental portion 35 against such jaw members. Thereafter the leading clamp jaws 37,100 rotates bodily around the axis of the driving shaft 31 together with the holder part 32,33 and the sheet 38 is drawn from the pick-up position and becomes progressively supported by the rotating arcuate support surface 39.

Because the holder parts 32,33 have been adjusted as hereinbefore described to make the support surface 39 of the correct length for the sheet 38 to be supported, the trailing margin of sheet 38 falls onto such support surface in the vicinity of the trailing clamp 48 and immediately thereafter the arms 51 operating the pivoted jaw members 36 of the trailing clamp are momentarily depressed by fixed cam 53 causing the trailing clamp jaws to open and then close onto the trailing margin of the sheet 38.

The next operation in the machine cycle is the tensioning of the sheet held on the support. This is effected by closing an electric circuit energising electromagnet 75. This causes a small displacement of link arm 76 secured to a shaft 77, and of a short link arm 78 which is also secured to such shaft. The arm 78 carries a roller 79 which engages in a fork 80 secured to the worm gear 41. It is this engagement which immobilises the worm gear 41 relative to shaft 31 during the size adjustments of the sheet support as hereinbefore described. The slight turning movement of shaft 77 caused by energisation of the electromagnet 75 effects a slight turning movement (anti-clockwise in the aspect of Fig. 2) of the worm gear 41 and consequently of the holder part 32 and the trailing clamp 48 which is secured to that part. This movement tensions the held sheet against the arcuate support surface 39. The electromagnet is kept energised, maintaining the tension on the sheet, until after the sheet has been carried through the image transfer station and is ready to be released. In order to ensure that the leading edge of the held sheet is not displaced during the tensioning step, the spring loading on the pivoted jaw members 37 of the leading clamp is made stronger than the spring bias on the pivoted jaw members 36 of the trailing clamp. If the tensioning force is sufficient to overcome the frictional grip exerted by the trailing clamp jaws the trailing margin of the sheet will slide relative to such jaws but the position of the leading edge of the sheet will remain unchanged.

The clamp jaws can have a high coefficient of friction with respect to the material of the sheets to be held.

After the sheet holder has been rotated through nearly 360° the clamping jaws are opened to release the sheet from the holder. The opening of the jaws is effected by fixed cams. At an appropriate position along the path followed by the transverse bar 67, this bar encounters a fixed cam which depresses that bar, thereby pivoting the jaw members 37 of the leading clamp into open position. This cam is not shown in Fig. 2 but it is shown in Fig. 3 which shows the apparatus parts at the moment the jaw members are opened. The opening of the trailing clamp is effected by the fixed cam 52 which by displacing arms 51 and bar 55 causes the jaw members 36 to swing open. The release of the leading and trailing margins of the sheet

allows the sheet to fall into a receiving zone for collection and further processing, e.g. for treating the sheet to make it image-wise receptive of printing ink.

During the major part (about three-quarters) of the revolution of the sheet holder, the follower roll 62 is in that part of the cam groove 91 (Fig. 5) which is concentric with the main shaft 31 and during that part of the revolution the leading clamp is therefore in juxtaposition to the leading end of the segmental portion 35 of the sheet holder. Before the segmental portions 34,35 arrive back at their position illustrated in Fig. 2 the follower roll 62 enters the sector corresponding with the angle marked α in Fig. 5 and during the last part of the revolution the said follower roll 62 is therefore displaced progressively inwardly towards the shaft 31. This displacement of the follower roll causes the entire leading clamp assembly to rock (clockwise in the Fig. 2 aspect) around the axis of shaft 59. The outer ends of the leading clamp jaws are thereby advanced away from the segmental portion 35 of the sheet support and they reach the pick-up position P-U as the revolution is completed and the apparatus is ready for a repetition of the cycle for handling a further sheet. The rotation of the sheet holder can be performed continuously, i.e. without stopping the rotation between successive revolutions or the holder can be rotated step-wise, one revolution or part of a revolution at a time.

The apparatus could be modified in regard to the control cam means to permit a held sheet to be retained on the rotatable support during more than one revolution, e.g. to permit take-up of the sheet by the support during one revolution and transfer of an image to the sheet during the following revolution.

If required two cam plates such as 90 can be provided, one at each end, of the sheet holder and one being a mirror image of the other. The or each cam plate can be secured to the supporting frame of the rotatable sheet holder by screws 92.

