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(54) Xerographic copier including hot roll fuser.

(57) In a xerographic copier employing a hot roll fuser and adapted to produce copies on various sizes of copy paper, the rolls of the fuser must be of a length to accommodate the largest copy sheet. Accordingly, when small sheets are employed, the total surfaces of the rolls are not used. The hot roll has a surface considerably softer than the back-up roll and is, therefore, subject to wear in use. With copy paper of differing dimensions, and referenced to one end of the rolls, uneven wear is caused to the hot roll as portions of the opposite end do not consistently contact copy sheets being fused. This wear is minimised by mounting the hot roll (14) in a frame (152) which is removable from the fuser unit to permit end-to-end reversal of the hot roll (14).

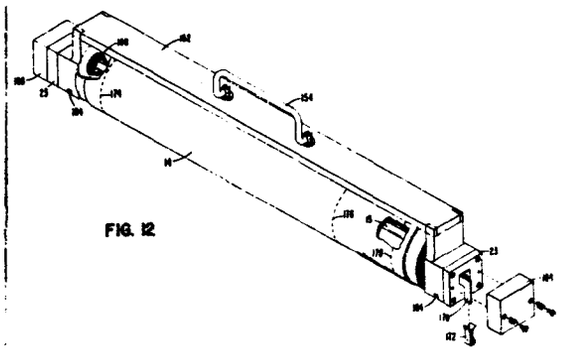

FIG. 12

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XEROGRAPHIC COPIER INCLUDING HOT ROLL FUSER

The present invention relates to xerographic copiers, and in particular to such copiers incorporating fusers of the hot roll type.

A hot roll fuser comprises a heatable roll and a back-up roll. In operation, these are positioned together to form a nip through which a copy sheet carrying a toned image passes. The toned image contacts the heatable roll to cause fusion of the toner to the sheet. The back-up roll normally has a metallic surface whereas the heatable roll has a softer surface of, for example, a polymeric material, to prevent toner offset to this roll. This relatively soft surface is subject to wear in operation of the fuser. When the fuser is designed to accept copy sheets of a single size, at least in the axial direction of the rolls, the length of the rolls can be chosen to correspond with the size of the sheets. Accordingly substantially the whole length of the rolls are used for each operation and wear is evenly distributed along the heatable roll. If, however, the fuser is in a machine which produces copy sheets of differing dimensions, the whole length of the rolls contacts only the largest sheets applied

thereto. In all other cases, the sheets are shorter than the lengths of the rolls, and this causes uneven wear of the hot roll surface.

The present invention is concerned with xerographic copying apparatus which is adaptable to minimise the above mentioned uneven wear. Such apparatus includes a hot roll fuser comprising a heatable roll and a backup roll, and means for feeding copy paper sheets of differing dimensions carrying toned images to and through the fuser for fixing the toned images to the sheets, characterised by a frame carrying the heatable roll, said frame, together with the roll, being removably mountable in the fuser unit such as to permit end-to-end reversal of the heatable roll.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a general view of a xerographic copier incorporating a hot roll fuser assembly;

Figure 2 is a simplified cross-sectional view of the Figure 1 fuser assembly;

Figure 3 is a diagrammatic view of the fuser assembly showing a roll closure mechanism;

Figure 4 is a diagrammatic view of a fuser assembly as in Figure 3, but seen from the opposite side;

Figures 5 and 6 are exploded diagrammatic views of the solenoid, pivoting link and clutch shown in Figure 4;

Figure 7 is a diagrammatic view of a mechanism used in conjunction with the fuser assembly to move associated hardware to facilitate access to the hot roll and backup roll area;

Figure 8 is a diagrammatic view as in Figure 7, with the associated hardware moved out of the way for access to the hot roll and cold roll;

Figure 9 is a perspective view of the fixed centre drive for producing rotation of the backup roll, and also shows the backup roll's scraping blade cleaner and the fuser's paper exit guide transport roller;

Figure 10 is a partially fragmented diagrammatic view showing removal of the subframe from the mainframe in the fuser assembly;

Figure 11 is a partially fragmented, exploded perspective view of the positioning surfaces and pin in the mainframe for supporting the subframe;

Figure 12 is an exploded perspective view partially in section showing the U-shaped metal subframe member and the handle thereon for effecting removal of the subframe from the mainframe of Figure 10; and

Figure 13 is an overall perspective view of the fusing assembly.

Figure 1 is a general view of xerographic copier 10 incorporating a fuser assembly 12, which is shown in its extended or pulled-out position in front of the copier, and is slidably supported within copier 10 by apparatus shown for purposes of simplicity. This is a non-operating position adapted to facilitate inspection, cleaning, repair and/or sheet jam clearance.

The slidably supported fuser assembly 12 includes a hot roll 14 and a backup roll 16. Generally, hot roll 14 is heated to an accurately controlled temperature by an internal heater 15, as seen in Figure 2, and an associated temperature control system which is not shown. Hot roll 14 preferably includes a deformable external surface formed as a thin elastomeric surface. This surface is designed to engage the toned image side of a copy sheet. Hot roll 14, acting in concert with backup roll 16, fuses the image onto the copy sheet and readily releases the sheet with minimum adherence of residual toner to the hot roll. As is conventional in hot roll fusers, the sheets toned side faces the hot roll.

Backup roll 16 is preferably a relatively cool and rigid roll. Both rolls 14 and 16 are circular cylinders and the fusing nip formed thereby defines a line (of some width due to deformation of roll roll 14) parallel to the axis of rolls 14 and 16.

The fusing nip formed by rolls 14 and 16 may be opened and closed in synchronism with the arrival and departure of copy sheet leading and trailing edges, respectively. This synchronism is achieved by a drum position sensing means which responds to the position of the photoconductor drum and of the copier and effects opening and closing of the nip by means of a copier control system (not shown). In the alternative, for a multi-copy run, the fusing nip may continuously remain closed until the trailing end of the last sheet

has passed therethrough.

Figure 2 shows the fusing nip closed. Rigid backup roll 16 is shown to be in contact with resilient hot roll 14, thereby deforming the surface of hot roll 14 so as to form a fusing nip 18 of a certain width, measured in the direction of sheet movement 19. Feed roller 20 cooperating with idler roller 21 continues sheet movement 19 until a copy passing therethrough is free of fusing nip 18 and has passed through fuser exit-way 22.

In Figure 3, hot roll 14 is removably, rotationally mounted on a fixed position axis in mounting blocks 23 which are supported by way of positioning surfaces 24 formed in the ends of a single piece mounting mainframe member 26. This mainframe member 26 includes a hanger which supports the fuser assembly by way of telescoping rails 30. Frame member 26 also includes rollers 32 which cooperate with a copier frame member to stablize the fuser assembly position within the copier.

As seen in Figures 3 and 13, roll 16 is rotationally supported, on axis 34, by way of pivoting cradle arms 36 at each end of frame member 26. These cradle arms are pivoted on the frame member at axis 38. Pivot arms 40, at each end of mainframe member 26, are pivotably mounted to the frame member by way of pivot 42. Pivot arms 40 have downwardly extending projections 41 which support rollers 44 which cooperate with nip opening and closing cams 46. The other ends of pivot arms 40 have mounted thereon ends 48 of compressible force-cells 50. The other end 52 of force-cells 50 operate

on cradle arms 36 to cause arms 36 to rotate clockwise about axis 38, as the fuser nip is closed. In addition to rotating arms 36, force cells 50 provide controlled pressure to backup roll 16 through axis 34, and consequently the pressure to fusing nip 18 is controlled. Springs 53, positioned between hanger 28 and pivot arms 40, provide an additional closing force to fuser nip 18.

The closing of fusing nip 18 is achieved by cams 46 which are rotationally mounted on axis 38. These cams include a low point 54 which, when positioned to cooperate with roller 44, establish a nip-open condition. To close the nip, solenoid 56 is energized and clutch 58, shown in Figures 4-6, operates to rotate cams 46, in Figure 3, clockwise 235^{o} (counterclockwise if observing Figure 4) to the position shown, causing nip 18 to close.

