

March 6, 1951

G. T. BAKER

2,544,440

PHOTOGRAPHIC RECORDING APPARATUS

Filed Jan. 16, 1948

5 Sheets-Sheet 1

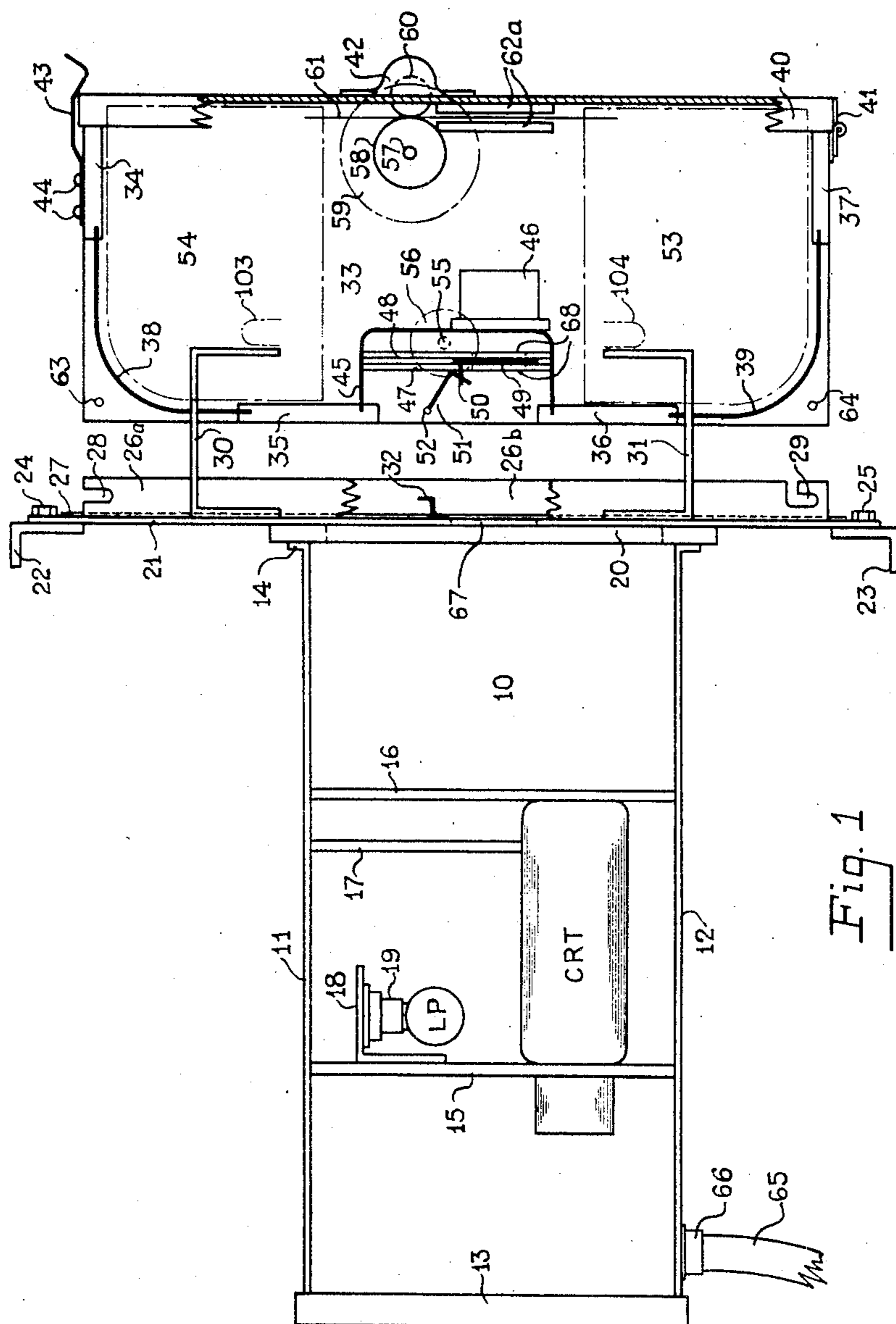


Fig. 1

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5 Sheets-Sheet 2

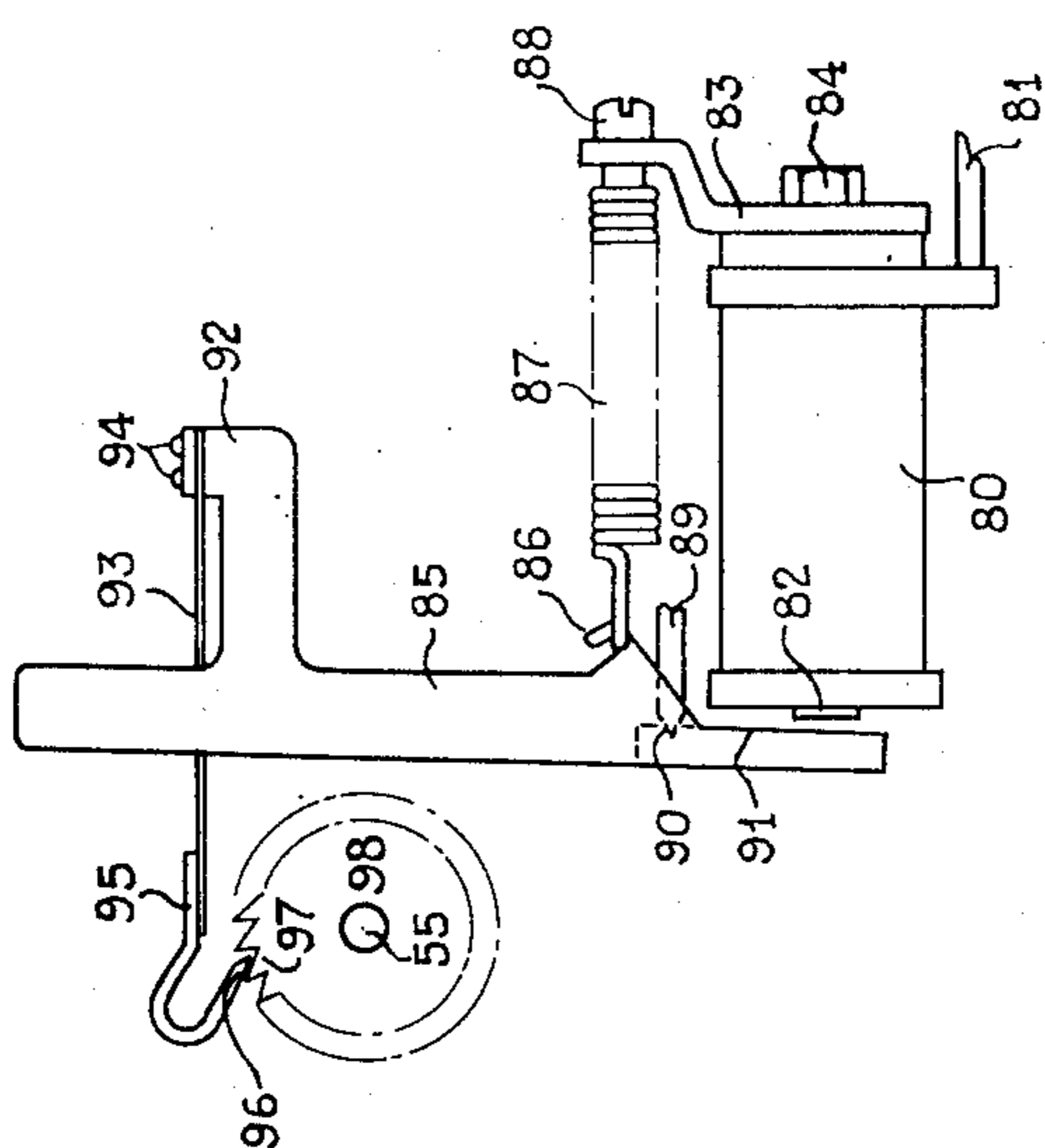


