

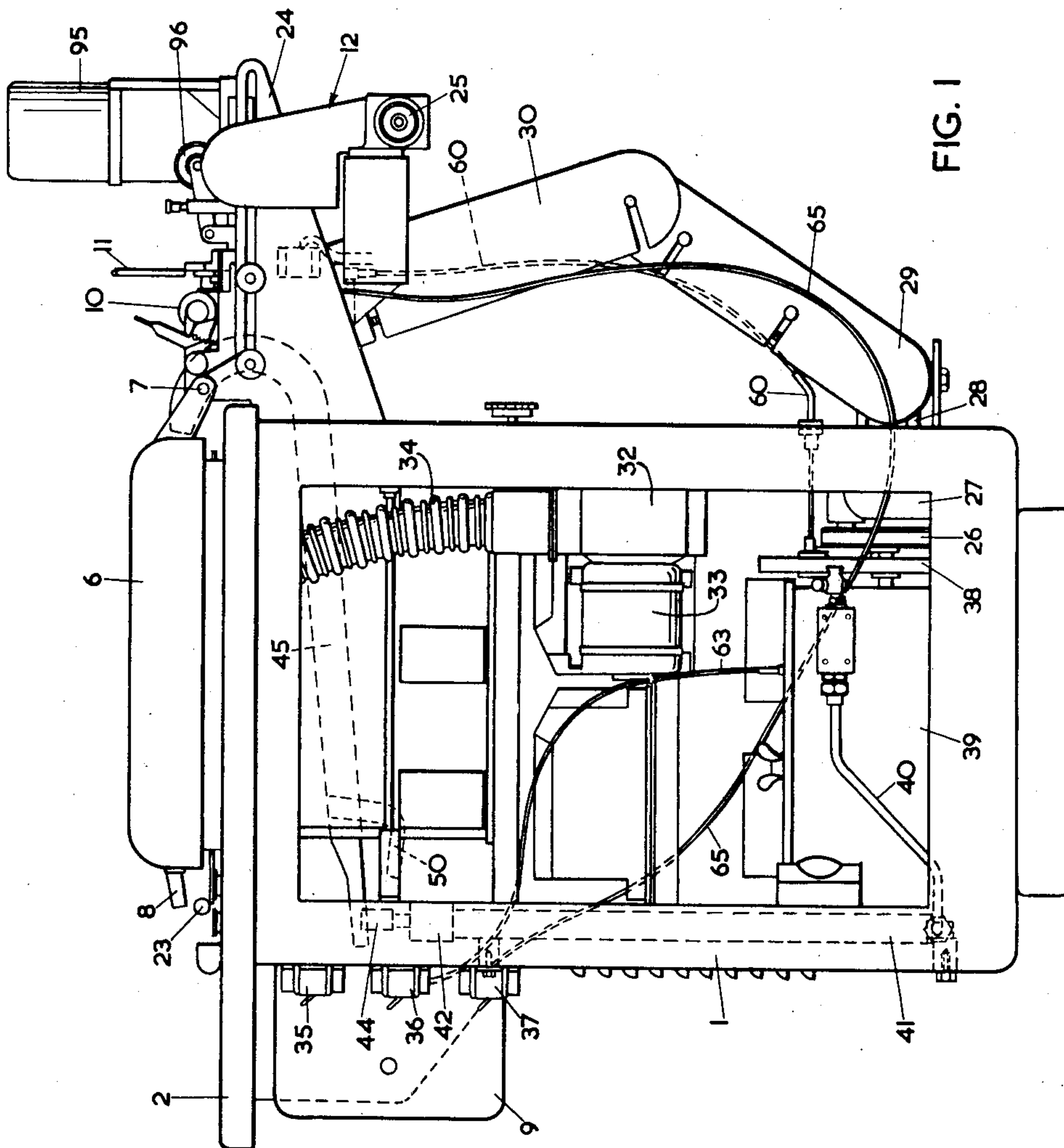
Sept. 20, 1960

T. E. F. SANDERSON ET AL  
PHOTOGRAPHIC PRINTING APPARATUS

2,953,077

Filed June 18, 1958

6 Sheets-Sheet 1



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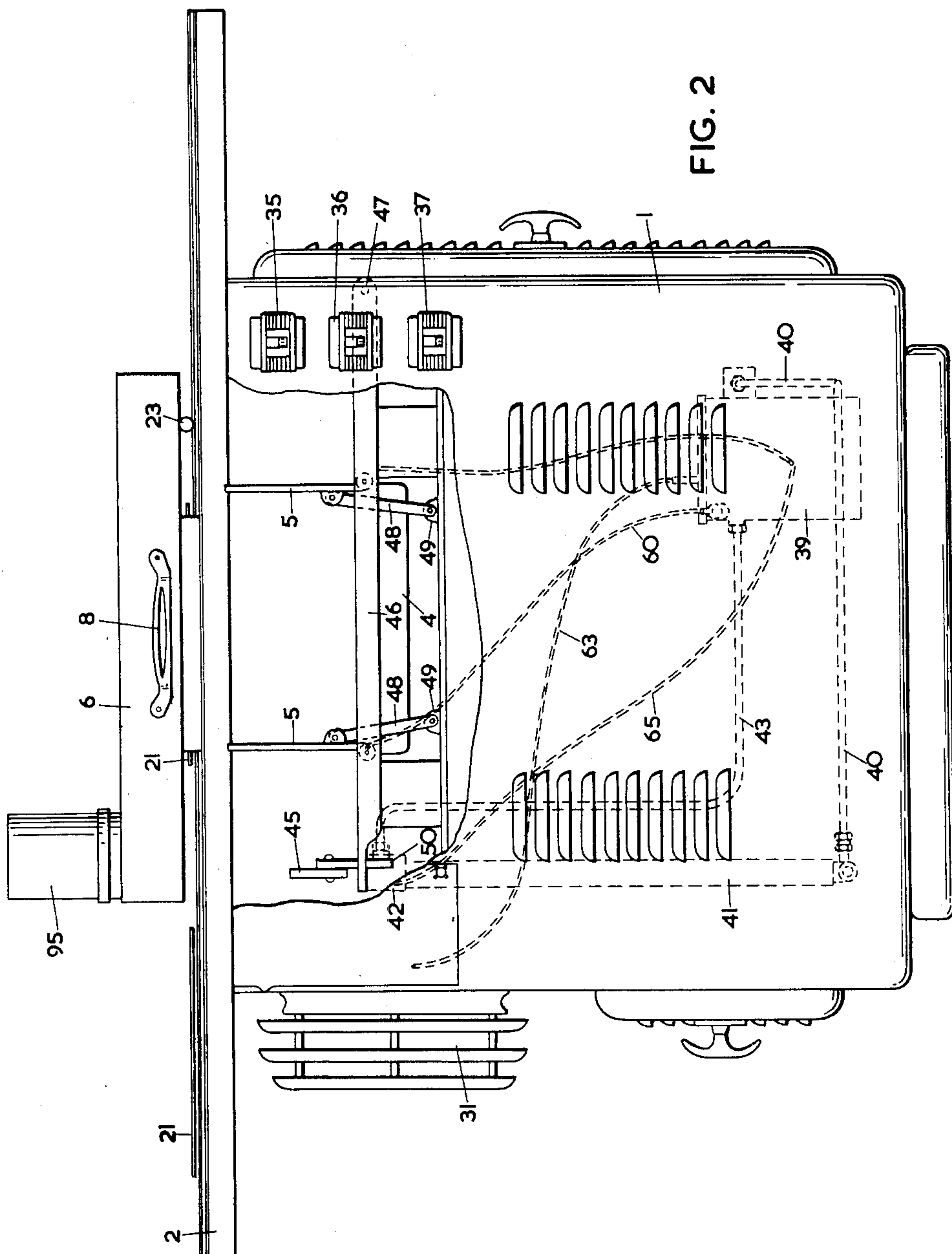
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PHOTOGRAPHIC PRINTING APPARATUS