During nip closure, pivot arms 40 (see Figure 3) rotate counterclockwise causing fixed-position pivot 42, force-cell pivot 60 and axis 34 to come into substantial alignment. However, pivot point 60 does not move over-center. Thus, subsequent rotation of cams 46, back to the nip open cam position 54, as a result of the de-energization of solenoid 56, allows force-cell 50 to rotate pivot arms 40 clockwise (when observed on Figure 3) about pivot 42, opening fusing nip 18.

In Figures 5 and 6, cams 46 are connected to rotate on axis 38 as long as clutch member 58 is free to rotate. In the de-energized position of solenoid

56, dog 62 is held against rotation by tab 64 on pivoting link 66. Link 66 is pivoted at fixed position pivot 68. When solenoid 56 is energized, clutch member 58 and cam 46 are driven 235° until dog 62 engages tab 70. Fusing nip 18 is now closed. Subsequently, when it is desired to open the fusing nip, solenoid 56 is de-energized, link 66 returns to its de-energized position, and clutch member 58 rotates until it is stopped by tab 64. Fusing nip 18 is now opened.

In the fragmented portion of Figure 4, a folded handle 72, for manually removing hot roll 14, is shown. The use of this handle for removing hot roll 14 from the fusing assembly will be explained hereinafter.

In Figure 13, a manually movable, rod-like handle 74 extends the length of the fuser assembly, parallel to axis 34. Opposite ends of this handle are attached to movable links 76, at each end of the fuser assembly. In Figures 7 and 8 it is seen that these links are pivoted on fixed-position axis 78. Both of the links have a notch 80, a pivot point 82 for one end of a drive arm 84. In Figure 7, links 76 are shown in their operative positions, wherein hot roll 14 detach bar (not shown) and the fuser's output sheet transport channel (not shown) are located closely adjacent the down stream portion of fusing nip 18 (shown closed).

In Figures 7, 8 and 13, links 88 are pivoted on fixed-position axis 90. Each of links 88 has a projection 92 thereon for holding mounting blocks 23 securely within mainframe 26. Links 88 carry locking pins 96 which lock links 88 (and the detach bar) in

operative position by virtue of an interface at 98 between pin 96 and pivotable links 100. Links 100 are pivoted on fixed-position axis 102.

The ends of the above-mentioned output sheet transport channel are attached to links 106. These links are pivoted on backup roll axis 34. Axis 34 is not a fixed-positioned axis because during nip closure, axis 34 moves a slight distance downward, as represented by arrow 108 in Figure 7.

The upper end of links 106 carry a locking pin 110, cooperating with notch 80 formed in links 76. The lower end of links 106 carry lower pivot axis 112 for the end of drive arm 84 that is opposite pivot point 82.

In Figure 8, two tension springs 114 extend between pins 116 carried by links 76 and pins 118 carried by links 100. The springs provide a closing force between links 76 and links 100. In addition to providing a closing force between links 76 and links 100, springs 114 provide a contacting force between links 88 and pivotable links 100. The above-mentioned interface 98 is created by these latter two sets of links.

In order to move the above-mentioned (but not shown) detach bar and output sheet transport channel out of the way for jam clearance or to remove hot roll 14, the above-mentioned rod-like handle 74 is lifted up and rotated counterclockwise about fixed-position axis 78, to the position shown in Figure 8. This causes the detach bar to generally rotate clockwise about hot roll 14 away from fusing nip 18,

and the output sheet transport channel to generally rotate counterclockwise about backup roll 16.

During such movement, pins 116 on links 76 engage links 100 and cause these links to pivot counterclockwise about their fixed-position axis 102. As a result, interface 98, as seen in Figure 7, created by contact between pins 98 and pivoted links 100 is broken. In Figure 8, as handle-actuated links 76 continue to rotate counterclockwise, notches 80 free pins 110. Counterclockwise rotation of links 76 transmits counterclockwise rotation to links 106 by virtue of drive arms 84. As pivot axis 112 moves counterclockwise as represented by arrow 120 in Figure 7, to its position in Figure 8, links 106 is pivoted clear of fusing nip 18. As counterclockwise rotation of links 76 continues, surfaces 122 formed thereon engage locking pin 96, causing links 88 to rotate clockwise about their fixed-position axis 90.

The detach bar and output sheet transport channel have now been moved out of the fusing nip for jam clearance. In addition, link 88 has been pivoted clockwise, eliminating the interface between projection 92 on links 88 and mounting blocks 23. Links 88 can now be manually rotated clockwise, as represented by arrow 124 in Figure 7, in order that hot roll 14 can be removed from mainframe 26.

In summary, interface 98 locks the detach bar in operative position, notch 80 and pin 110 lock the output sheet transport channel in operative position, spring 114 maintains interface 98, pin 116 lifts link

100 to interrupt interface 98, counterclockwise rotation of link 76 frees pin 110 and rotates link 106 by virtue of drive arm 84, and counterclockwise rotation of link 76 rotates link 88 clockwise as a result of interference with locking pin 96.

Figure 9 shows the fixed center drives for (1) producing rotation of the fuser's backup roll 16, (2) producing oscillatory movement of the backup roll's scraping blade cleaner 126; and (3) producing rotation of the fuser's paper exit guide transport roller 20. Roller 20 is supported by the exit paper transport guides, and engages the non-toner side of a sheet, as the sheet emerges from fusing nip 18. Additional information pertaining to the blade cleaner 126 appears in IBM Technical Disclosure Bulletin, Vol. 18, No. 2, July 1975, pp 326-327.

Counterclockwise rotation of backup roll 16 is produced by gear 132 which meshes with continuously drive gear 134. Gear 132 is connected to the backup roll's axis 34 and causes counterclockwise rotation of this roll. When the fusing nip is being closed or opened, the backup roll's rotational axis 34 moves in an arc about axis 38. Thus, gear 132 merely rolls about its meshing gear 134.

Cleaner 126 is supported by double helix lead screw 138. This lead screw is driven in a counterclockwise direction by virtue of gears 140-142 with gear 140 being fixedly mounted on an end of lead screw 138, gear 141 being rotatively mounted on fixed axis 144 and gear 142 being fixedly mounted on axis 34. Since

all of these gears are carried by cradle arm 36, a fixed center relationship is maintained during nip opening and closing.

As a sheet of newly fused copy paper emerges from the fusing nip, and as it is driven by counterclockwise rotation of backup roll 16, its leading edge is guided into the output sheet transport channel (not shown in Figure 9). This sheet channel is supported by pivoting links 106. Links 106 supported at the rear end of the fuser, and shown in Figures 9 and 13, carry a pair of gears 146, 148 which mesh with a gear 150 which is integral with backup roll 16. Counterclockwise rotation of sheet transport roller 128 by gears 146, 148 and 150 transports the copy paper out of the fusing nip. Roller 128 cooperates with idler roller 21, shown in Figure 2, to trap the copy sheet therebetween. The idler roller engages the toned side of the copy sheet.

When the fuser's sheet detach bar and output sheet transport channel are manually moved out of the way, as for jam clearance, links 106 rotate in a counterclockwise direction as discussed above with reference to Figures 7 and 8. Since link 106 pivots about the backup roll's rotational axis 34, a fixed center is maintained for gears 146-150, and gears 146 and 148 merely rotate in a circle about gear 150. Consequently, a constant center distance between the gears is maintained and transport roller 20 is driven with minimum backlash by the gearing.

The fuser's main frame member 26, shown in Figures 10 and 11, comprises a central portion surrounding, but spaced from, the surface of hot roll 14 and having upstanding end flanges establishing the various rotational axes of the backup roll and its associated structure. These end flanges include U-shaped slots or positioning surfaces 24 adapted to receive the ends of the reversible hot roll.