Fig. 3

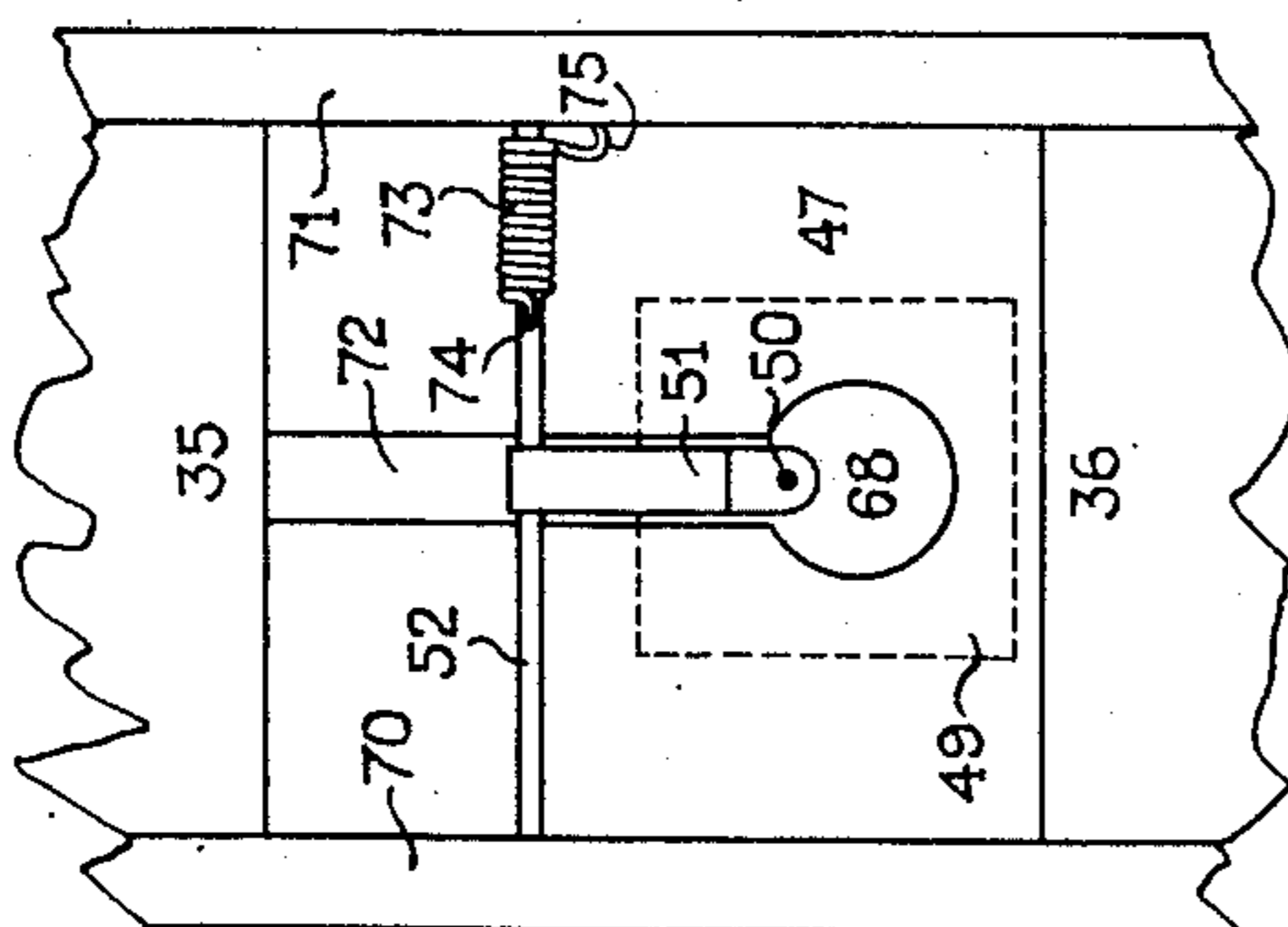


Fig. 2

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5 Sheets-Sheet 3

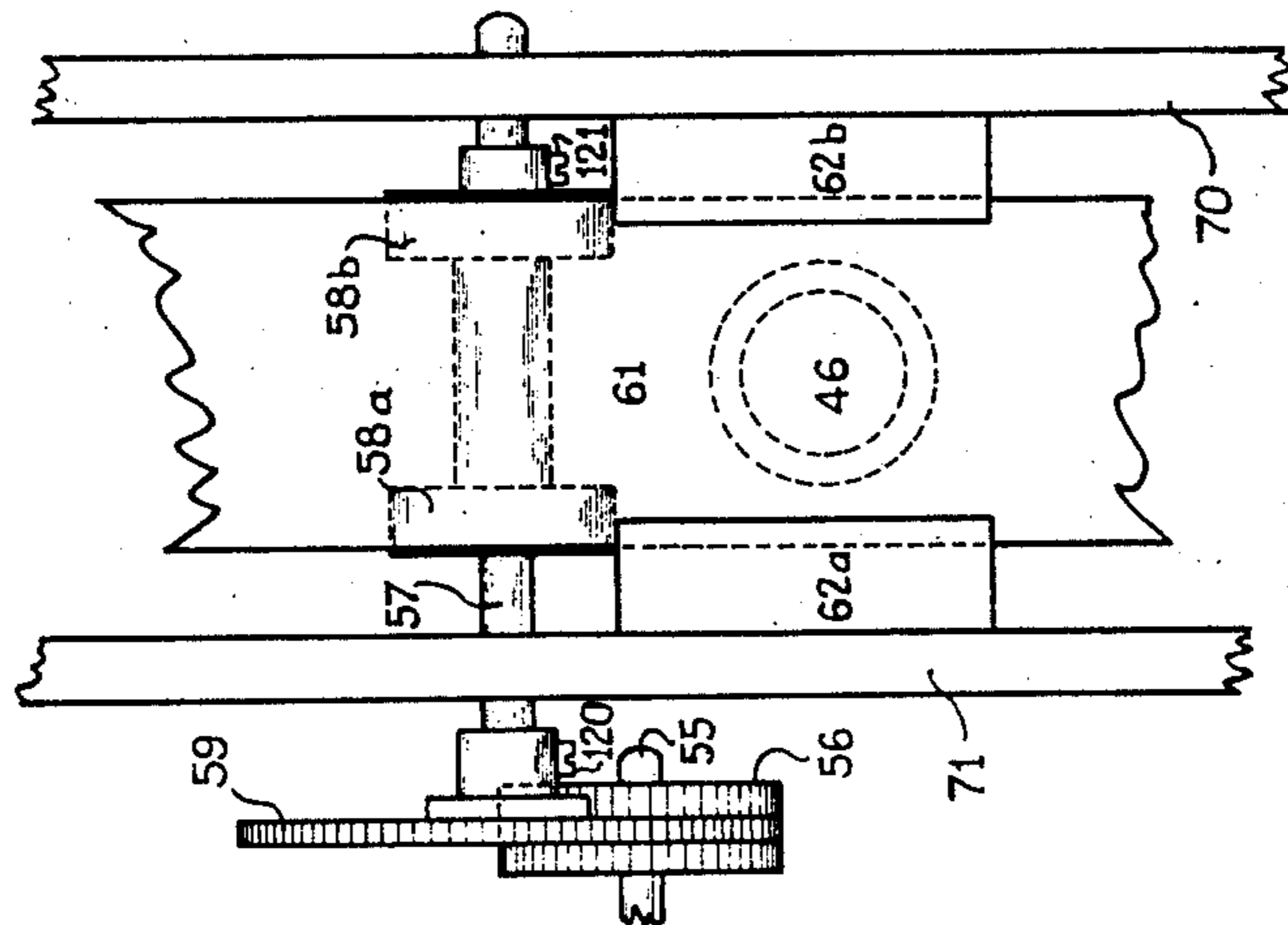


Fig. 5

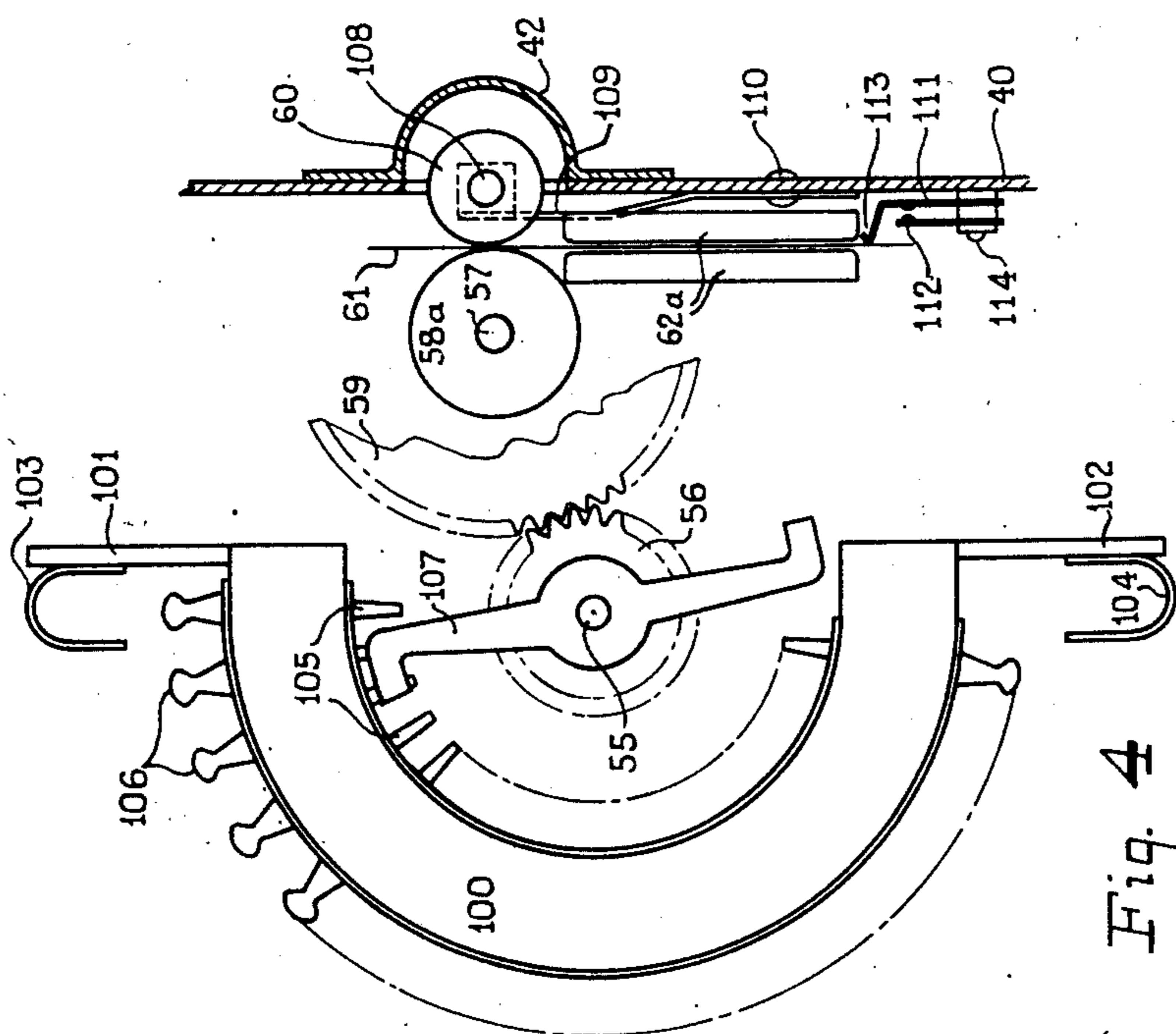


Fig. 4