Fig. 6 shows the axial distribution of the various components already referred to. The left-hand side of the figure shows the appratus parts involved in the clamping of the leading margin of a sheet whereas the right hand side of the figure shows parts involved in the clamping of the trailing margin of the sheet.

Fig. 6 also shows means which is provided for taking up any axial play of the main shaft 31. This means is provided at what in the aspect of Fig. 5 is the left-hand end portion of the shaft and comprises nested bushings 93,94 housing a compression spring 96. The bushing 93 is secured in the fixed cam plate 90 and the outer race of a shaft bearing 95 fits slidingly in said bushing. The inner race of the bearing is secured to the shaft. The compression spring 96 bears at one end against the flange of the bushing 93 and at its other end via the bushing 94 against the outer race of the shaft bearing 95 so that the spring constantly urges the shaft 31 to the left, so ensuring that any axial play which might otherwise occur, e.g. as a consequence of wear, is automatically taken up. The shaft is axially withhold by the bearing 101 at the opposite side. It is thereby ensured that a sheet held by the rotatable sheet holder 30 will receive the transfer image at a predetermined position on the sheet. This is a particularly important factor if for example a plurality of toner images have to be transferred to the sheet in register.

While the sheet-holding apparatus has been illustrated as employed in a xerographic plate-maker, the apparatus can be employed in other reprographic work. The sheet holder can be used not only for holding metal plates e.g. plates of aluminium or copper, but also for holding sheets of various other materials, e.g. sheets of paper, polymeric material, silver halide sheets materials, or sheets comprising inorganic or organic photo-conductors.

The leading clamp 58 may comprise jaws that are arranged for engaging the leading sheet margin through holes that are provided in said margin, rather than by friction as illustrated in the figures. In that way, a more positive hold of the leading sheet margin and a better registering of the sheet, may be obtained.

The angular adjustment of the sheet holder 30 in order to accomodate different sheet formats, may also occur otherwise than by a worm and wormgear. For instance, the interior of the sheet holder may be provided with two linear air-motors that are fitted together with their cylinders in back-to-back relationship, and the pistons of which have different stroke lengths. One piston rod is connected to one holder part 32, and the other piston rod is connected via suitable links to the other holder part 33. By actuation of either

one of the motors, or of both motors simultaneously, three different end-to-end rod lengths may be obtained, and thereby three corresponding relative positions of the plate holder.

CLAIMS :

1. Sheet-holding apparatus comprising a rotatable sheet holder (30) having a cylindrically curved surface (39) for supporting a sheet of flexible material (38) concentric with the axis of rotation of the holder and comprising mechanical fastening devices (58,48) for engaging the leading and trailing margins of the sheet and holding it taut against said curved supporting surface, characterised in that the holder (30) comprises two parts (32,33) having segmental peripheral portions (34,35) of comb-like structure with intermeshing teeth (96,97) which portions together form a said cylindrically curved sheet supporting surface (39) which subtends an angle of less than 360°; the said holder parts (32,33) are relatively angularly displaceable about their common axis of rotation to enable the angle subtended by the said sheet-supporting surface (39) to be adjusted to suit different sheet dimensions; and the leading and trailing fastening devices (58,48) are likewise relatively angularly displaceable to permit them to hold leading and trailing sheet margins in the vicinity of the leading and trailing ends of said supporting surface (39) in any said adjusted setting of said holder parts (32,33).

2. Apparatus according to claim 1, wherein there is mechanism (75,76,78,80,41,40) which causes the angular spacing of the leading and trailing fastening devices (58,48) to increase slightly at a stage such as to cause tensioning of a sheet (38) held by such devices.

3. Apparatus according to claim 2, wherein said mechanism for causing tensioning of a sheet comprises an electromagnet (75) which functions through mechanical coupling means (76,78,80,41,40) to cause partial rotation of one said holder part (32) together with the adjacent sheet fastening device (58).

4. Apparatus according to any preceding claim, wherein the leading and trailing fastening devices (58,48) are in the form of clamps and the apparatus includes means (70,67,63) which automatically opens and closes the leading clamp (58) at a predetermined region (P-U) along the path followed by the periphery of the holder (30) during its rotation so that such clamp can take hold of a margin of a sheet (38) if this is held ready for pick-up at

that region (P-U), and includes means (52,53,57,54) which automatically subsequently opens and closes the trailing clamp (48) to permit it to take hold of the trailing margin of such sheet.