With reference to Figure 12, hot roll 14 is rotationally mounted in rigid U-shaped subframe member 152 which is symmetrically located between positioning surfaces 24. Subframe 152 is locked to mainframe 26 and is unlocked therefrom by rotation of rotatable handle 74. A handle 154 shown folded in Figure 10 and shown extended in Figure 12, is mounted on the central portion of subframe member 152.

Each end of the hot roll is supported for substantially frictionous rotation in metal end blocks 23. End blocks 23 each have a stub shaft which fit into bearings at both ends of hot roll 14. Hot roll 14 is easily replaceable because metal end blocks 23 are removable from subframe 152. These end blocks are substantially identical, the only exception being that one end block cooperates with a helix compression spring 160 which axially biases hot roll 14 towards the other end block for retention purposes. End blocks 23 nonrotationally support heating element 15, as also seen in Figure 2, on the hot roll's axis of rotation. A hot roll core temperature sensor (not shown) is mounted on mainframe 26 under hot roll 14. Hot roll 14 is driven

in a counterclockwise direction by frictional engagement with counterclockwise rotating backup roll 16 when the fusing nip is closed.

As seen in Figure 12, both end blocks 23 have a mounting channel 164. Channels 164 are of uniform cross-section and run perpendicular to the hot roll's axis of rotation. As shown in Figures 10 and 11, the back mounting channel only of mainframe member 26 includes a positioning pin 166 adapted to mate with channel 164 in the end block adjacent helix compression spring 160. The front positioning channel of mainframe member 26, however, does not include such a positioning pin.

Each end of the reversible subframe member 152, in Figure 12, includes an electrical connector portion 168, one of which is exploded and separated from end block 23 to illustrate electrical connector 170. Connector 172 is insulatively mounted on the mainframe member's forward end flange. The rear one of these connectors 168 is maintained in a fixed position by virtue of locking engagement between channel 164 and pin 166. Electrical connector 170 experiences movement along the axis of the hot roll as the temperature of the hot roll's U-shaped subframe member 152 changes. Metallic U-shaped subframe member 152 expands and contracts with temperature changes. However, since connector member 172 has a channel extending in a direction parallel to the axis of the hot roll, sliding movement of connector 170 within the channel of member 172 is accommodated.

Paper is fed through the copier with its long dimension parallel to the hot roll's rotational axis, and with sheets of various sizes referenced to a common rear edge (corresponding to the common corner registration for all original documents to be copied on the master document support glass). This rear edge is indicated by broken line 174 in Figure 12. The forward edge of a 216 mm x 280 mm sheet of paper would reside at broken line 176, whereas the forward edge of 216 mm x 355 mm sheet of paper would reside at broken line 178. The hot roll's variable forward working area 176-178 makes it desirable to reverse hot roll 14, end for end, periodically to distribute wear on the hot roll.

Before removing subframe 152 and hot roll 14 out of the fuser assembly 12, subframe 152 is unlocked from mainframe 26 by actuating rotatable handle 74 and movable links 76 which rotate links 88 clear of mounting blocks 23. A shroud (not shown) which overlies hot roll 14 is pivoted clear of the roll and foldable handle 154 is unfolded to allow for the lifting of hot roll 14, including subframe 152, out of main frame 26. With reference to Figure 12, as subframe 152 is lifted, the connection between positioning pin 166 and channel 164 in end block 23 is broken. The electrical connection between the male and female connectors on the other end block 23 and main frame 26 respectively, is also broken. The upward motion of subframe 152 continues and end blocks 23 continue sliding until free of positioning surfaces 24. Once

out of mainframe 26 and the fusing area, subframe 152 is reversed, end for end. After reversal of subframe 152, the above steps are reversed until subframe 152 is again locked to main frame 26. Even through the handle for lifting subframe 152 out of the copier is shown and described as being permanently attached to subframe 152, it should be understood by those having skill in the art that modifications to the handle-subframe configuration can be made. For example, handle 154 could be detachable and stored until needed to remove subframe 152 from the copier. These simple manual steps allow hot roll reversal to be accomplished within a short period of time and also reduce the risk of component damage due to handling. Additionally, the hot roll core temperature sensor is not disturbed during reversal of the hot roll.

CLAIMS

1. A xerographic copier including a hot roll fuser comprising a heatable roll (14) and a backup roll (16), and means for feeding copy paper sheets of differing dimensions carrying toned images to and through the fuser for fixing the toned images to the sheets, characterised by a frame (152) carrying the heatable roll, said frame, together with the roll, being removably mountable in the fuser unit such as to permit end-to-end reversal of the heatable roller.

2. A xerographic copier as claimed in claim 1 further characterised in the said frame includes electrical connectors (170) connected to heating means within the heatable roll and arranged to engage with power supply connectors (172) as the frame is mounted in the fuser unit.

3. A xerographic copier as claimed in claim 1 or claim 2 further characterised by mounting means (23) for mounting the heatable roll in the frame, said mounting means being arranged to accomodate axial expansion of the heatable roll.

4. A xerographic copier as claimed in any of the previous claims further characterised by spring means (160) arranged to bias the heatable roll to a substantially fixed axial position within the frame.

5. A xerographic copier as claimed in any of the previous claims characterised by means for locking said frame into position within the fuser unit.

6. A xerographic copier as claimed in claim 5 characterised in that said means for locking comprises a notch (164) in the frame and a pin (166) in said fuser unit positioned to engage said notch.