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6 Sheets-Sheet 2



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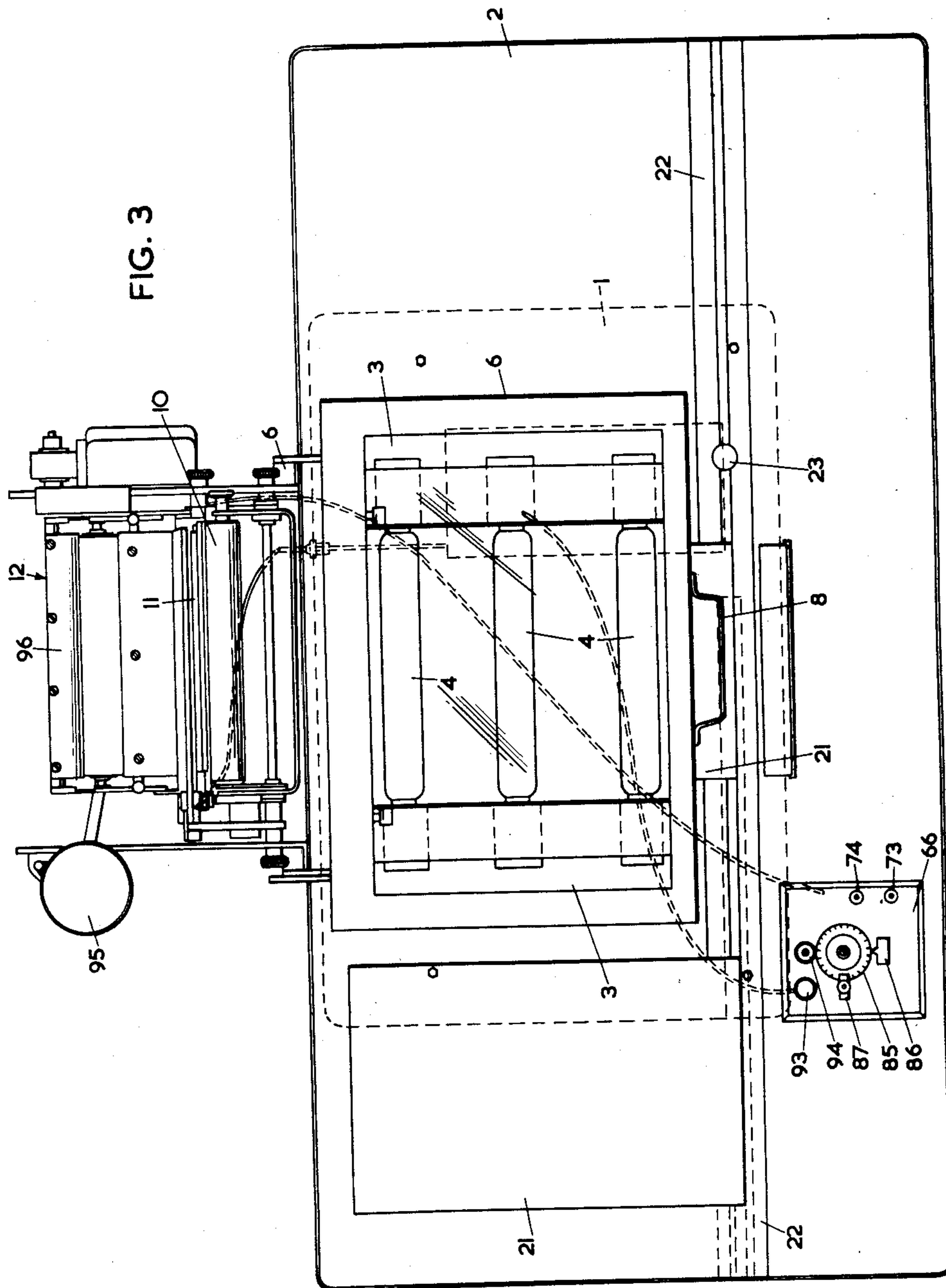
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6 Sheets-Sheet 3