5. Apparatus according to claim 4, wherein there is means (91,62,61) which controls the movement of the leading clamp (58) so that for a period of time during part of a revolution of the said holder parts (32,38) said leading clamp (58) is angularly spaced from and is held (against rotation with said segmental parts) at said sheet pick-up region (P-U), and means which during said period of time opens and closes said leading clamp (58) for taking hold of a sheet (38) before said leading clamp is caused to accompany the rotation of said holder parts (32,33) and thereby draw said sheet (38) onto the cylindrically curved supporting surface (39).

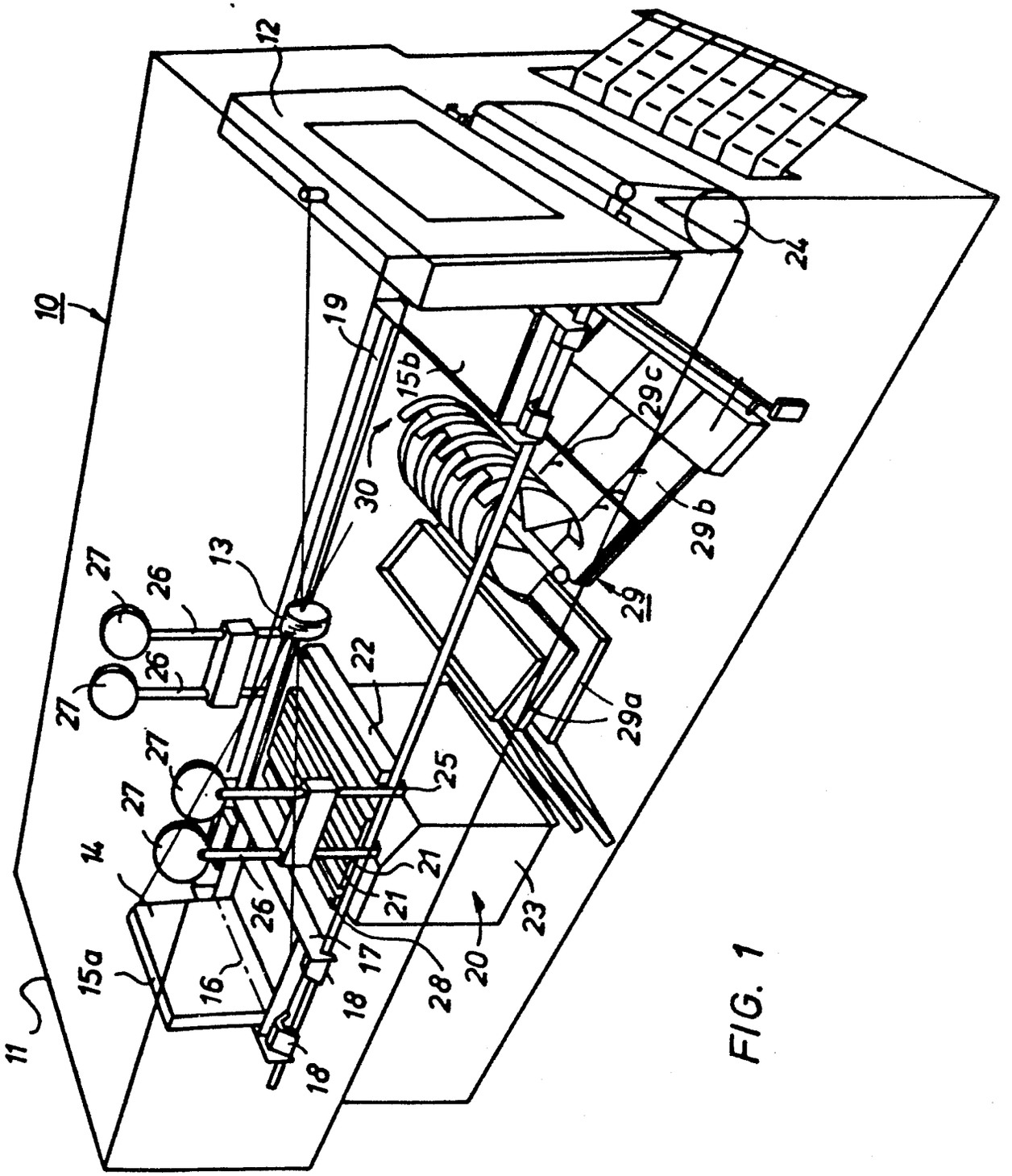
6. Apparatus according to claim 4 or 5, wherein each of the leading and trailing fastening devices (58,48) is in the form of a clamp comprising a series of jaws (36-47; 37-109) distributed in spaced relation across the holder (30).