FIG. 1

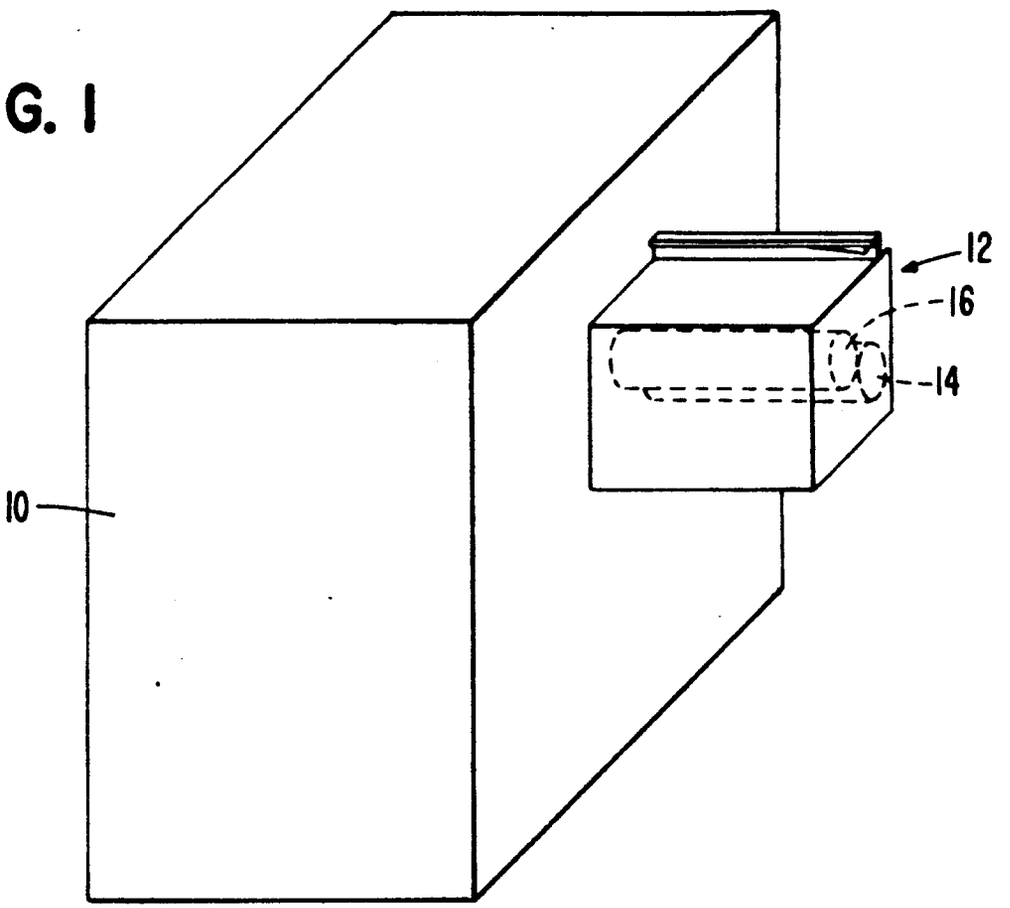
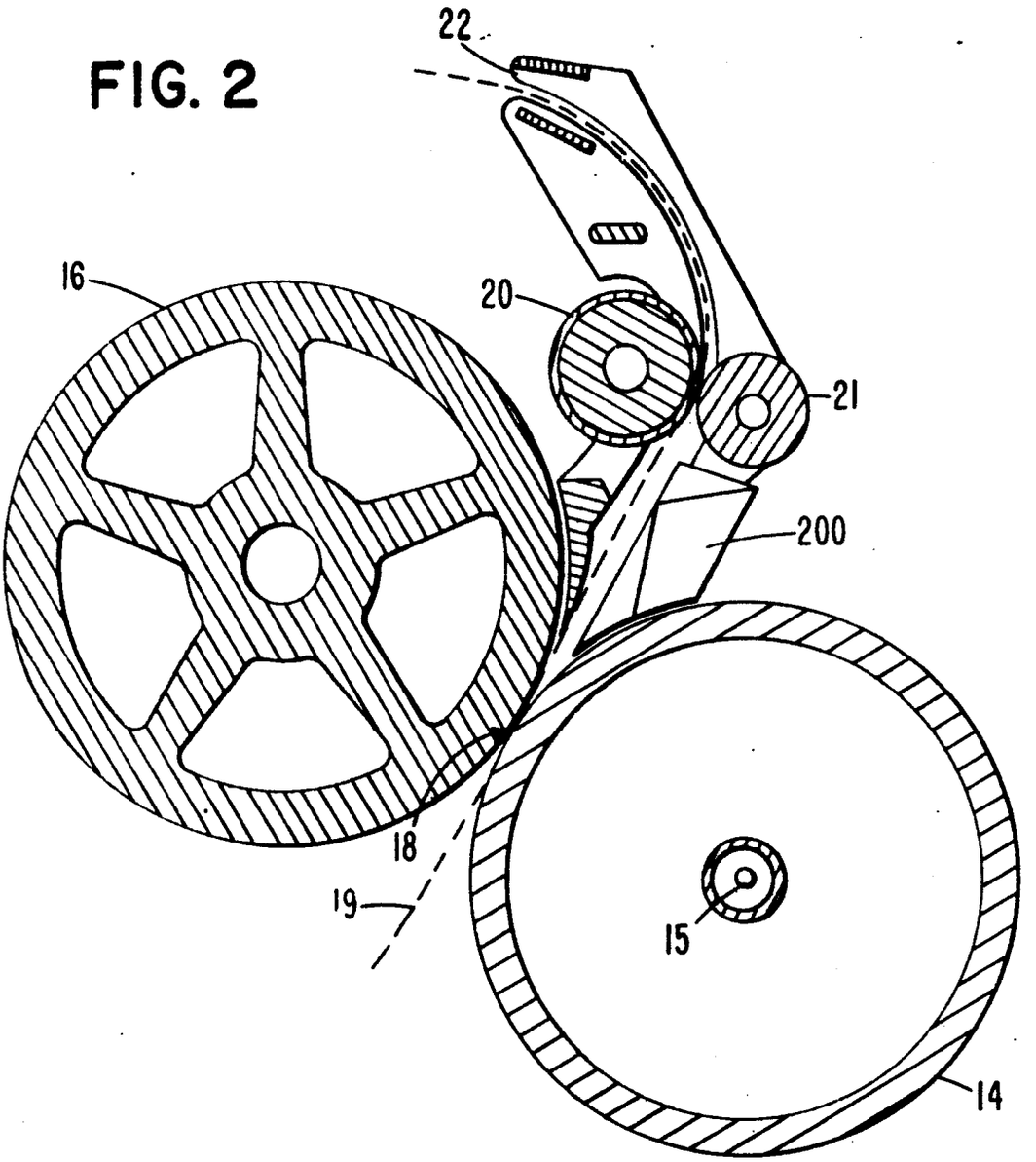