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6 Sheets-Sheet 4

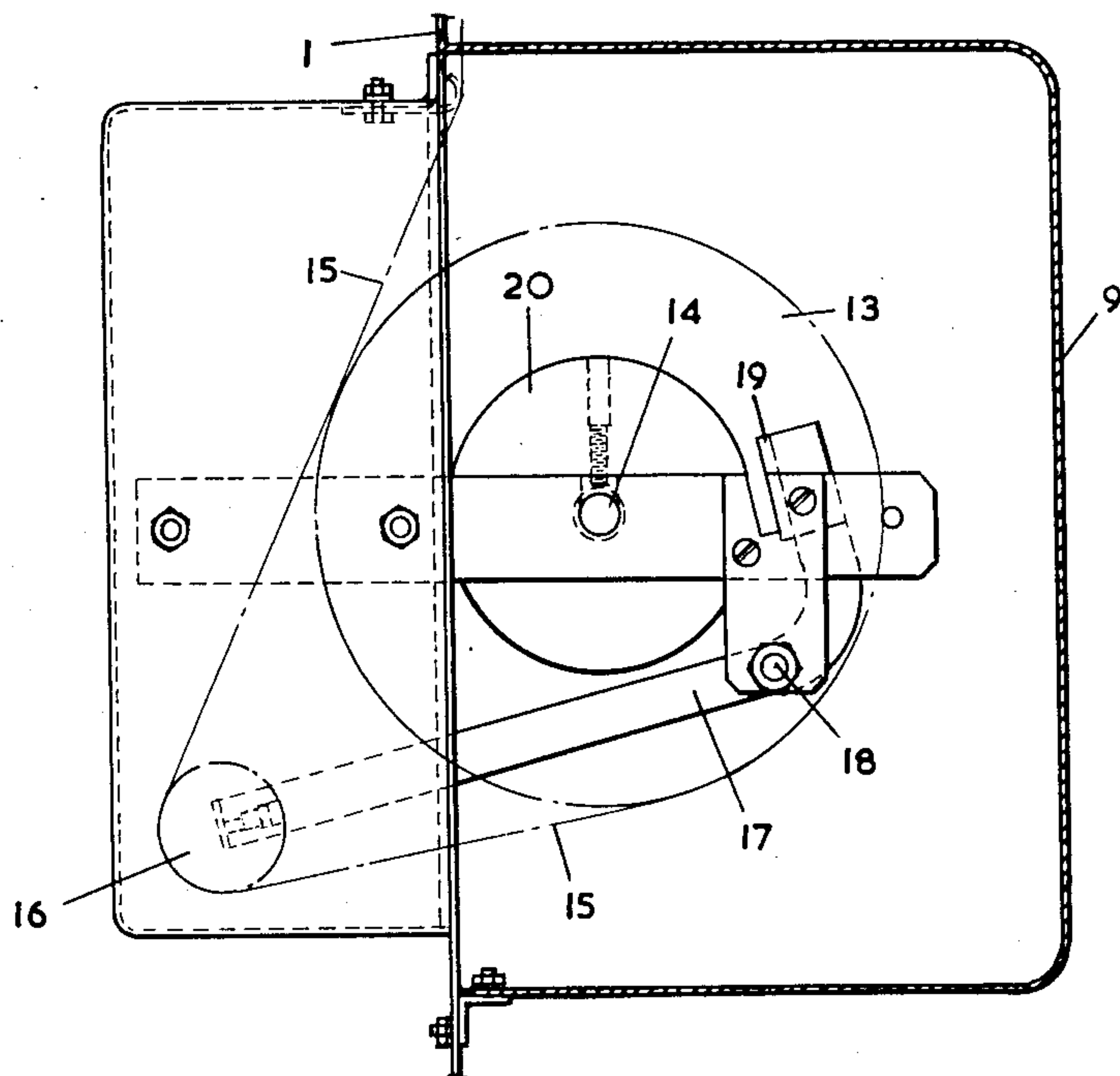


FIG.4

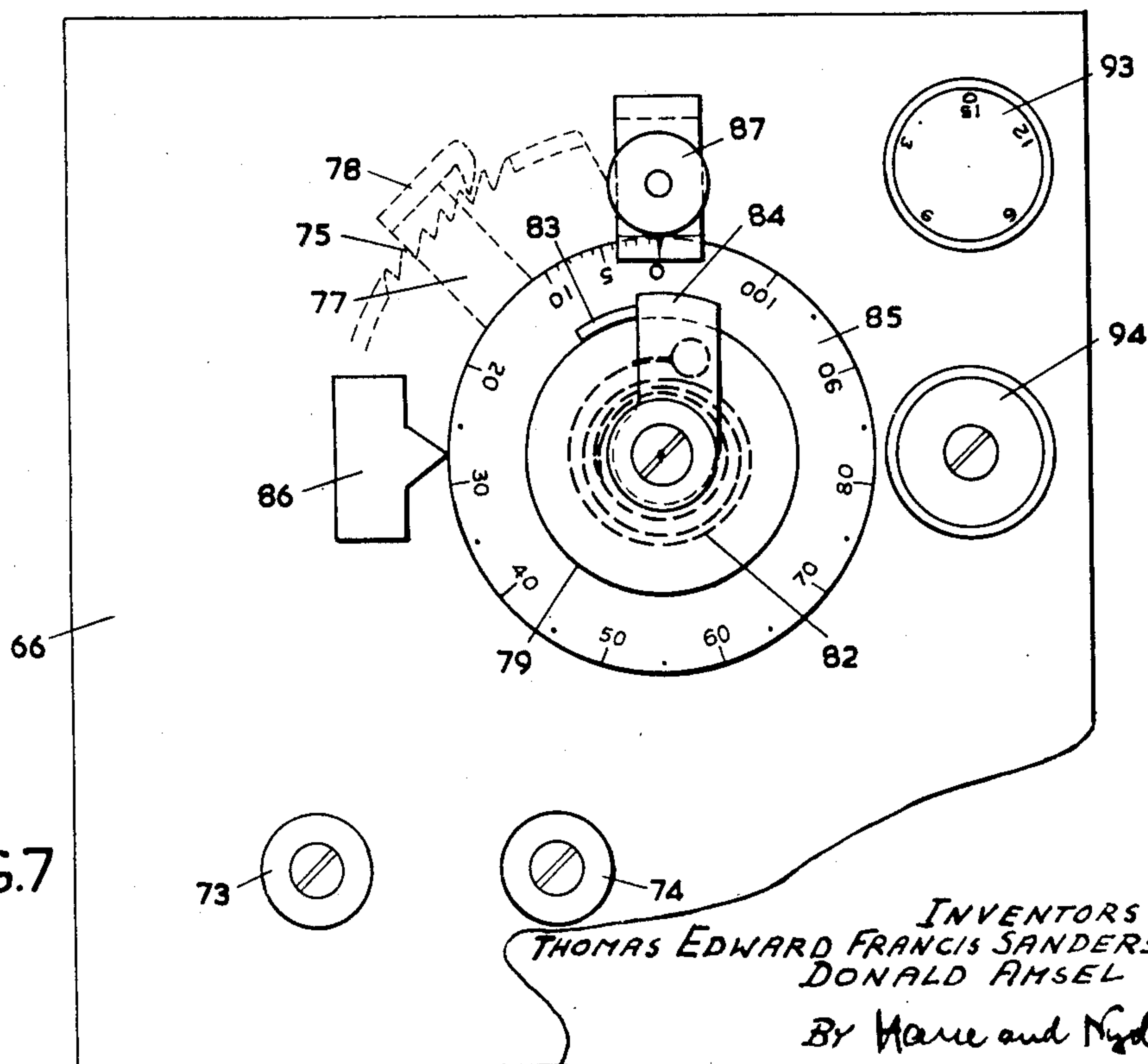


FIG.7

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PHOTOGRAPHIC PRINTING APPARATUS