7. Apparatus according to claim 6, wherein said jaws (36,37) are independently biased by springs (63,54) towards closed position.

8. Apparatus according to claim 6 or 7, wherein the means (55,67) for closing the jaws operates to close the inner jaws of each series before the outer ones.

9. Apparatus according to any preceding claim, wherein the size and adjustment range of said sheet holder (30) are such that it is capable of holding sheets ranging in size from A4 to A1.

10. Printing apparatus comprising sheet-holding apparatus according to any of claims 4 to 8, means (29a) for supporting flexible sheets in a position near the path followed by the periphery of the sheet holder (30) for take-up by the leading clamp (58), and means (15a, 15b) for conveying image-carrying material to the vicinity of said sheet holder (30) for image-wise transfer of the image to a sheet (38) while it is held by and rotates with said sheet holder (30).


10
11
12
13
14
15a
15b
16
17
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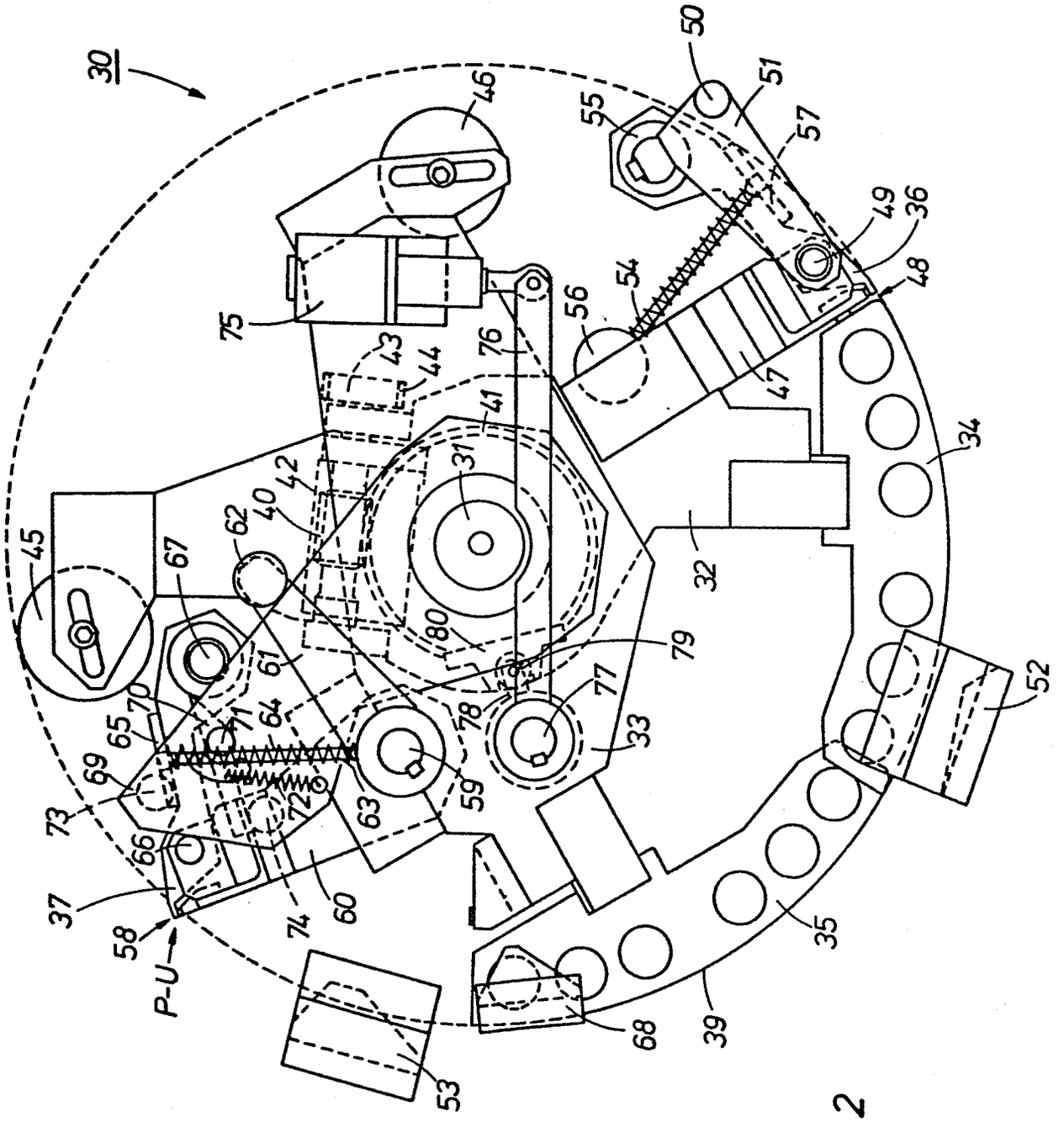
21
22
23
24
25
26
27
28
29
29a
29b
29c
30