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Filed Jan. 16, 1948

5 Sheets-Sheet 4

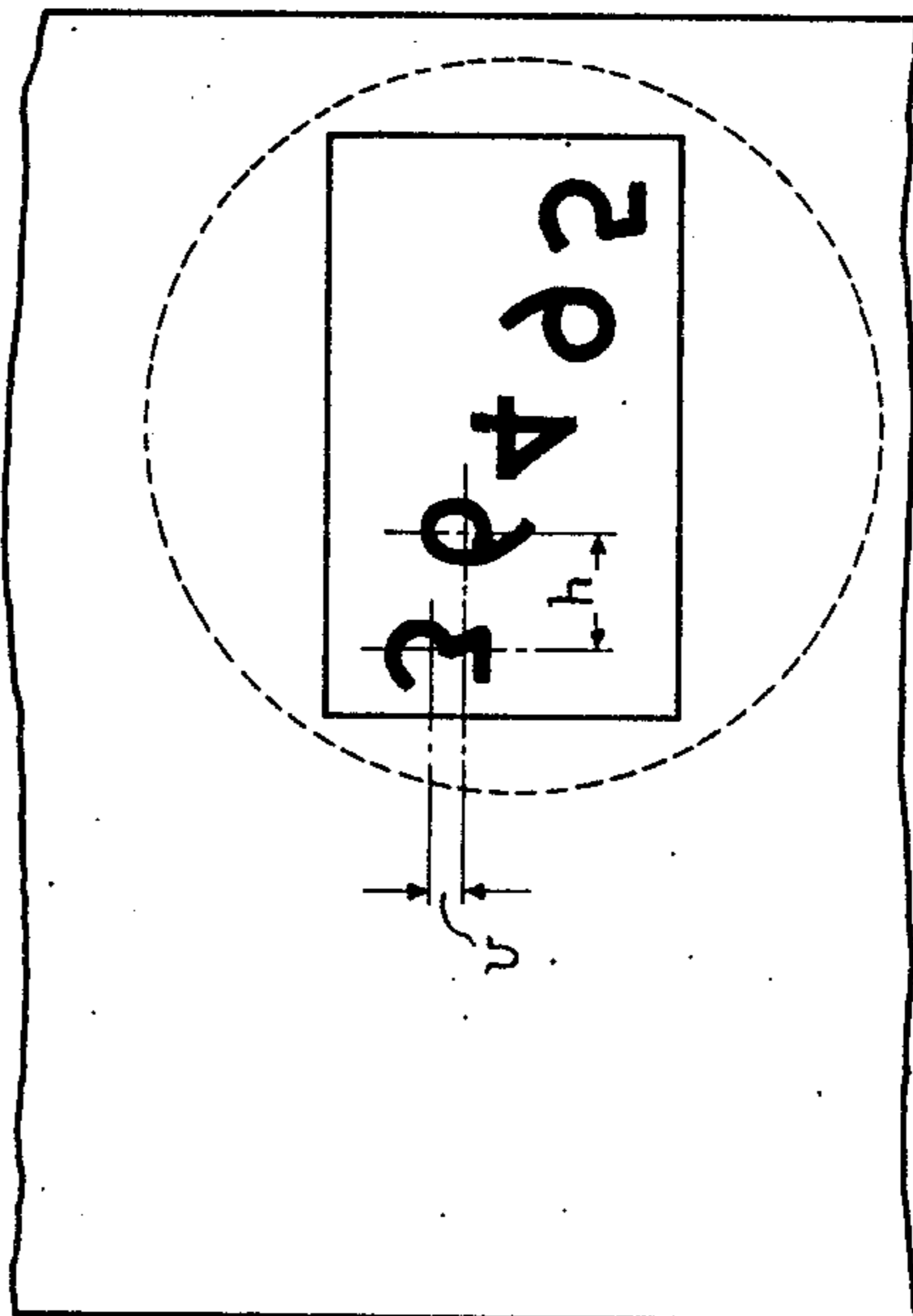
TO	36495
FROM	74382
TIME	1245
DATE	23-11

TO	69354
FROM	37862
TIME	1406
DATE	6-10

TO	85142
FROM	91637
TIME	0349
DATE	26-.8

Fig 7

DATE