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6 Sheets-Sheet 5

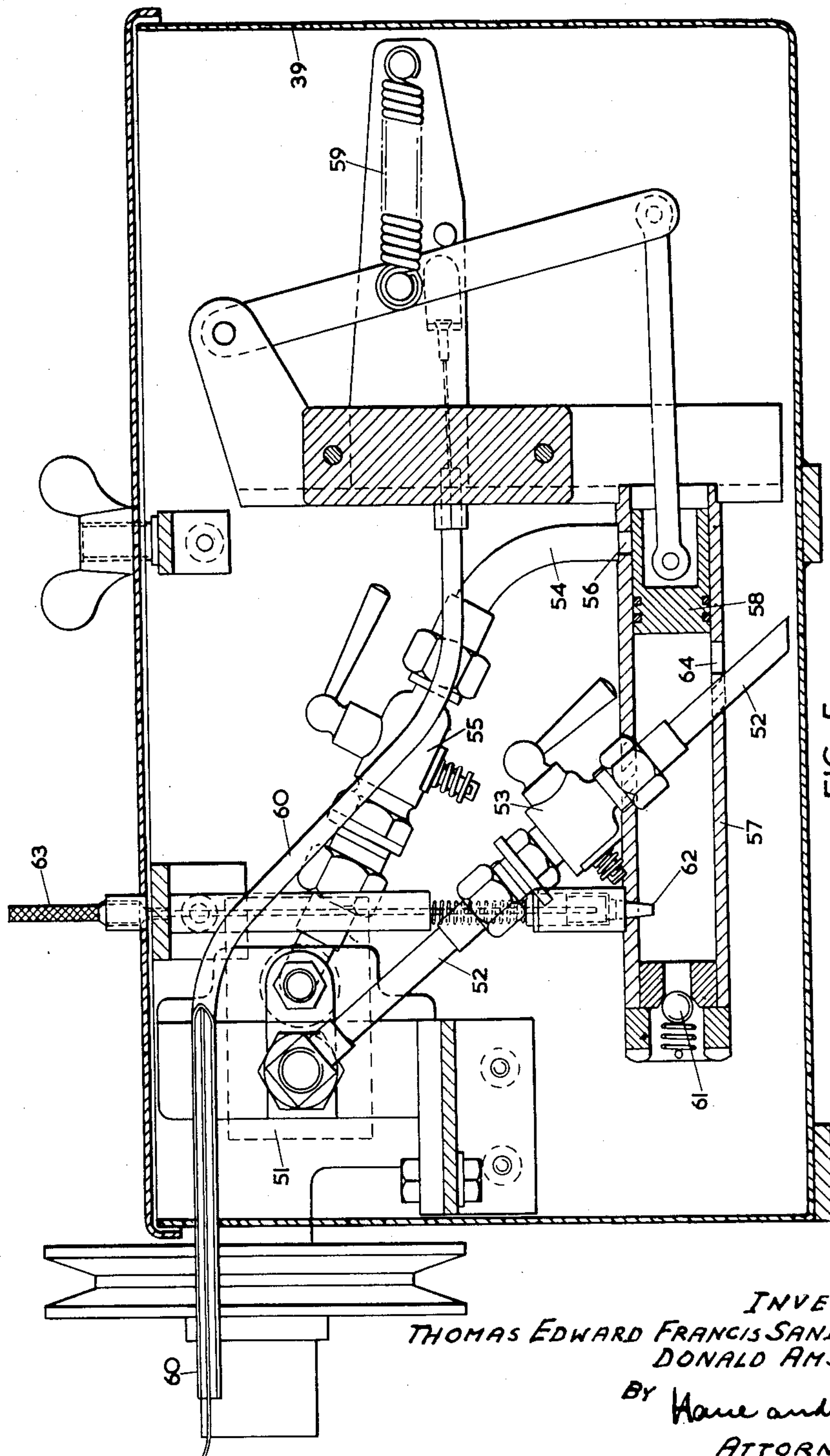


FIG. 5

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6 Sheets-Sheet 6

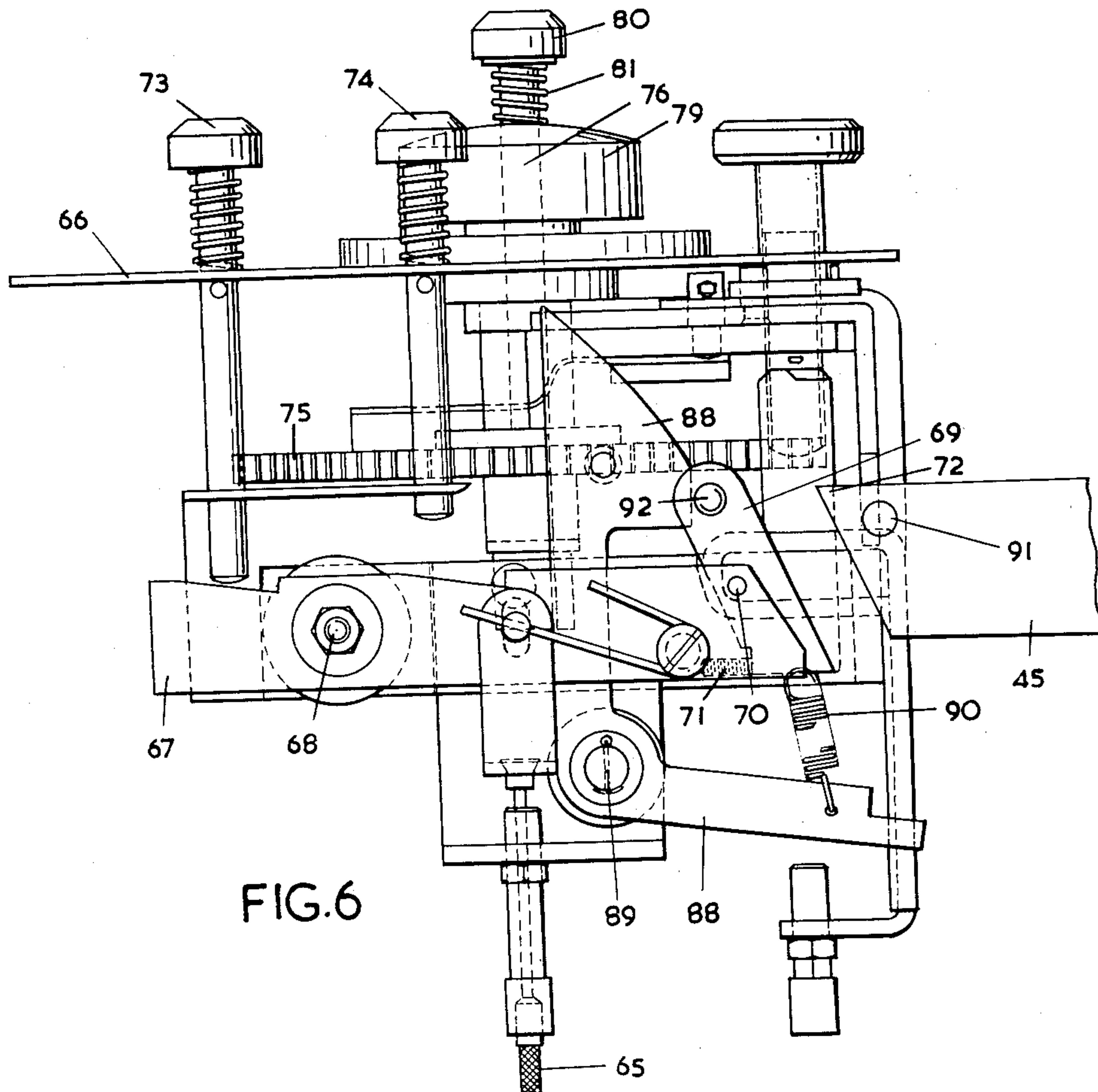


FIG. 6

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2,953,077

## PHOTOGRAPHIC PRINTING APPARATUS

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7 Claims. (Cl. 95—75)

This invention relates to automatically operating photographic printing apparatus. Apparatus in accordance with the invention includes means for effecting the step by step feed of a continuous web of photo-sensitive sheet material past a printing position at which a negative, or other master to be copied, is positioned and the apparatus operates automatically and successively to clamp the length of web at the printing position against the master, to expose it to light for a preselected length of time, to release the clamped web, to advance it through a predetermined distance to bring a fresh length of the web to the printing position, and to sever a previously exposed length from the web.

In the preferred form of the invention, the apparatus automatically repeats this cycle of operations any preselected number of times (up to, say, 100) and then ceases to operate until restarted manually. Preferably also the apparatus includes means for developing the exposed sheets as they are delivered by the printer, so that the complete apparatus constitutes a fully automatic print making machine.

The accompanying drawings show by way of example one form of apparatus constructed in accordance with the invention. In these drawings Figure 1 is a side view of the apparatus with an inspection door removed; Figure 2 is a front view of the apparatus with parts omitted and broken away to show internal features; Figure 3 is a plan view of the apparatus; Figure 4 is sectional view on a larger scale of means included in the apparatus for controlling the feed of the web of photo-sensitive material; Figure 5 is a sectional view also on a larger scale of an hydraulic unit included in the apparatus for controlling the duration of the printing exposure; and Figures 6 and 7 are respectively a side view and a plan again on a larger scale of a control panel and associated parts.