FIG. 2



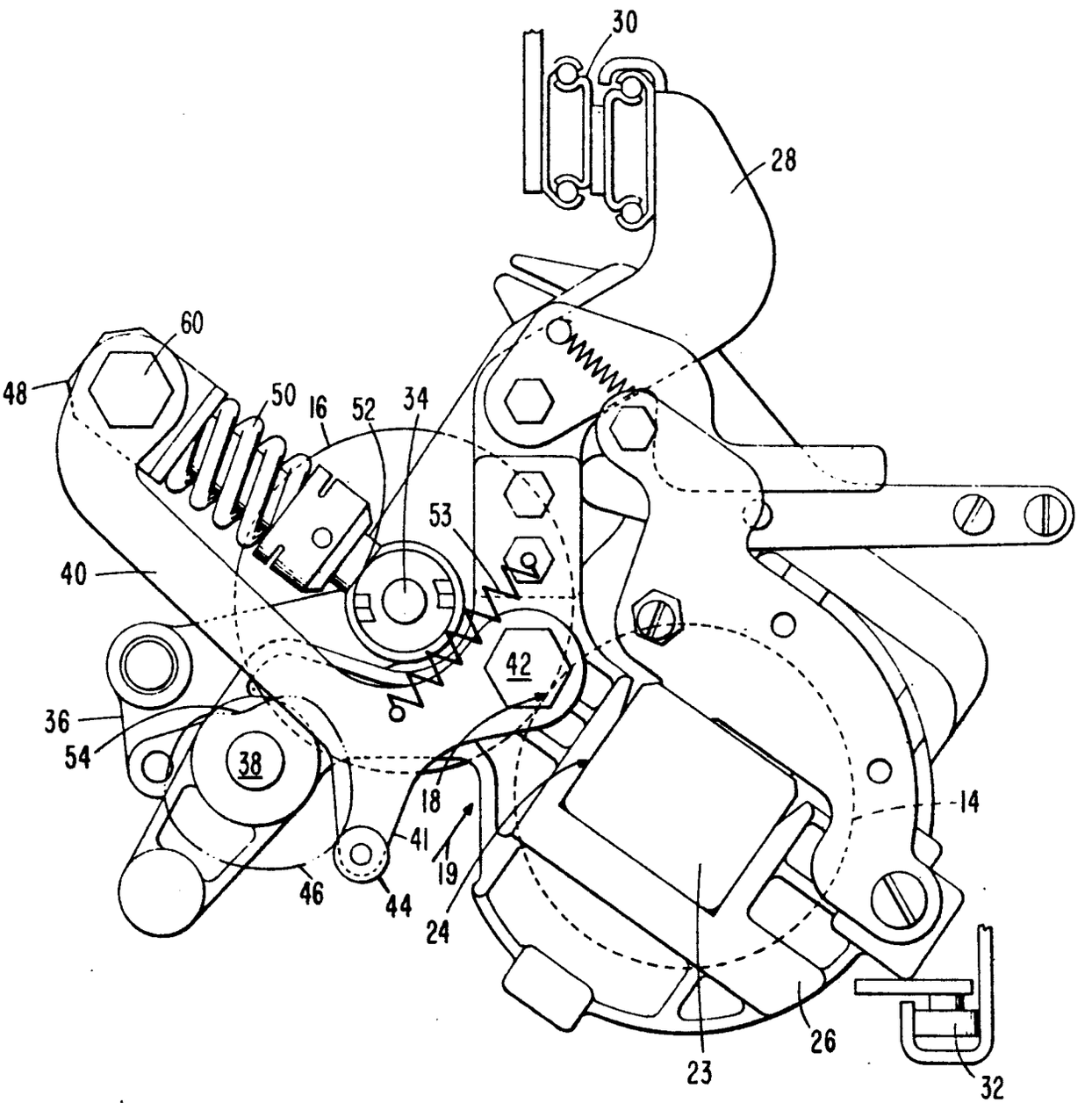


FIG. 3

FIG. 4

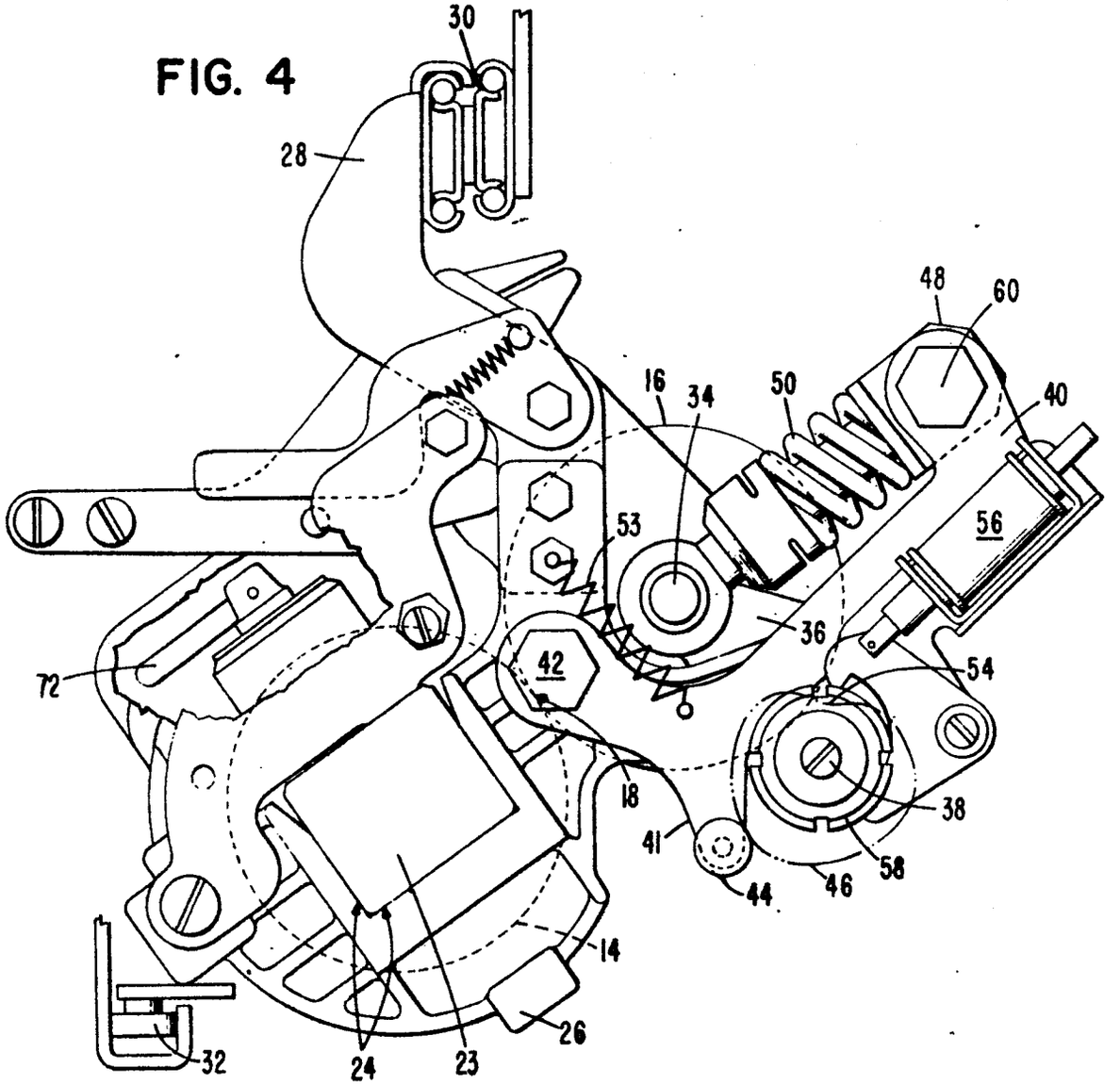


FIG. 5

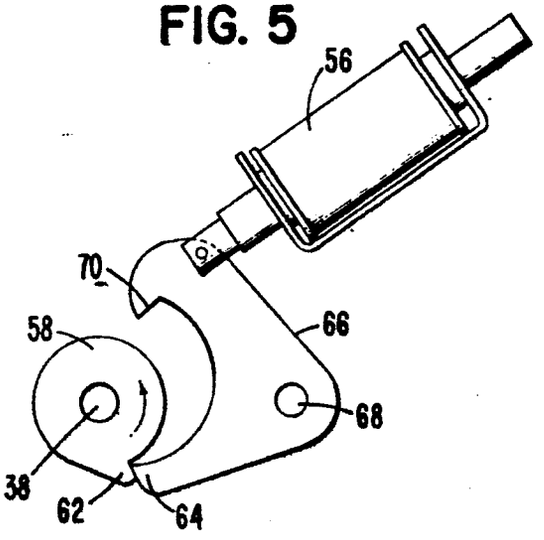
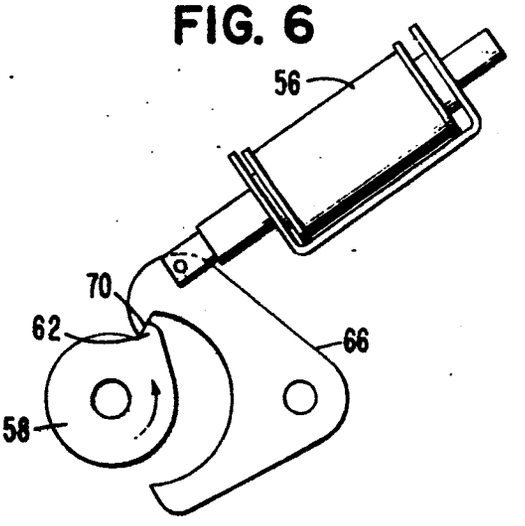


