

Dec. 5, 1944.

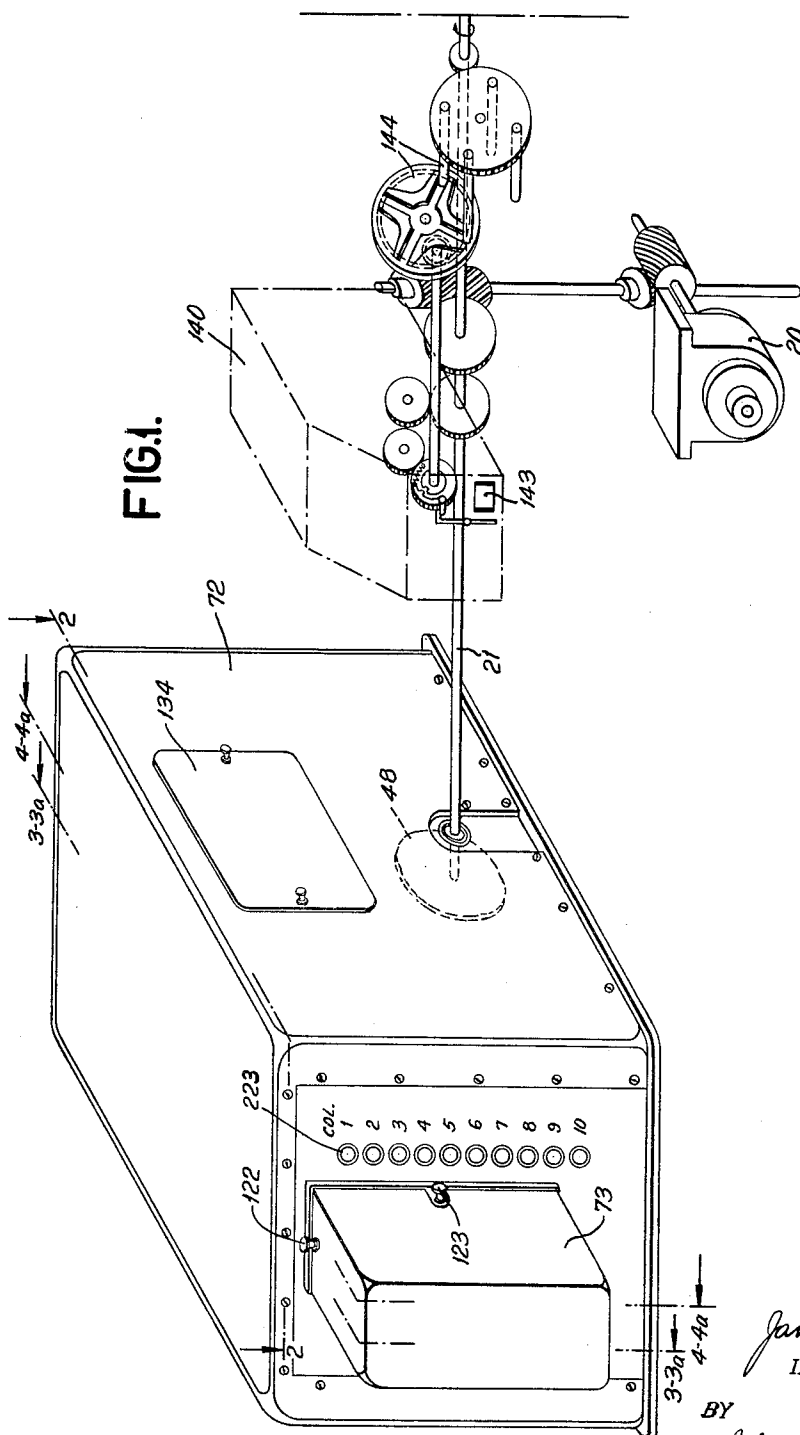
J. W. BRYCE

2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 1



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Dec. 5, 1944.