The apparatus illustrated comprises a rectangular cabinet 1, having a flat table top 2, the central portion of which is formed by a plane sheet of glass 3. The upper part of the cabinet contains three tubular electric lamps 4 of the fluorescent type, which constitute the source of printing light. A shutter 5 formed by a pair of hinged flaps (shown in the open position) is interposed between the light source and the glass top of the cabinet. A cover, or head 6, having its underside formed by a yielding cushion, of pneumatic or other suitable construction, is attached at its rear edge to the cabinet by a hinged connection 7. Closure of the head 6 operates (in a manner described below) to open the shutter 5 and initiate the exposure, while a small upward movement of the head closes the shutter and terminates the exposure. A handle 8 on the front edge of the head allows the latter to be fully raised when desired and a stay (not shown) is provided for holding it in this position.

A reel of photographic paper, or other stock to be printed on, is supported in a casing 9 at the front of the cabinet 1, the free end of the web (which is not shown in Figures 1 to 3) passing rearwardly (sensitised face down) across the transparent top of the cabinet to a pair

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of feed rolls 10 for effecting the step by step movement of the web and thence to a guillotine 11 for severing exposed sections from the web and a developer unit 12. Referring to Figure 4, a hollow roll 13 of photo-sensitive paper to be printed on is held between a pair of coned end members, fast on a rotatably supported spindle 14. The web of paper 15 drawn from this roll passes round a guide 16, carried on a U-shaped frame 17, which is pivotally supported at 18. One arm of frame 17 carries a brake pad 19 adapted to engage a disc 20, fast on spindle 14. Each time that the web 15 is pulled by the feed rollers 10, the frame 17 is raised about its pivot, releasing the brake and shortening the path of the web sufficiently to prevent a sudden pull upon the roll 13. When the feed rollers 10 stop, the frame 17 drops back to the position shown, taking up the length of web delivered by continued rotation of roll 13 and applying the brake to halt such rotation.