TIME
FROM
TO



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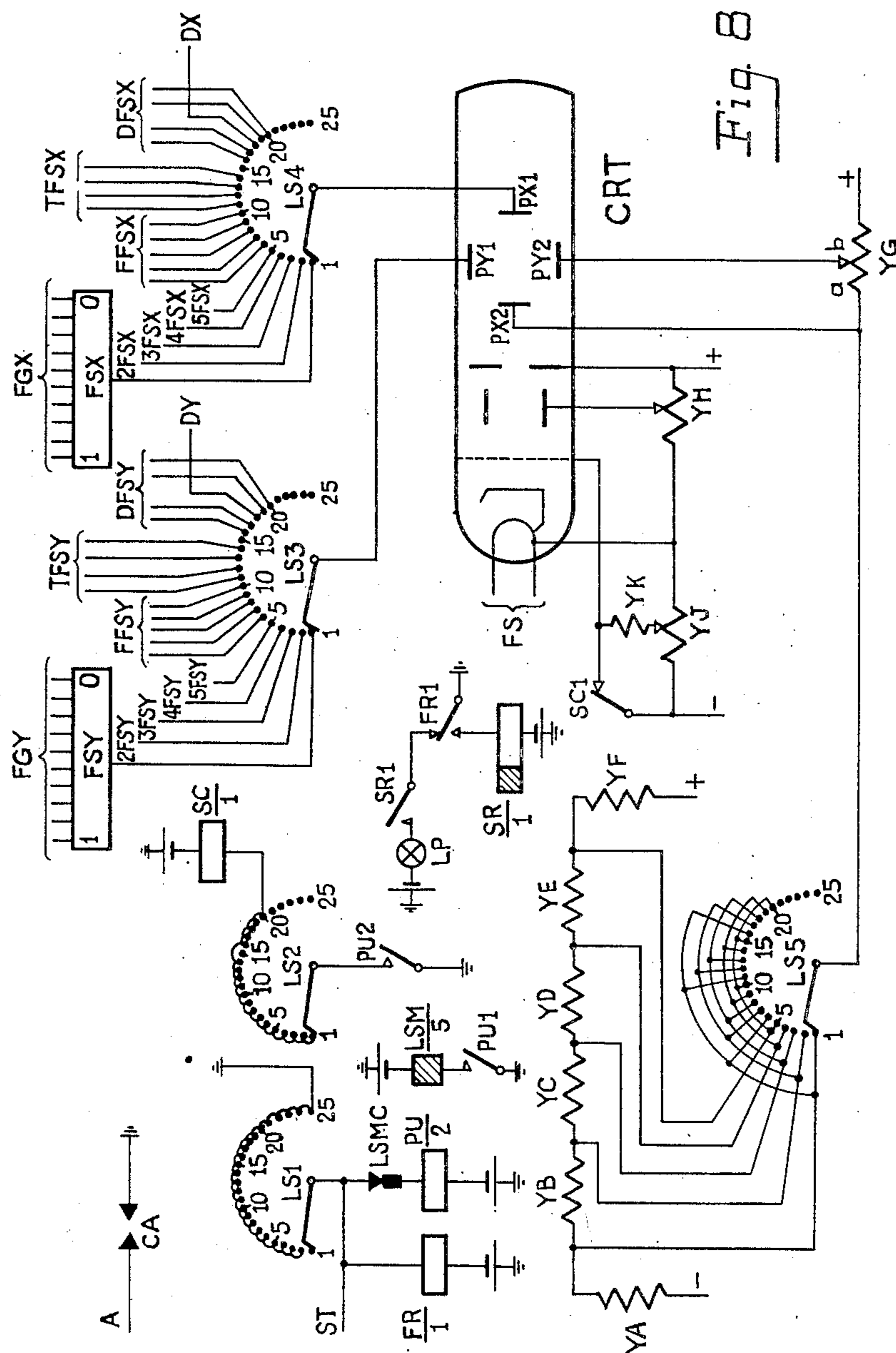
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PHOTOGRAPHIC RECORDING APPARATUS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,544,440