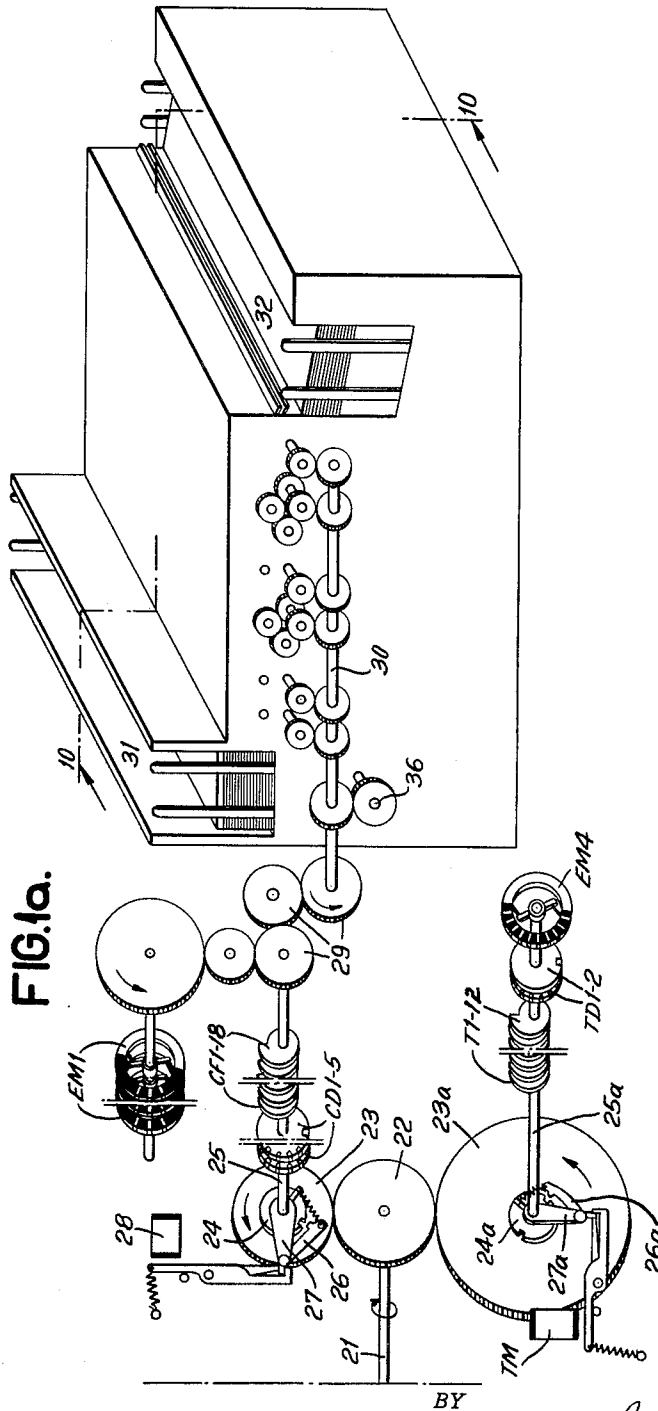
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Filed April 1, 1942