The negative, or other master to be printed from, is supported on the flat transparent top 3 of the cabinet, beneath the web of printing stock. A master sheet to be printed from is laid between a pair of transparent flexible sheets 21, which are bound together along their front edges but are otherwise unconnected. The upper sheet 25 may be made slightly longer and narrower than the lower sheet to facilitate their separation. A bar longitudinally slidable in guides 22, extending transversely across the front part of the cabinet top 2 carries an operating handle 23 and two sets of projections, each adapted to engage in apertures provided in the binding strips of the master carriers 21. One set of these projections is always exposed on one side or the other of the web of printing stock. A carrier with a master in position is engaged over the exposed set of projections and the bar is then shifted laterally to position the master beneath the web, at the same time moving the master which was previously in printing position clear of the web, ready for unloading.

The feed rolls 10, guillotine 11 and developer unit 12 are moveably supported on guides 24 extending rearwardly from the cabinet, so that the distance of the guillotine from the rear edge of the length of stock in the printing position can be adjusted to be equal to the length of the steps by which the web is advanced. The feed rolls and guillotine are driven through clutches (whose operation is described below) by a main electric motor (not shown), housed in the lower part of the cabinet 1. The developer unit is driven by a separate electric motor 25. The drive to the feed rolls and guillotine is through belt 26, gearing 27, belt 28 and a tandem pair of chains housed in casings 29, 30. The chain sprockets are supported by articulated links, so that the drive is not affected by alterations in the positions of the feed rolls and guillotine relative to the cabinet. In the apparatus described, alteration of the length of the steps by which the web is advanced is effected by replacing the feed rolls (which make two complete revolutions in each cycle of operation) by rolls of different diameter, but such alteration could be effected by providing suitable change speed gear in the drive to the rolls.

The cabinet 1 also accommodates the electrical equipment required for starting up and operating the lamps 4, an exhaustor fan which, driven by its own electric motor, discharges warm air from the cabinet through an outlet 31, and a blower 32 driven by an electric motor 33 which delivers a stream of cooling air through a hose 34 across the underside of the glass sheet 3. Electric switches 35, 36, 37 mounted on the cabinet control respectively the lamps 4, the main drive motor and the developer motor 25, and the motors driving the fan and blower.

The main electric motor, which runs continuously while the apparatus is in operation and drives the feed



rolls and guillotine, also drives through belt 38 an hydraulic pump mounted within an oil reservoir 39, which delivers oil through a pipe 40 to a vertically disposed ram cylinder 41. The upper end of the ram cylinder is surrounded by a cup 42, any oil which may overflow collecting in this cup and draining back through a pipe 43 to the reservoir 39. The vertically moving member 44 of the ram is adapted to engaged an operating arm 45 secured to the head 6 and to raise the latter sufficiently to allow free movement of the web of printing stock and (when necessary) of the master holders 21, the head being held raised so long as hydraulic pressure is maintained in the ram cylinder.

Movement of the operating arm 45 also serves to close and open the shutter flaps 5. These flaps are pivotally supported about their lower edges between the side bars 46 of a rocking frame, which is itself pivotally supported at 47. Lugs on the inner faces of the flaps are coupled by links 48 to fixed anchorages 49. An extension of one of the bars 46 is engaged by a hook-like member 50 secured to the operating arm 45. It will be appreciated that a small upward movement of the operating arm will raise the rocking frame about its pivot sufficiently to swing the shutter flaps 5 inwardly and downwardly into substantially horizontal positions, where they overlap and form an effective screen between the lamps 4 and the glass plate 3. Return downward movement of the operating arm allows the rocking frame to drop, opening the flaps to the position shown.

Referring now to Figure 5, the oil pump 51 within the reservoir 39 draws oil from the bottom of the reservoir through a pipe 52 fitted with a control cock 53 and delivers it (as stated above) to the ram cylinders. The delivery pipe has a branch 54, fitted with a control cock 55, which communicates with a relief port 56 in the wall of a timing cylinder 57, immersed in the oil in reservoir 39. A piston 58 working in this cylinder is urged by a spring 59 towards the outer end of its stroke (as shown), where it closes the relief port, so that pressure in the ram cylinder is maintained and the head is held raised. When the guillotine operates a pull is given to the tension member of a Bowden cable 60 and this acts to move the piston 58 to the inner end of its stroke, the oil in the timing cylinder escaping through a non-return valve 61 at the inner end of the cylinder. The relief port 56 is thereby opened, releasing the pressure in the ram cylinder, so that the head is allowed to closed down onto the top of the cabinet, clamping the length of the paper web which is in printing position against the master. As explained above, this movement of the head opens the shutter and starts the printing exposure. Oil then flows from the reservoir into the timing cylinder through a passage controlled by a needle valve 62, which can be adjusted by means of a Bowden cable 63 to alter the period of exposure. The piston 58 accordingly moves gradually back under the influence of its spring 59, at a rate determined by the setting of the needle valve 62, until it begins to uncover a port 64 in the cylinder wall which permits free entry of oil. The piston then rapidly completes its movement, closing the relief port 56 and allowing the pump to restore the pressure in the ram cylinder and thus raise the head, thereby closing the shutter and terminating the exposure. By adjusting the setting of control cock 53 the speed at which the head is raised can be altered and alteration of the speed at which the head closes can be effected by adjustment of cock 55.