PHOTOGRAPHIC RECORDING APPARATUS

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Application January 16, 1948, Serial No. 2,565
In Great Britain March 1, 1947

9 Claims. (Cl. 346—33)

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The present invention relates to photographic recording apparatus and is more particularly concerned with apparatus which is employed in conjunction with display equipment for recording data displayed thereby.

Frequently the display equipment is mounted in a fixed position, for instance, on a rack or the like and the recording apparatus is secured in a position which is predetermined with relation to the display equipment.

One of the objects of the invention is to provide an improved method of mounting the recording apparatus and according to this feature of the invention, the recording apparatus is arranged to be jacked in to the display equipment, shutter-controlling arrangements being provided whereby the recording apparatus is maintained light-tight when jacked out except when opened for specific purposes such as loading or unloading photographic paper or film.

It has been shown in United States application Serial No. 750,142 how predetermined characters may be caused to appear on the fluorescent screen of a cathode ray tube and how the location of these characters may be controlled. In many cases it is advantageous to make a photographic record of the said characters and to have the characters co-related horizontally row by row and/or column by column with reference to row and/or column titles. A particular application of these principles is found in the recording of telephone call data for fee charging purposes as in the case of long distance calls which are chargeable at multi-fee rates. In such an example it will be of advantage to construct a photographic record associated with each call of a plurality of horizontal rows of digits characterising the called and calling subscriber's identities together with the date and time of establishment of the telephone connection and any other relevant data.

A further object of the invention is, therefore, to provide improved means of compiling a photographic record of characters appearing on the fluorescent screen of a cathode ray tube, and according to a further feature of the invention the display equipment includes a cathode ray tube and the recording apparatus is adapted to record characters appearing in sequence on the screen of the cathode ray tube in correlation with suitable titles prerecorded by the recording apparatus.

According to a further feature of the invention, each character is displayed separately on the screen of a cathode ray tube forming part of the display equipment and the film or paper on which the characters are recorded is advanced between each character display, means being provided whereby the position of appearance of each character is so displaced with reference to

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that of the others as to compensate for the movement of the photographic paper or film between the display of each character to enable the characters to be recorded in one or more lines.

According to a further feature of the invention, characters forming the data are recorded against prerecorded titles on a photographic film or paper and in order to facilitate accurate registration between the characters and the titles, arrangements are provided for advancing the film or paper in small steps during a recording operation while in order to enable the characters to be recorded in one or more lines arrangements are also provided for compensating for such movement of the film or paper.

According to a still further feature of the invention, the display equipment includes a cathode ray tube and characters appearing on the screen of the cathode ray tube are adapted to be recorded on photographic film or paper which is advanced by means of a uniselector mechanism which also serves to control the positions of the characters appearing on the screen of the tube.

According to a still further feature of the invention, titles are prerecorded on the photographic film or paper by passing light through the transparent portions of a stencil or photographic negative plate or the like in such positions as to designate the rows and/or columns of the record of the characters forming the data set up by the display equipment.

According to another feature of the invention, groups of characters forming the data are recorded against prerecorded titles on photographic film or paper and on the completion of a recording cycle, the recording apparatus is automatically controlled to record on the film or paper the titles against which subsequent groups of characters are recorded.

The invention will be better understood from the method of carrying it into effect as applied to recording data relating to telephone calls in ticket form, reference being made to the accompanying drawings comprising Figs. 1-8 in which:

Fig. 1 shows the general layout of the display equipment and the camera.

Fig. 2 is one view of the camera shutter arrangement.

Fig. 3 shows the actuating mechanism of the uniselector.

Fig. 4 shows the method of deriving movement of the photographic paper from the uniselector.

Fig. 5 is a view towards the right of the camera with the cover removed.

Fig. 6 shows the photographic negative plate of the display equipment as seen from the direction of the camera lens.

Fig. 7 shows a strip of photographic paper with

the data relating to three typical telephone calls printed thereon.

Fig. 8 is the circuit diagram.

Referring now to Fig. 1, the apparatus comprises two main components, the chamber 10 housing the display equipment and the photographic camera 33. The display equipment provides, at appropriate times, a cathode ray tube display of characters required for telephone charging purposes and an illuminated photographic negative of prearranged line titles and dividing lines which may be desirable for designating and separating the call data. The camera contains the supply of photographic paper and lens whereby the images of the above displays are projected on to the photographic paper and, together with motive power derived from a uniselector mounted at the side of the display equipment, means for advancing the photographic paper in such a manner that the cathode ray tube display images appear on the photographic paper in correct relationship to each other and to images due to the illuminated photographic negative.

The display equipment is arranged to be permanently mounted on a rack while the camera is secured to the rack on the "jack-in" principle.