24 Sheets-Sheet 2



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24 Sheets-Sheet 3

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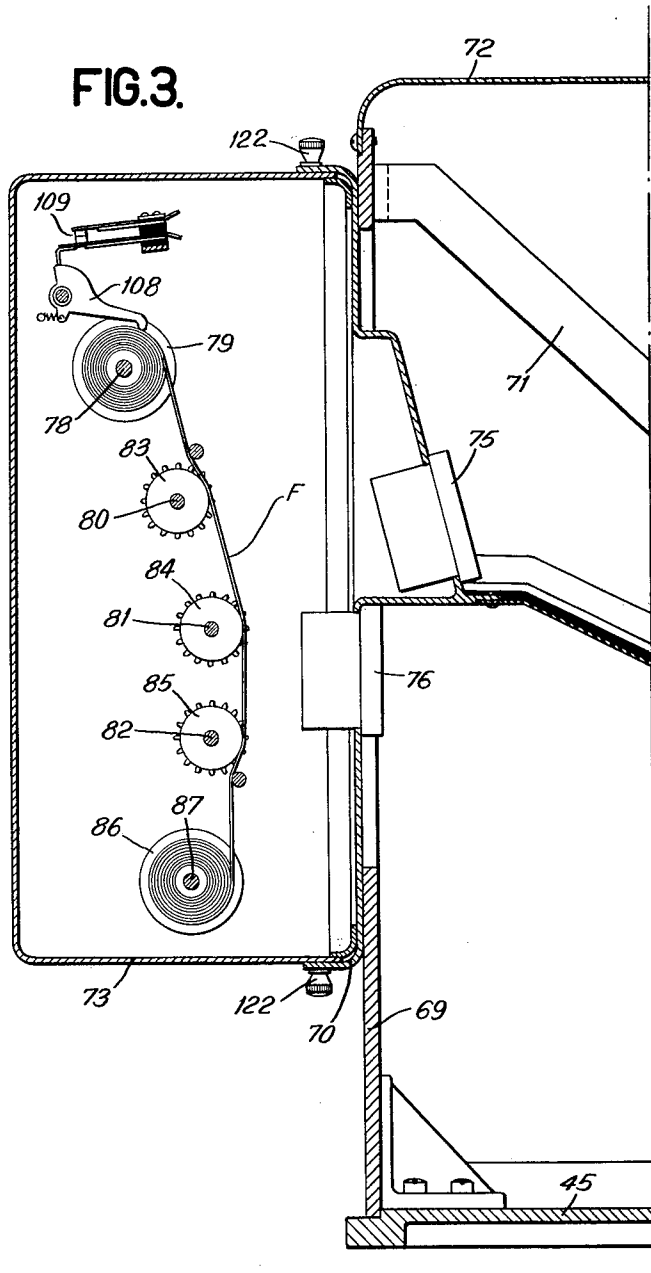
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 4



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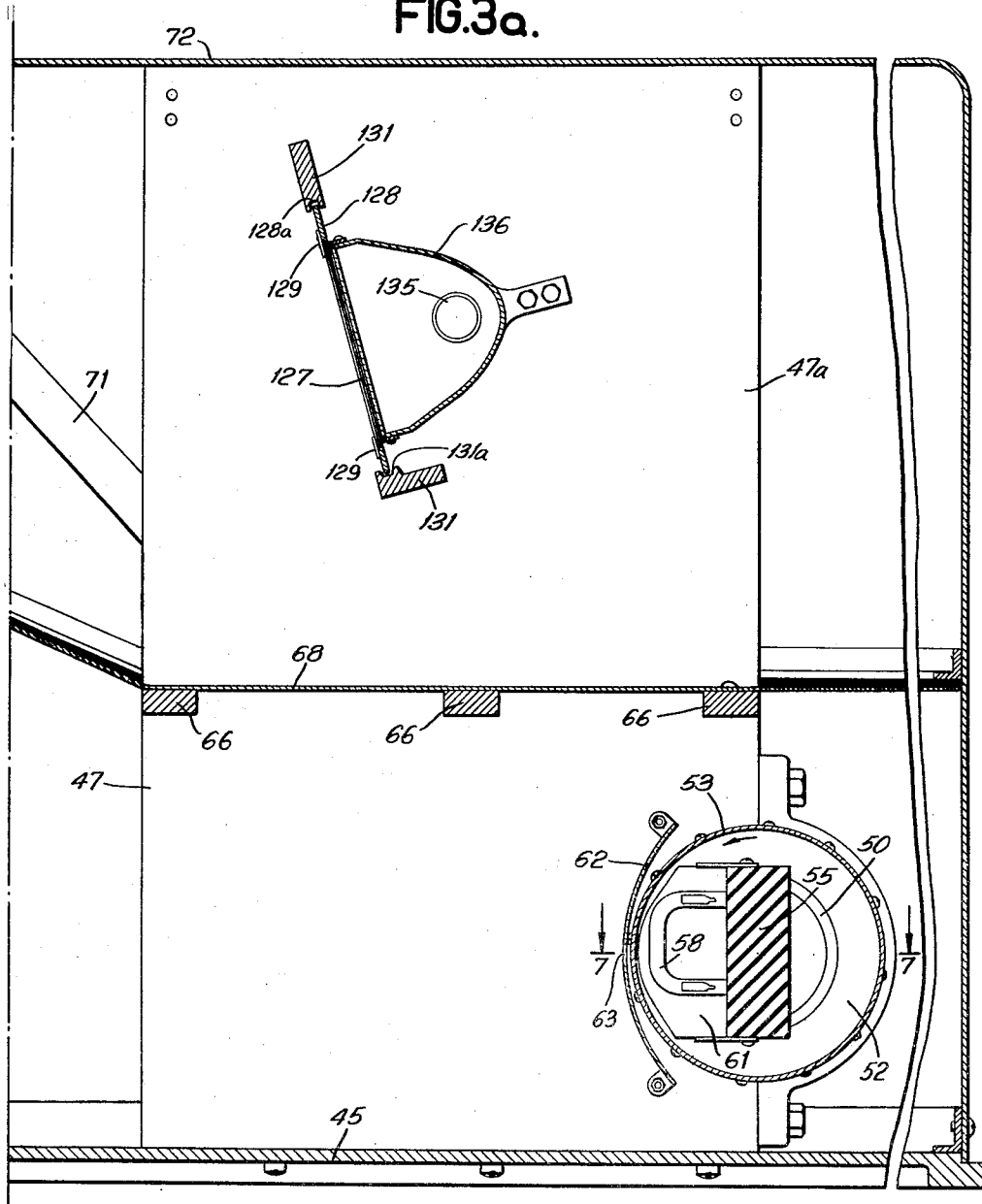
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24 Sheets-Sheet 5