A cycle of operation of the apparatus is initiated by a pull upon the tension member of a third Bowden cable 65, the head 6 being in its raised position. This causes the engagement of a one revolution clutch included in the final drive to the feed rollers. A 1 to 2 step up gear is included between the clutch and the feed rollers, so that these rollers make two complete revolutions and advance the web of photographic material to bring a fresh length into printing position and to move the length exposed

during a previous cycle of operation past the blades of the guillotine. Shortly before completing its movement, the feed roller drive shaft operates to engage a second one revolution clutch, included in the final drive to the guillotine. The guillotine accordingly operates to sever an exposed length of stock from the web and a pull is given to Bowden cable 60. As explained above, this moves the timing piston 58 to the inner end of its cylinder, allowing the head 6 to move down and clamp the paper and opening the shutter 5 to start the exposure. After an interval determined by the setting of valve 62, the head is raised and the shutter closed, thus completing the cycle.

Automatic repetition of the printing cycle and the automatic stopping of the apparatus after a preselected number of cycles have been performed are effected by the mechanism shown in Figures 6 and 7. Mounted beneath a control panel 66 (shown also in Figure 3) is a lever 67, pivotally supported at 68, to which is attached the tension member of Bowden cable 65. A pawl 69, pivoted at 70 to lever 67, is urged by a compression spring 71 into the position shown, where its nose lies in the path of the nose 72 of the head operating arm 45. When the arm descends, pawl 69 is temporarily swung aside, but on return upward movement of arm 45, the pawl is lifted bodily, tilting lever 67 about its pivot 68 and giving a pull to the cable 65, which causes engagement of the feed roller clutch to start another cycle. Lever 67 can also be tilted to pull on cable 65 by depressing manually a spring loaded button 73, this button being used to initiate the first cycle of a series and set the apparatus in operation. Operation of the apparatus can be interrupted manually by depressing a second spring loaded button 74 which tilts lever 67 sufficiently far in the reverse direction to carry the nose of pawl 69 clear of the path of the nose 72 of the operating arm.

The mechanism for automatically stopping the apparatus after a given number of cycles have been performed includes a peripherally toothed disc 75 disposed horizontally below control panel 66 and above the level of lever 67 and rotatably supported. A vertical shaft 76 passing freely through the centre of disc 75 carries at its lower end an arm 77, at the outer end of which is an upstanding projection 78 formed with an inwardly facing tooth which engages between two of the teeth of disc 75. Shaft 76 passes slideably through a drum 79, to which it is keyed, and has an operating knob 80 at its upper end. A compression spring 81 urges the shaft into the raised position shown and a clockspring 82 housed within drum 79 urges the shaft in a clockwise direction. While the shaft is raised, the engagement of projection 78 with the toothed disc 75 ensures that projection 78 (together with arm 77, shaft 76, drum 79 and knob 80) will not move relative to the toothed disc 75. When knob 80 is depressed manually, spring 82 rotates the shaft 76 and its associated parts until (as shown) a projection 83 on the drum engages a stop 84 carried by a graduated dial 85, which rotatably surrounds the shaft above the control panel 66 and below the drum 79. The dial 85 carries markings (indicating the number of cycles to be performed) which co-operate with a fixed index 86 on the control panel, and it can be secured in any desired position of adjustment by a clamping screw 87. It will be appreciated that the position of adjustment of the dial 85 determines the position to which the projection 78 will be moved by spring 82 when knob 80 is depressed.

Rotation of the toothed disc 75 is effected by a pawl (not shown) carried on the inner face of the vertical arm of a bell crank lever 88, which is pivotally supported at 89. Lever 88 is urged into the position shown by a tension spring 90, but is rocked (clockwise in Figure 6) when the head operating arm 45 descends by the engagement of a pin 91 on the operating arm with the horizontal arm of lever 88. Such movement of lever 88 causes the pawl which it carries to rotate the disc 75 through one tooth



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space. When the operating arm 45 rises, the lever 88 returns to the position shown and its pawl rides over the next tooth of the disc 75, a ratchet pawl or brake (not shown) preventing reverse rotation of disc 75. When the preset number of cycles have been performed, the projection 78 is brought into a position where it prevents the return movement of lever 88, so that a nose on the vertical arm of this lever engaging a pin 92 on pawl 69 holds the pawl clear of the path of arm 45. Arm 45 accordingly rises without giving a pull to cable 65 and operation is interrupted. (It will be understood that every clockwise rocking movement of lever 88 moves pawl 69 clear of the path of nose 72, but that during normal operation the parts 88 and 69 return to the positions shown before arm 45 reaches the position in which it operates cable 65.) The apparatus can be restarted to perform automatically the same number of cycles as before by first depressing knob 80 to reset member 78 to its original position and then depressing knob 73 to give the initial pull on cable 65.

The control panel 66 also carries an adjusting screw 93, which operates through Bowden cable 63 to adjust the setting of needle valve 62 controlling the exposure period, and a knob 94 which operates to project a stop (not shown) into the path of operating arm 45 and prevent its descent. This stop is employed when it is desired to feed out the exposed length of paper at the printing position without making further exposures, for example when the reel of paper is exhausted. When the stop is projected and the start button 73 is depressed, the feed rolls and guillotine operate in the normal manner and the ram rod 44 is lowered and raised, but the head 6 remains in raised position and the shutter 5 is not opened. The automatic repeat mechanism is not operated, but further feed and cutting movements can be obtained by again depressing start button 73.

The developing apparatus 12 is disposed a short distance to the rear of the guillotine and in the form illustrated comprises a single pair of rollers, which are driven continuously at a peripheral speed less than that of the intermittently operating feed rollers of the printer and are positioned to receive the leading edge of the web fed between the blades of the guillotine. The lower roller of the pair (not visible in the drawings) dips into a bath of developing liquid, which is automatically replenished from a reservoir 95, and thus wets the lower sensitised face of the web. The upper roller 96 is of sponge rubber, or other absorbent material, and during the intervals between the passage of successive exposed sheets it is wetted with the developing liquid by transfer from the lower roller. During the passage of a sheet, its upper surface is wetted by the liquid retained in the upper roller, thus ensuring thorough wetting of the sheet with the developing liquid. If desired, a second pair of rollers may be provided to squeeze out from the sheet excess developing liquid, which is allowed to drain back into the bath. Owing to the higher peripheral speed of the feed rollers of the printer, a hump or loop develops in the web during the latter part of each operation of the feed rollers, this hump being located between the developer rollers and the guillotine blades 11, which latter are disposed immediately to the rear of the feed rollers 10. When the feed rollers stop and during the operation of the guillotine to sever a sheet from the web, the continuously running developer rollers draw the web from the loop.