The L shaped section members 22 and 23 are rigidly fixed across the rack and the plate 21, having a window 67, is secured to them by screws 24 and 25. On its right hand face, the plate carries the camera shutter actuating arm 32, the uniselector mounting brackets 30 and 31, and two strip metal vertical brackets 26a and 26b which are set such a distance apart as to permit the camera 33 to nest snugly between them. A thin sheet 27 of felt or similar material covers that area of the plate 21 lying between the brackets and provides a seating for the camera.

The display equipment chamber 10 comprises metal walls such as 11 and 12 secured at the lip 14 to the frame 20 which in turn is affixed to the left hand face of the plate 21. The chamber has preferably a matt black finished interior and is light tight, except at the window 67 when the camera is not in its working position. The contents are made accessible by removing the cover 13 and electrical connections may be extended thereto by way of the armoured tubing 65 coupled to the chamber by gland 66.

Within the chamber the cathode ray tube CRT is mounted on the insulating plate 15 to which the bracket 18, carrying the lamp holder 19 and its lamp LP, is also attached. The circumferential surface of the cathode ray tube is coated with a matt light excluding pigment and abuts against the photographic negative plate 16. A light diffusing screen 17 is interposed between the lamp and the plate 16.

The uniselector, elements of which are shown in Figs. 3 and 4 (drawn to a larger scale than Fig. 1), is attached to the brackets 30 and 31, and to present some idea of the working position of the uniselector the gear wheel 56 and wiper spindle 55 are shown in dotted outline. The uniselector is preferably of the type described in Herbert and Proctor's "Telephony" vol. 2, page 137 et. seq., modified insofar as the aforesaid gear wheel is affixed to the wiper spindle.

The camera 33 embodies a light-tight box having a matt black interior finish and may be loaded or unloaded by opening the lid 40 hinged at 41 and normally held securely in position by a spring clip 43. Two light-tight and detachable chambers 53 and 54 are mounted within the cam-

era, the lower chamber 53 containing the unused photographic paper and the upper chamber 54 accepting the paper 61, which is moved upwardly between rollers 58 and 60 after exposure. This arrangement permits, if need be, loading and unloading of the camera in its mounted position. Guides 62a and 62b (Fig. 5) are fitted to the sides of the camera to prevent lateral movement of the photographic paper. The metal bridge 45 supports the camera lens 46 and the shutter guides 47.

Now the near and remote sides of the camera are each fitted with two pins protruding outwardly at positions 63 and 64 so that the camera may be assembled to the display equipment by first placing its left hand face against the felt bed 27 and then lowering it so that the pins rest in the roots of the corresponding slots 28 and 29 in the brackets 26a and 26b. As the camera is lowered into position arm 32 engages with the member 51 pivoted at 52 and spring loaded in a clockwise direction. The pin 50 is attached to the shutter 49 and passes through the member 51 so that as the latter is rotated anti-clockwise by arm 32, the shutter is lifted to uncover the window space 68 in the guides 47 and 48. It follows that should the camera be subsequently removed, the member 51 moves out of engagement with arm 32 as the camera is raised but still abutting against the felt bed and permits the spring-loaded shutter to be urged downwards to the closed position. It will be apparent that this arrangement, whilst ensuring that the shutter is automatically opened and closed when the camera is respectively attached to and removed from the display equipment, also maintains the camera light-tight during the attaching and removing operation.

Fig. 2 shows a view of the shutter arrangement from the direction of the actuating arm 32 in Fig. 1. The spindle 52 carrying the member 51 is pivoted in the sides of the camera 70 and 71 and is loaded to close the shutter 49 by the spring 73 which has one end 74 bedded in the spindle and the other end 75 in the side 71. The shutter guide 47 is slotted at 72 to provide a path for the pin 50.

Referring now to Fig. 3 which shows the driving mechanism of the uniselector, the operation of this mechanism is briefly as follows. When the electromagnet 80 is energized by a current fed to tags such as 81, the face 91 of the armature lever 85 is attracted to the pole piece 82 to cause the armature lever to move anti-clockwise over a small angle about the knife edge 90 of the member 89. The flexible strip 93 is attached to the armature lever extension 92 by rivets 94 and carries the pawl 95 which is tensioned against the ratchet wheel 98. Thus when the lever 85 moves anticlockwise the pawl tooth 96 advances to the left over one tooth 97 of the ratchet wheel. When the electromagnet is subsequently de-energized the armature lever restores under control of the tensioned spring 87, which at one end is anchored to the lug 83 and at the other to a hook 86 on the lever, and in so doing steps the ratchet wheel clockwise by one tooth pitch to rotate the wiper spindle attached thereto an equivalent distance.

It will be noted by referring to the skeleton diagram shown in Fig. 4 that the uniselector is modified in that a gear wheel 56 is secured to the wiper spindle 55 which has been shown elsewhere in Figs. 1 and 3. Wipers such as 107 attached to, but electrically insulated from, the spindle are arranged to step clockwise over sets of contacts 105, as determined by the operation of the mechanism shown in Fig. 3. Now when the camera

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is attached to the display equipment the gear wheels 56 of the uniselector and 59 of the camera mesh to provide preferably a 2 to 1 ratio between the wiper spindle and spindle 57 which is clamped to the gear wheel 59.

The spindle 57, rotatable in bearings in the sides of the camera, has a bobbin-like structure (shown more clearly in Fig. 5) secured to it by screw 121. This structure embodies two rollers 58a and 58b of rubber or similar resilient material.

When the camera lid 40 is closed the edges of the photographic paper are gripped between rollers 58a and 58b and a pair of ball bearing rollers, one of which is shown at 60, the rollers being rotatable on the shaft 108 attached to the spring strip 109. The latter is riveted to the cover at 110 and applies the pressure to the photographic paper. The cover 42 provides a recess for the ball bearings. It follows, therefore, that anti-clockwise rotation of the spindle 57 caused by the clockwise stepping of the uniselector wiper spindle results in a corresponding upward movement of the photographic paper, and that as the wipers continue to step the paper is fed from the lower light-tight chamber 53 of the camera to the upper chamber 54.

A contacted spring assembly comprising springs 111 and 112 is attached to the lid by screw 114. Since the tip 113 of the spring 111 is normally resting on the surface of the photographic paper the contact points are opened, but when all the paper has been taken from the lower chamber the tension on the paper is removed and the contacts are allowed to close for alarm or other purposes.

Fig. 5 shows the photographic paper passing between the slotted guides 62a and 62b, which prevent lateral movement of the paper, and over the rollers 58a and 58b. The position of the camera lens 46 is indicated in dotted outline.