FIG. 1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31
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P-U
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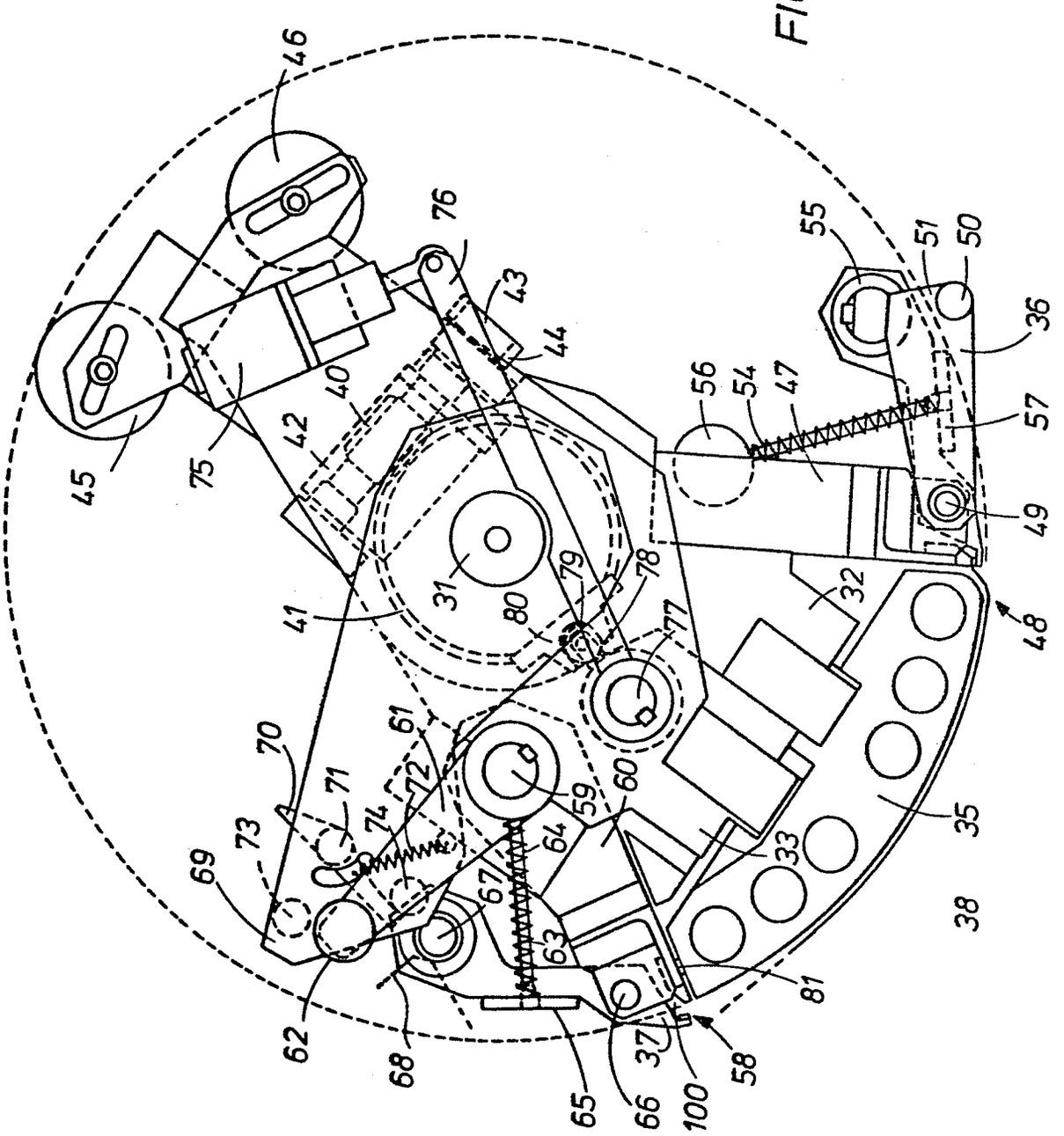
FIG. 2