FIG. 6



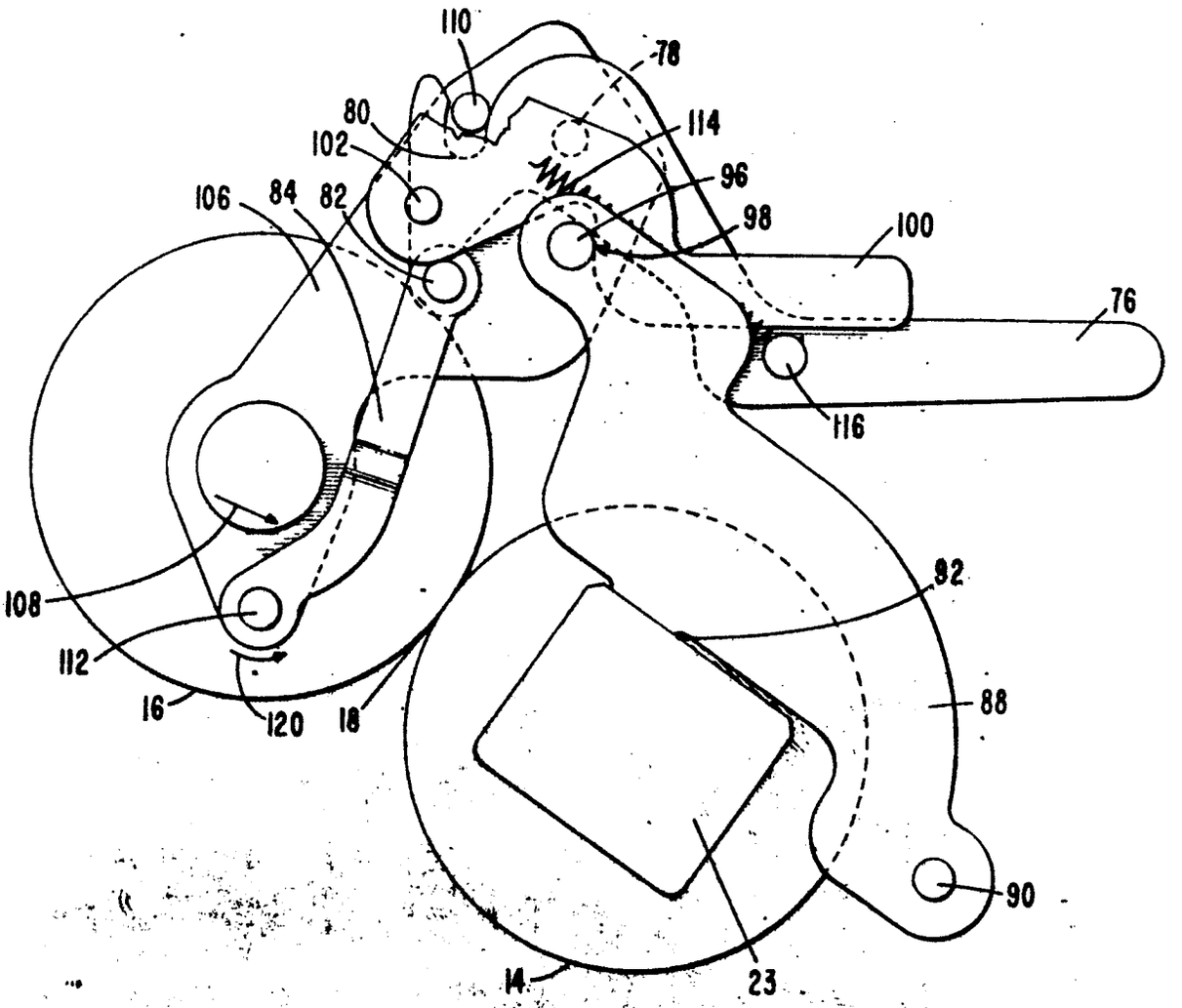

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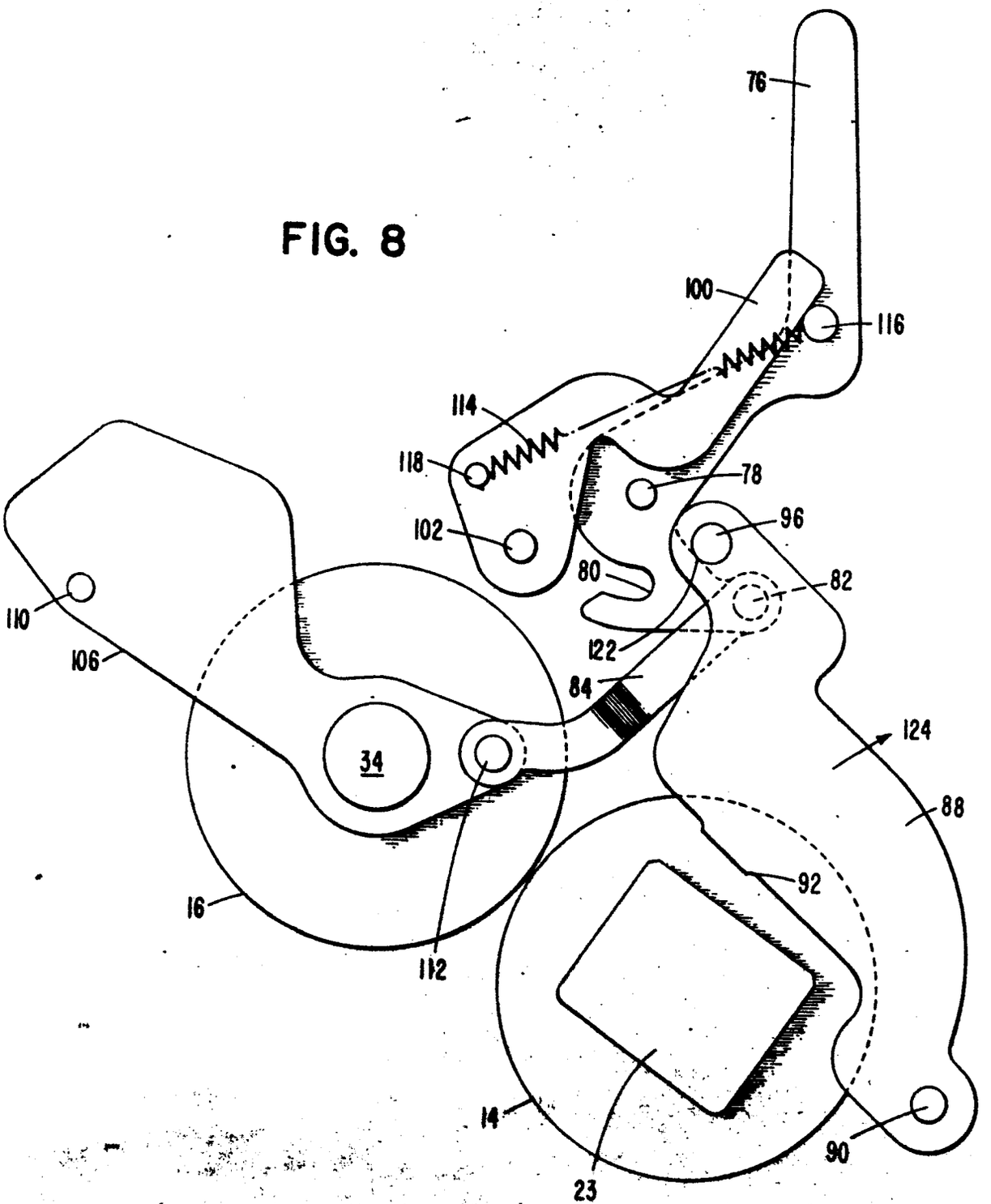
FIG. 7

FIG. 8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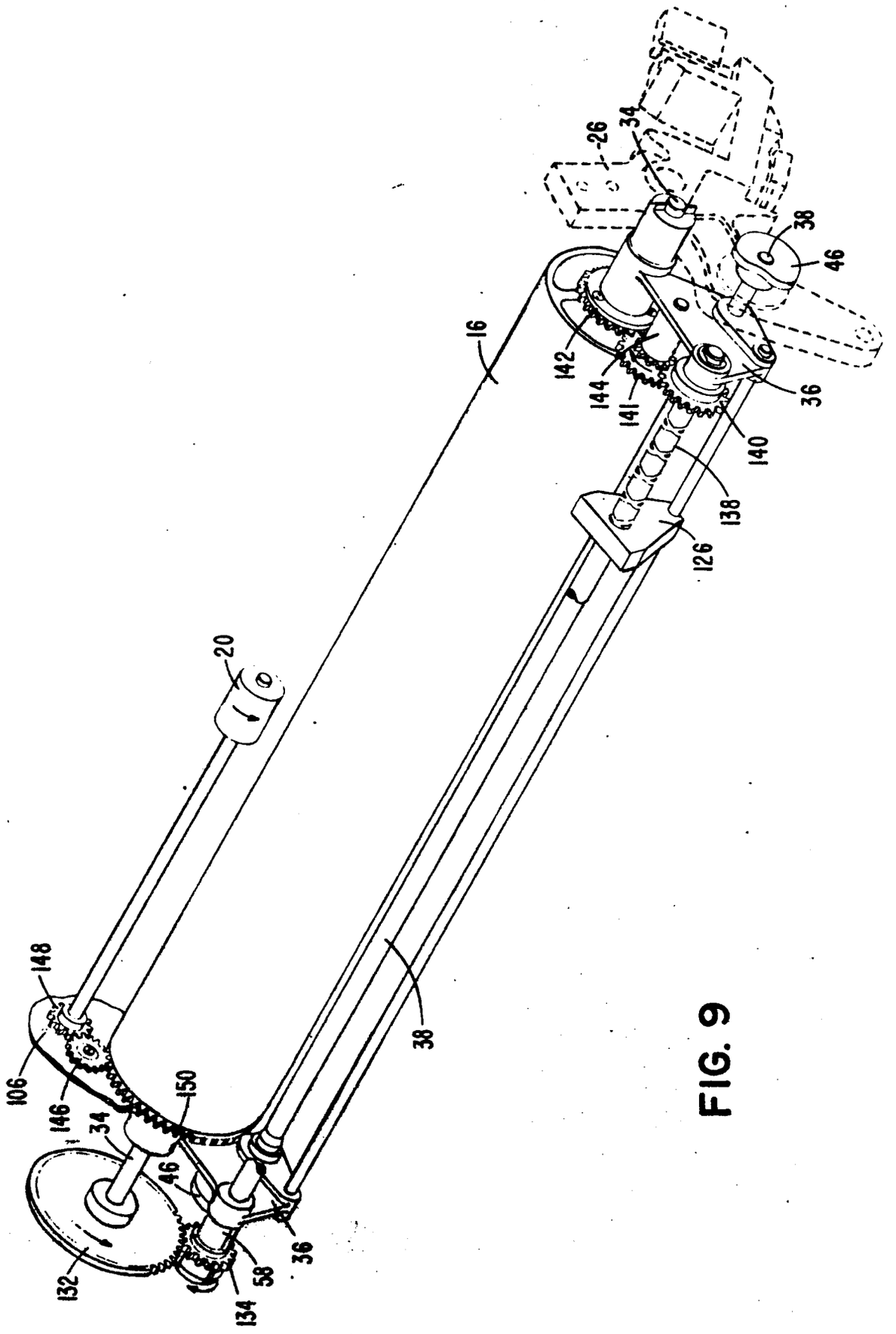
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FIG. 9