Fig. 6 shows the layout of the photographic negative plate 17 of the display equipment when viewed from the direction of the camera lens. The plate is transparent at the characters and the dividing line in the upper position and also within the rectangle which forms a window in the lower portion, but is opaque elsewhere. The position of the cathode ray tube is indicated by the dotted circle and the relative positions of typical characters to be displayed thereon, singly and consecutively from left to right, are also indicated. The centres of the latter characters are displaced in turn by predetermined vertical and horizontal distances v and h respectively.

Now if Fig. 6 were inverted and viewed through a mirror some idea of the images registered on the photographic paper through the medium of the camera lens is given. Thus, if the photographic plate were illuminated by diffused light at the rear, the line titles "To," "From," "Time" and "Date" and the dividing line would appear on the photographic paper in a lower position than the cathode ray tube display and would be registered in that position. Meantime a like block of images has been pre-registered immediately above for use in conjunction with the present cathode ray tube display. The left hand character, appearing on the cathode ray tube while the uniselector is first energised, registers its image, digit "3," in alignment with the word "To" in the pre-registered block as in the top line of Fig. 7. The display is deleted before the uniselector steps upon the release of the magnet and is replaced, when the magnet is re-energised, by

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the character to its right by which time the photographic paper has advanced upwardly under control of the uniselector by an amount proportional to the distance v . The second character therefore registers its image, digit "6," in horizontal alignment with digit "3." The images of remaining characters appearing separately in the positions shown on the cathode ray tube are also registered in alignment with the title "To" to construct the called subscriber's number 36495 as shown in Fig. 7. A similar type of display indicative of the calling subscriber's number appears character by character in corresponding positions to those shown as on the cathode ray tube. Again, by association with the movement of the photographic paper the appropriate digits appear in alignment with the second pre-registered title "From" to construct the calling subscriber's number. The data relating to the time and date of establishment of the call are recorded in line with the words "Time" and "Date" in a similar manner. The advance of the paper proceeds under control of the uniselector, after the last character relating to the date has been recorded. However, no further characters are displayed as the uniselector continues to step to its home position, by which time a second pre-registered title block is in position to accept data relating to a subsequent call, and a further block is registered thereunder.

Referring now to the circuit diagram Fig. 8. The units FSY and FSX shown schematically constitute a figure selector and each may be, for example, a pyramid arrangement of relay contacts whereby the single lead from contact 1 on level LS3 or LS4 of the layout selector (which is the circuit term applied to the uniselector previously mentioned) may be extended to any one of a group of leads FGY1 to 0 or FGX1 to 0. Each of the leads FGY1 to 0 in association with a relevant lead of leads FGX1 to 0 are supplied with electrical potentials by a figure generator, of the type described in United States application Serial No. 750,142, whereby any character predetermined by the setting of the figure selector may be caused to appear on the cathode ray tube CRT. Figure selectors 2FSY/2FSX to 5FSY/5FSX, also extending to the figure generator, are terminated respectively on contacts 2, 3, 4 and 5 of levels LS3 and LS4 of the layout selector. These five figure selectors are set under control of the calling subscriber's dial in accordance with the called subscriber's number which consists of a five digit number, the first digit being a predetermined code common to that subscriber's exchange and the remaining four being his number on that exchange.

A second group of five figure selectors extending over leads FFSY/FFSX also connecting with the figure generator are set in accordance with the identity of the calling subscriber, which identity may have been determined and transmitted over a junction in the manner described in United States application Serial No. 739,478. Hence, again, the identity is represented by a five digit number, the first digit being the exchange code of the calling subscriber, the signal of which may be injected at the remote end of the junction, while the remaining four digits are the calling subscriber's number on his exchange.

The next two groups of figure selectors TFSY/TFSX and DFSY/DFSX similar to the foregoing are set respectively in accordance with the time and date of the establishment of the telephone conversation under control, for instance, of a

time and date relay set. It will be noted that only four figure selectors are used in conjunction with the time display which is on the basis of the twenty-four hour clock. The date display, which gives numerically the date and month which are separated by a dash as shown in Fig. 7, also employs only four digit selectors since those contacts on the layout selector levels 3 and 4 associated with the dash are connected direct over leads DY and DX to a dash producing element of the figure generator.

To initiate the recording of the call data a start earth pulse is applied to lead ST to operate relays FR and PU. Relay FR operates the slow release relay SR while relay PU operates relay SC and energises the layout selector magnet. Relay SC disconnects negative battery from the modulator grid of the tube to permit the electron beam to trace the first character on the fluorescent screen of the tube under control of the potentials applied to plates PY1 and PX1 in accordance with the setting of the first figure selector FSY/FSX. The magnet, in operating upon the armature lever, opens the contacts LSMC to release relay PU. Relay PU releasing disconnects the magnet and releases relay SC which interrupts the electron beam to terminate the character display. Upon disconnection, the magnet permits the wipers to advance to contacts 2 on the bank when contacts LSMC reclose and at the same time advances the photographic paper in the camera by a predetermined amount as previously described.

The start pulse is substituted by earth, over level LS1 contacts 2 to 25, to hold relay FR while the wipers are passing over those contacts and to permit the re-operation of relay PU each time contacts LSMC are closed. It will be apparent that the layout selector and relay PU interact to cause the wipers to continue to advance at a substantially constant speed, and further that when the wipers are in transition from one set of contacts to the next (i. e. between characters), relay SC is released to interrupt the beam.

While the wipers are on contacts 2, potentials indicative of the second character to be displayed are extended from the second figure selector 2FSY/2FSX to the PY1 and PY2 plates of the tube to cause the second character to be displayed. The third, fourth and fifth characters are displayed singly in turn as the wipers rest on contacts 3, 4, and 5 respectively, due to the potentials extended by the figure selectors 3FSY/3FSX to 5FSY/5FSX, to complete the display of the called subscriber's number.

In order that the characters shall have their centres of appearance displaced horizontally by equal amounts h as in Fig. 6, potentials progressively increasing by equal amounts are applied to the PX2 plate of the tube as wiper LS5 advances over contacts 1 to 5. These potentials are determined by the choice of the values of the resistors YA to YF in combination with resistor YG.

It has been previously shown that the layout selector moves the photographic paper upwardly in the camera by a small amount each time its wipers are advanced one step, and in order to compensate for this movement the centres of appearance of the characters had to be displaced vertically by proportionate amounts. These displacements are effected by applying suitable potentials to the PY2 plate of the tube co-incidentally with the display of each character. To this end the values of the arms a

and b of resistor YG are so chosen in relation to the values of resistors YA to YF that the vertical displacement potentials progressively increase by equal amounts as wipers LS5 advances over contacts 1 to 5.