It will be understood that the invention is not limited to the particular form of apparatus described above, which may be modified in many ways, the following being examples only of the modifications possible. The action of moving a master into the printing position may serve to start up the apparatus. The fluorescent lamps may be replaced by any suitable source of light and in appropriate cases the shutter may be dispensed with, the lamps being switched on and off to start and terminate the exposure.

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The light source may be made vertically adjustable, so that when prints of small size are being made it can be raised to increase the printing speed, while when large prints are being made it can be lowered sufficiently to ensure even illumination over the required area. Instead of, or in addition to, illuminating the printing material from below, a light source may be arranged in the moveable head, whose undersurface is then formed by a plane sheet of glass. When two light sources are provided, they may be used either simultaneously or alternatively, as required for the printing operation to be performed. Masters may be positioned above, or both above and below, the printing stock. If the nature of the photo-sensitive material used so requires, the apparatus may be arranged to treat the exposed sheets with two or more processing agents in succession.

We claim:

1. Automatically operating photographic printing apparatus for printing on sheet material, said apparatus comprising, in combination, a printing station including a horizontal transparent table for placing thereon a master to be printed, transport means for effecting step by step feed of a web of photo-sensitive sheet material to be printed upon, said transport means including support means for a roll of said web disposed on one side of said table, a pair of intermittently driven feed rolls disposed on the other side of said table, said feed rolls receiving the web from the roll and drawing it step by step across the surface of said table, a head disposed above said table movable perpendicularly relative thereto, a hydraulic ram connected to said head, a continuously running pump supplying the ram, fluid pressure in the ram holding the head raised, a valve which can be opened to relieve the pressure in the ram and thereby allow the head to drop to clamp the master and a length of web upon the table against the table surface, timing means for automatically reclosing the relief valve a predetermined time after it has been opened, whereby to re-establish pressure in the ram to raise the head and release the master and the respective web length, a source of light disposed beneath the table, means to expose the web length on the table to light from said source when the head is lowered and to end such exposure when the head is raised, cutter means for severing the exposed web length after the same has been drawn off the table surface and control means controlling the actuation of said transport means, head, light source and cutter means in a sequential cycle and re-starting the actuation upon completion of a cycle.

2. Apparatus in accordance with claim 1 in which the timing means comprise an hydraulic cylinder having in its wall a port for relieving the pressure applied to the ram, a non-return valve communicating with said port, a piston working in the cylinder and biased to the outer end of its stroke, where it closes the relief port, but moveable to uncover the port and expel liquid from the cylinder through the non-return valve, the cylinder having an inlet which allows liquid to refill the cylinder at a controlled rate thereby allowing the return of the piston to reclose the relief port.

3. Automatically operating photographic printing apparatus for printing on sheet material, said apparatus comprising, in combination, a printing station including a horizontal transparent table for placing thereon a master to be printed, transport means for effecting step by step feed of a web of photosensitive sheet material to be printed upon, said transport means including support means for a roll of said web disposed on one side of said table, a pair of intermittently driven feed rolls disposed on the other side of said table, said feed rolls receiving the web from the roll and drawing it step by step across the surface of said table, a head disposed above said table movable perpendicularly relative thereto, means for lowering and raising said head at timed intervals to clamp the master and a length of web upon the table against the table surface and to release the master and the respec-



tive web length, a source of light disposed beneath the table, means to expose the web length on the table to light from said source when the head is lowered and to end such exposure when the head is raised, cutter means for severing the exposed web length after the same has been drawn off the table surface, control means controlling the actuation of said transport means, head, light source and cutter means in a sequential cycle terminating with the raising of said head, a lever rockable to start the cycle of actuation, manually operable means for rocking said lever, a pawl carried on said lever and normally lying in the path of an operating member moving with said head, so that on upward movement of the head at the termination of one cycle of operation said operating member will engage the pawl and rock the lever to start another cycle of operation, a blocking member movable to an operative position in which it holds the pawl withdrawn from the path of said operating member, and means responsive to the performance of a predetermined number of complete cycles of operation for moving said blocking member to operative position.

4. Apparatus in accordance with claim 3 in which said blocking member comprises a projection carried by a toothed disc, the disc being rotated step by step, to bring the projection into position to block movement of said pawl, by means of a second pawl operated by the rising and falling movements of the head.

5. Apparatus in accordance with claim 4, in which the blocking projection is releasably coupled to the toothed disc and is biased for rotation relative to it, so that on being uncoupled from the disc it returns to a starting position determined by a stop, which is adjustable in position to alter the number of cycles that will be performed before the projection is brought into blocking position.

6. Automatically operating photographic printing apparatus for printing on sheet material, said apparatus comprising, in combination, a printing station including a horizontal transparent table, transport means for effecting step by step feed of a web of photosensitive sheet material to be printed upon, said transport means including support means on one side of said table for a roll of said web, a pair of intermittently driven feed rolls dis-

posed on the other side of said table, said feed rolls receiving the web from the roll, and drawing it step by step across the surface of said table, a first master holder for locating on said table at a position beneath said web a master to be printed, a second master holder for locating on said table at a position clear of said web a second master to be printed subsequently to the printing of said first master, said first and second master holders being connected together and mounted for sliding movement transversely of the web, whereby movement of the second master to a position beneath said web moves said first master clear of the web, the head disposed above said table movable perpendicularly relative thereto, means for lowering and raising said head at timed intervals to clamp the master and a length of web upon the table against the table surface and to release the master and the respective web length, a source of light disposed beneath the table, means to expose the web length on the table to light from said source when the head is lowered and to end such exposure when the head is raised, cutter means for severing the exposed web length after the same has been drawn off the table surface, and control means controlling the actuation of said transport means, head, light source and cutter means in a sequential cycle and restarting the actuation upon completion of a cycle.

7. Apparatus in accordance with claim 6 in which each master holder comprises a pair of superimposed sheets of flexible transparent material secured together along one edge only, and in which a slide is movable transversely of the web, each of said holders being secured at said one edge to said slide.

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