FIG. 10

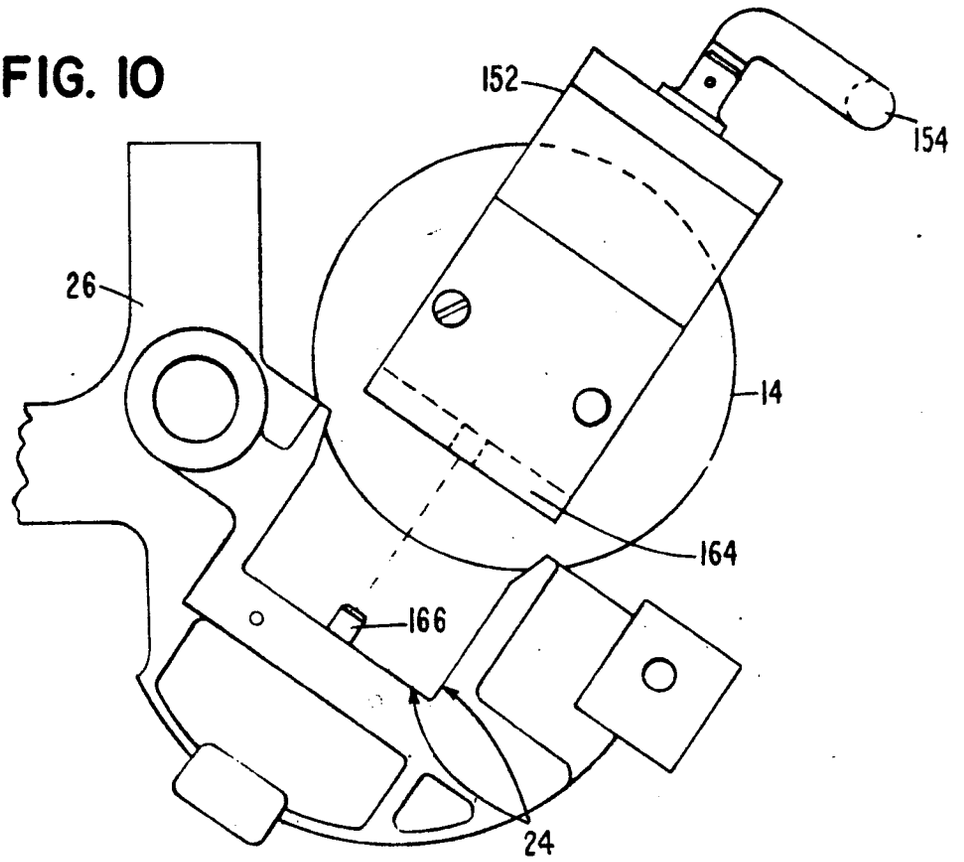
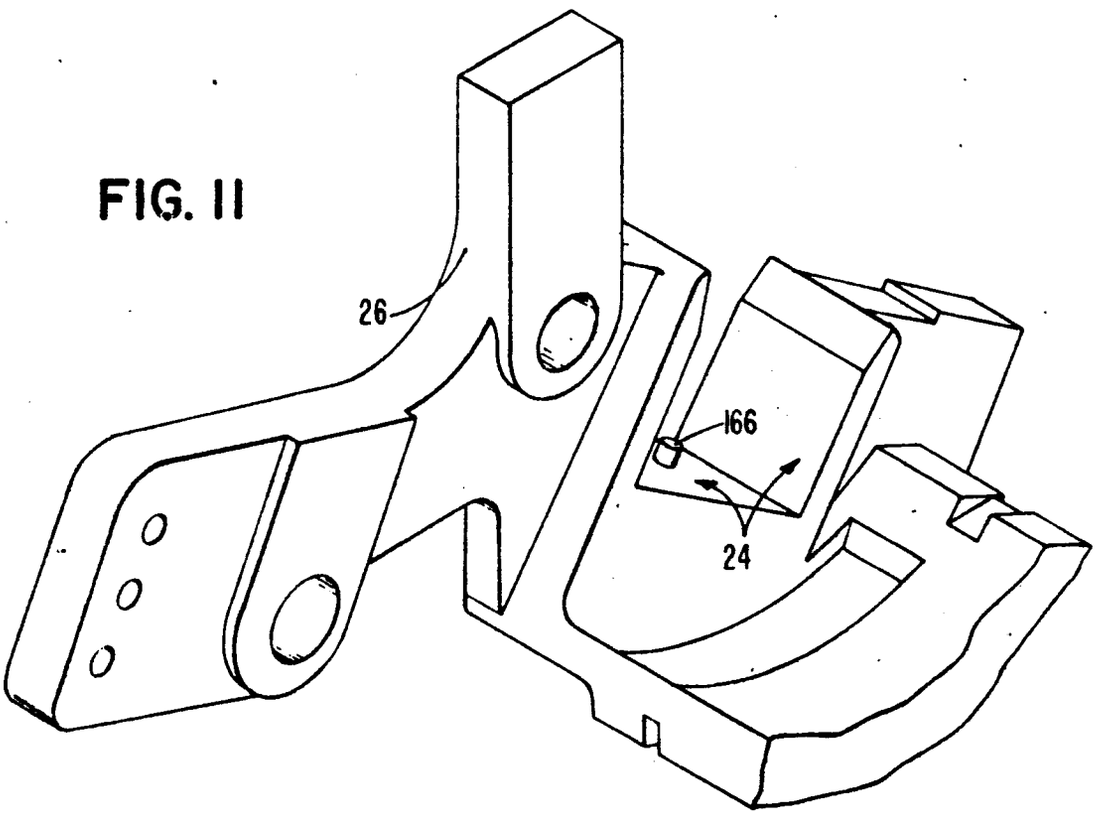