It will be apparent that the appropriate horizontal and vertical displacements of the characters might alternatively be effected by divorcing the PX2 and PY2 plates, and extending independent potentials to each from separate potentiometer arrangements similar to YA to YF by way of separate levels of the layout selector. In this case the values of the four inner resistors associated with horizontal displacements would be equal and the corresponding resistors associated with vertical displacements would also be equal.

Reverting again to Fig. 8, it will be noted that the leads from the potentiometer comprising resistors YA to YF appear four times on level LS5. Hence as the characters comprising the calling subscriber's number are displayed, while the wipers are traversing contacts 6 to 10, vertical and horizontal displacement voltages are again applied to the tube to make the appropriate characters appear in the positions previously occupied by the called subscriber's number display.

The characters relating to the time and date are similarly displayed and displaced but, in order that the fifth character position of the time display shall not be occupied, contact 15 on level LS2 is not wired. When the wiper attains that contact relay SC is not operated and the electron beam remains cut off. When the date is to be designated by four digits, as on the upper ticket of Fig. 7, the first pair of characters displayed denoting the day are separated from the pair denoting the month by a dash produced by the figure generator. However, when the day or month is designated by a single digit this occupies the position normally allocated to the units digit, while the tens digit position is occupied by the undeflected spot whose position is determined by the displacing potentials and which remains undeflected since the tube is disconnected from the figure generator by the appropriate figure selector.

The layout selector continues to step until it attains the home position and at the same time drives the photographic paper. Relay FR then releases to disconnect the slow release relay SR and to complete, for the release time of relay SR, a circuit to the lamp LP which illuminates the photographic negative plate in the display equipment. The images due to that plate are registered on the photographic paper in the camera for use in conjunction with the next but one call.

Contacts CA are those designated 111 and 112 in Fig. 4 and are closed as the supply of photographic paper in the camera is running out. When they close earth is extended over lead A to a circuit whereby an audible and/or visual alarm is given and a standby camera is brought into operation if that facility is required.

I claim:

1. Photographic recording apparatus comprising a display device, means for successively displaying a plurality of characters on said display device in at least one line, recording means for recording said characters on a photographically-sensitive strip, driving means for advancing said strip a predetermined amount as each character is recorded and means for varying the position of appearance of the characters on said

display device, said last-mentioned means being controlled by said driving means to vary the position of the characters vertically thereof for each advancement of said strip to compensate for the movement of said strip whereby the characters are recorded in a line.

2. Photographic recording apparatus comprising a cathode ray tube, means for displaying in succession a plurality of characters on the screen of said tube, recording means for recording said characters on a photographically-sensitive strip, a uniselector mechanism having a plurality of wipers and associated bank contacts, driving means for said strip, means for operating said driving means and for rotating said wipers in step-by-step manner over said bank contacts and connections over wipers and bank contacts of said uniselector for controlling the position of appearance of said characters on said screen.

3. Photographic recording apparatus comprising a cathode ray tube, means for displaying a plurality of characters in succession on the screen of said tube, recording means for recording said characters on a photographically-sensitive strip, a uniselector mechanism provided with a plurality of wipers and associated bank contacts, means for automatically operating said uniselector mechanism to step said wipers from a normal position over the associated bank contacts back to said normal position, means controlled by said uniselector as said wipers step from one bank contact to the next for advancing said strip, connections completed over one wiper and associated bank contacts for varying the position of appearance of said characters on said screen as said wiper rotates over said bank contacts to enable the characters to be recorded in line and means controlled by said uniselector in said normal position for recording titles on said strip against which subsequent characters are recorded.

4. Photographic recording apparatus comprising a cathode ray tube, means for displaying a plurality of characters in succession on the screen of said tube, recording means for recording said characters on a photographically-sensitive strip, a uniselector mechanism having a shaft on which are mounted a plurality of wipers, means for rotating said shaft one step on the recording of each character, means on said shaft for advancing said strip one step on the recording of each character, and means controlled by one of the wipers of said uniselector mechanism for applying a vertical shift voltage to a deflection of said cathode ray tube to vary the position of appearance of the characters on said screen to enable the characters to be recorded in line.

5. Photographic recording apparatus as claimed in claim 4 wherein the means for applying said vertical shift voltage to said deflection plate comprise a potential divider having a plurality of tapping points, connections between said tapping points and contacts in a bank of said uniselector and a connection from the wiper associated with said bank contacts to said deflection plate.

6. Photographic recording apparatus comprising a cathode ray tube, means for applying varying voltages in succession to the deflection plates of said tube to enable a plurality of characters to be displayed in succession on the screen of said tube, recording means for recording said characters on a photographically-sensitive strip

against prerecorded titles, a uniselector mechanism provided with a shaft on which are mounted driving means for said strip and a plurality of wipers having a normal position, said shaft and wipers making one complete rotation during a recording cycle, means for rotating said shaft and said wipers from said normal position a predetermined number of steps to apply said varying voltages over certain of said wipers to said deflection plates to cause the display of said characters, to apply vertical shift voltages over another of said wipers to one of said deflection plates and to advance said strip a predetermined amount for each character recorded, means for rotating said shaft and wipers a further predetermined number of steps to said normal position to advance said strip into position for the next recording cycle and means effective when said shaft and wipers reach said normal position for recording titles on said strip for use in the next but one recording cycle.

7. Photographic recording apparatus as claimed in claim 6 wherein said means for recording titles on said strip comprise a stencil bearing the titles, a lamp and a circuit for said lamp momentarily closed when said uniselector is in the normal position whereby the titles are recorded on the strip behind the characters just recorded.

8. Photographic recording apparatus comprising a casing, a cathode ray tube, a lamp and a stencil located within said casing, means for displaying a plurality of characters in succession on the screen of said cathode ray tube, means for causing said lamp to illuminate titles provided on said stencil, recording means for recording said characters and said titles on a photographically-sensitive strip, a uniselector mechanism, means for automatically operating said uniselector mechanism in step-by-step manner, driving means for said strip controlled by said uniselector mechanism and circuit connections including wipers and bank contacts of said uniselector mechanism for controlling the display of characters on the screen of the cathode ray tube and for controlling the lighting of said lamp to cause the titles to be recorded on said strip.

9. Photographic recording apparatus as claimed in claim 8 wherein the lighting of the lamp to record the titles takes place at the end of a recording cycle and the characters of the next but one recording cycle are recorded against such titles.

GEORGE THOMAS BAKER.

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