FIG. 3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78
77
41
61
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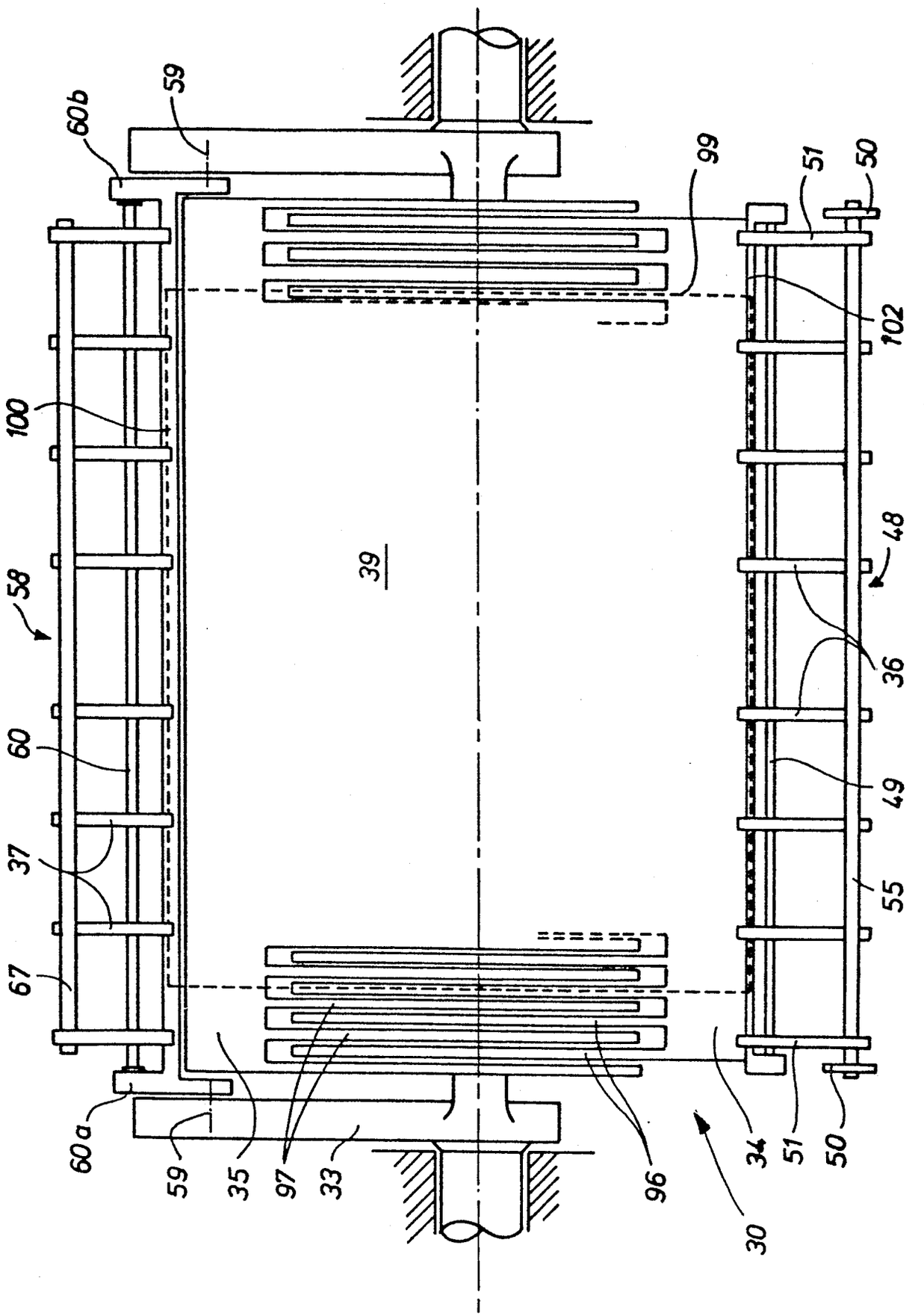
65
66
100
58
81
37
33
35
38


60b
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99
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50
102
100
39
58
48
36
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49
37
55
67
60a
59
35
97
33
96
34
51
50
30