FIG. 11



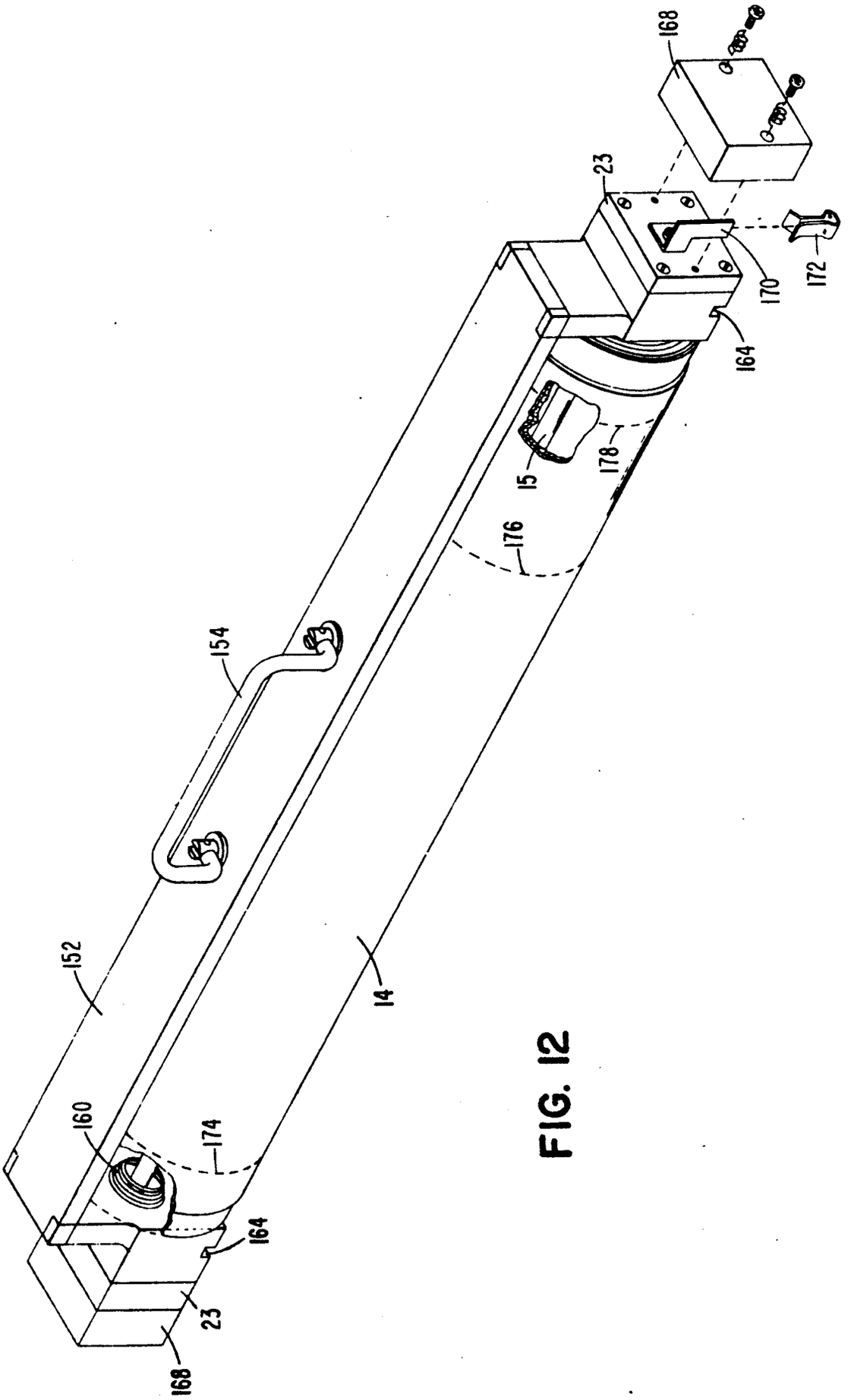


FIG. 12

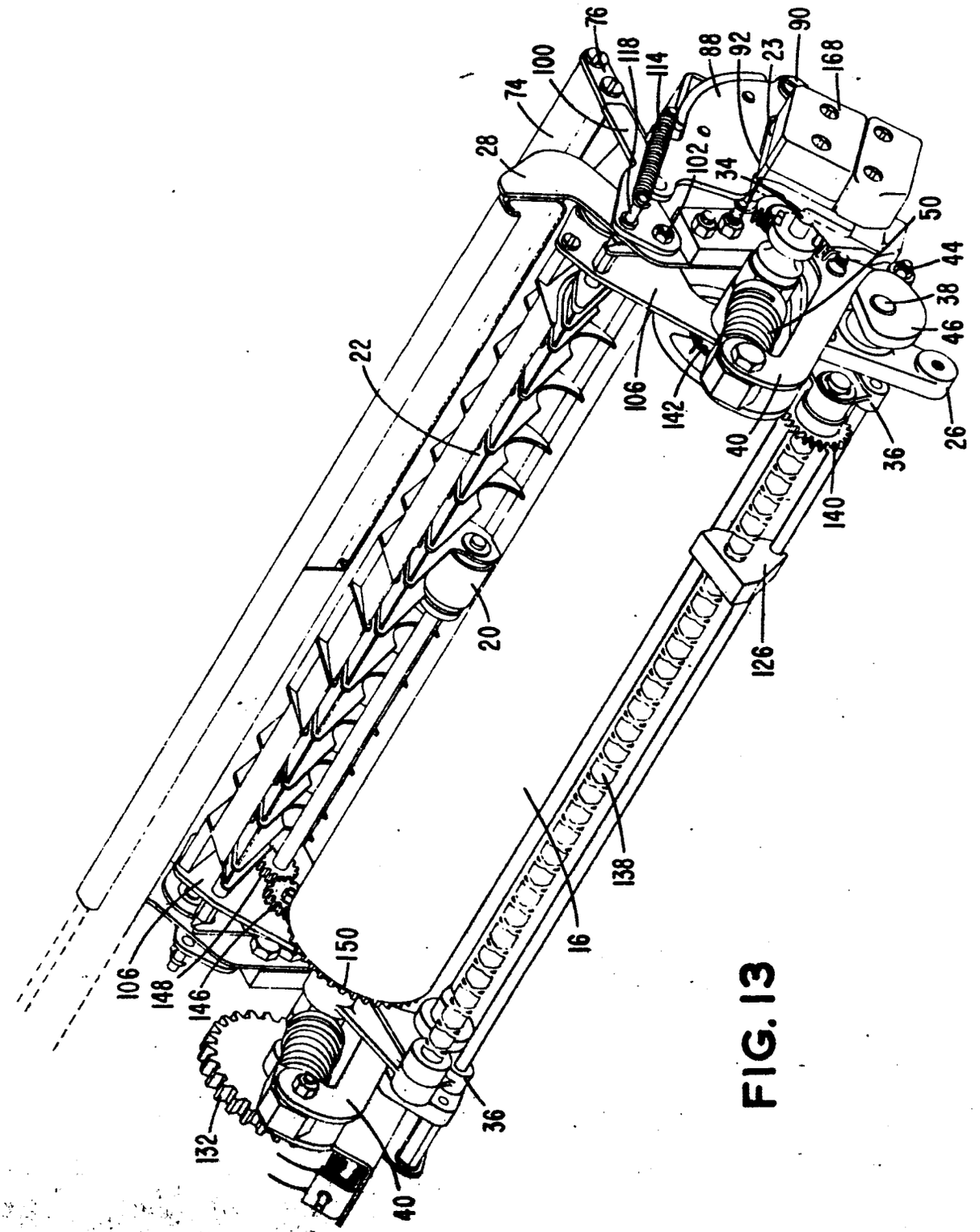

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FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

0000631

Application number

EP 78 300 138.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
-	DE - A - 2 626 088 (RICOH) * claims 1, 4; page 2 paragraph 1 *	1
-	DE - A - 2 440 154 (XEROX) * claims 1, 10; page 2, paragraph 3 *	1
A	DE - B - 2 359 187 (INTERNATIONAL BUSINESS MACHINES) * claim 9; fig. 3 *	
A	US - A - 3 973 844 (XEROX) * fig. 2; col. 6, lines 19-49 *	
A	US - A - 3 324 791 (XEROX) * fig. 2, 4; col. 10, lines 50-64 *	

CLASSIFICATION OF THE APPLICATION (Int. Cl.)

G 03 G 15/20

TECHNICAL FIELDS SEARCHED (Int.Cl.²)

G 03 G 15/20
G 03 G 13/20
G 03 G 15/00
G 03 G 21/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	20-10-1978	HOPPE