FIG. 4

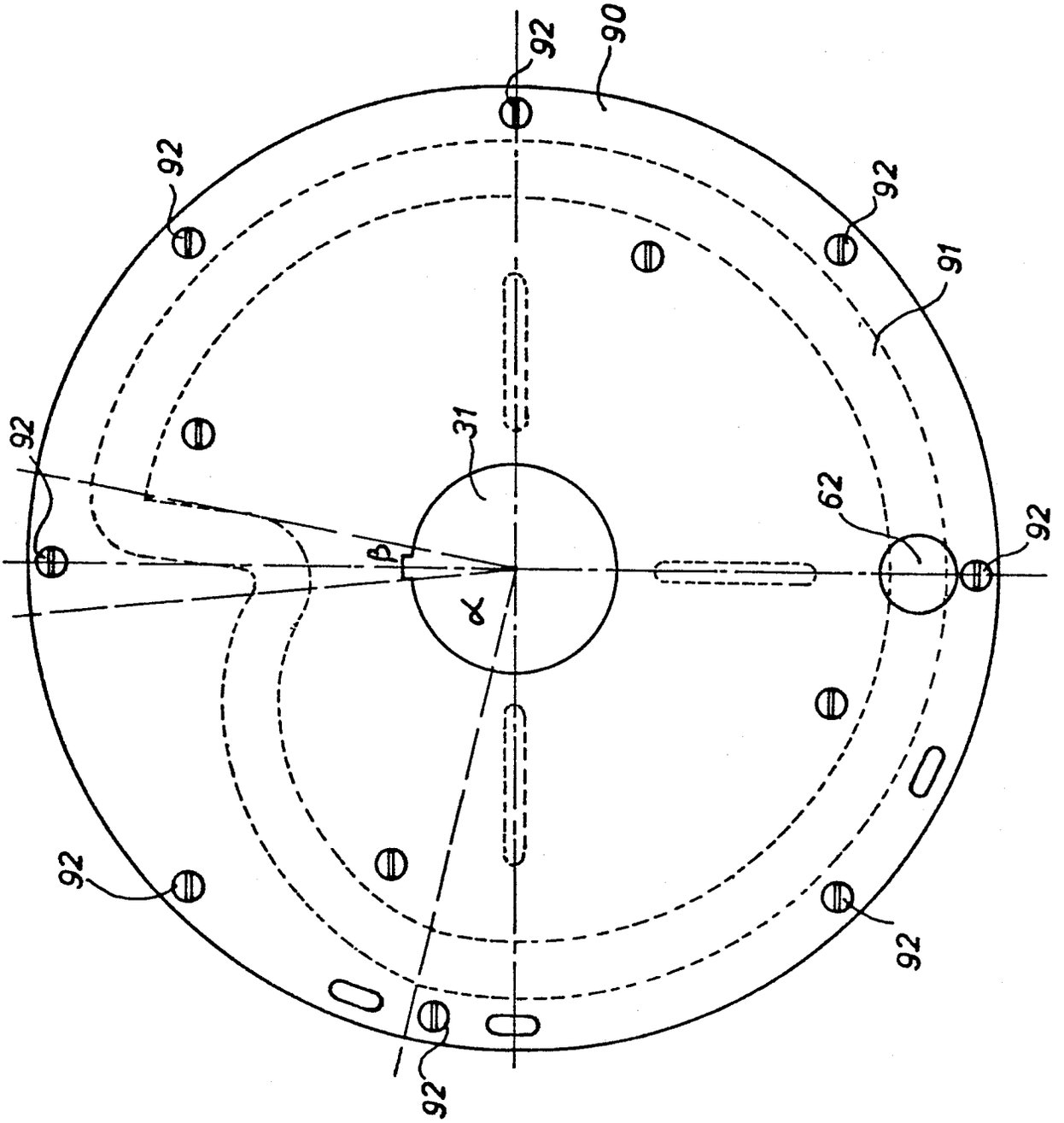
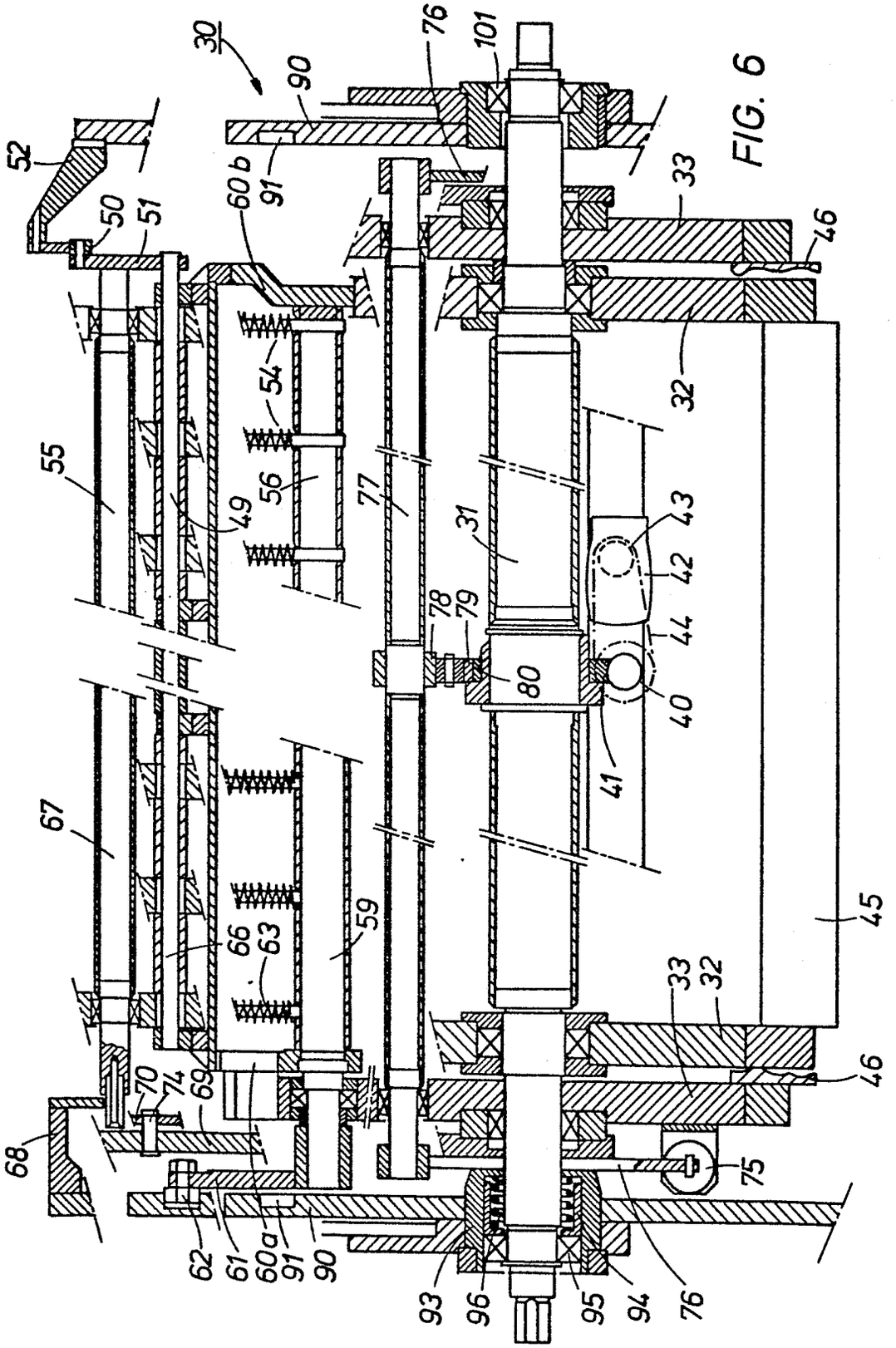


FIG. 5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52
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60b
91
90
76
101
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46
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54
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77
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79
44
80
40
41
67
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63
59
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74
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68
75
62
61
60a
91
90
93
96
95
94
76

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

0089080
Application number

EP 83 20 0310

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	US-A-3 869 985 (F. STEINMETZ et al.) * Claim 1; figures 1,2 *	1	B 41 L 29/14 G 03 G 15/22
A	US-A-1 967 266 (G.S. ROWELL) * Page 1, line 95 - page 2, line 13; figures 1,2 *	1	
A	US-A-2 966 848 (H.W. FAEBER) * Column 3, lines 29-55; figures 7,10 *	1	
A	US-A-4 018 158 (L.A. BORNEMAN) * Claim 1; figure 3 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 41 F 27/12
B 41 L 29/12
B 41 L 29/14
B 41 L 29/16

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14-06-1983	GRASSELLI P.

CATEGORY OF CITED DOCUMENTS

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