FIG.3a.



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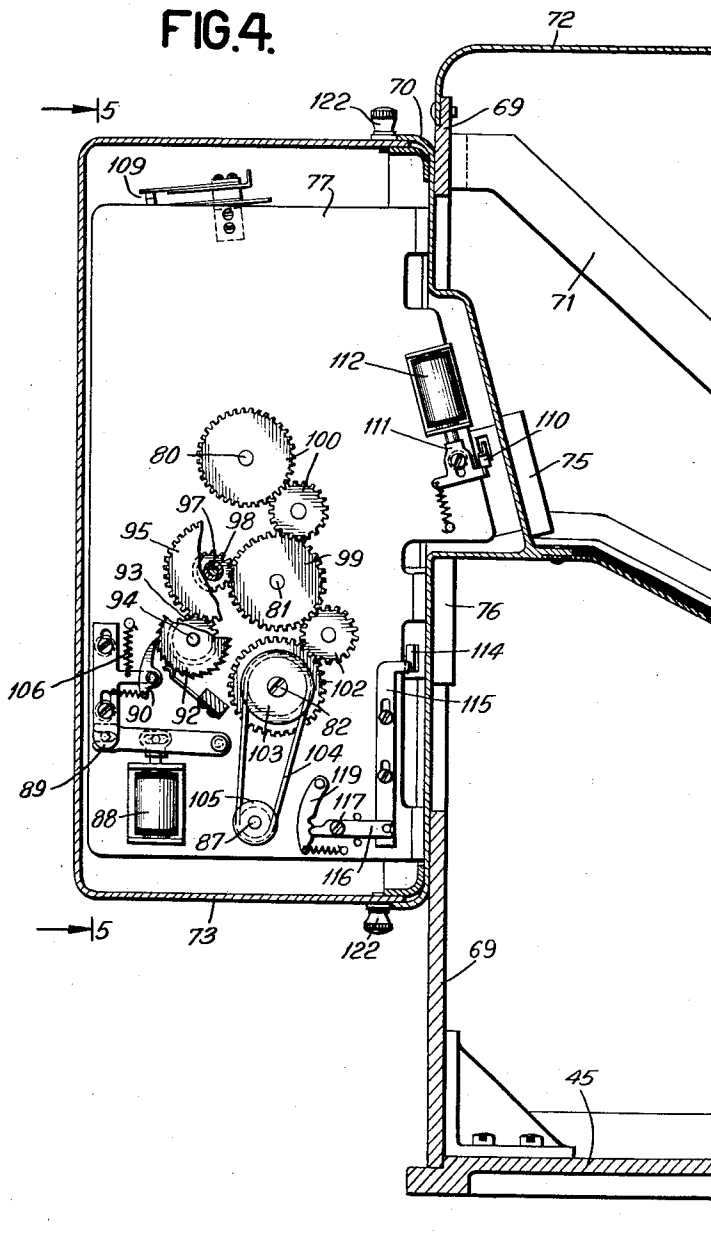
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24 Sheets-Sheet 6

FIG.4.



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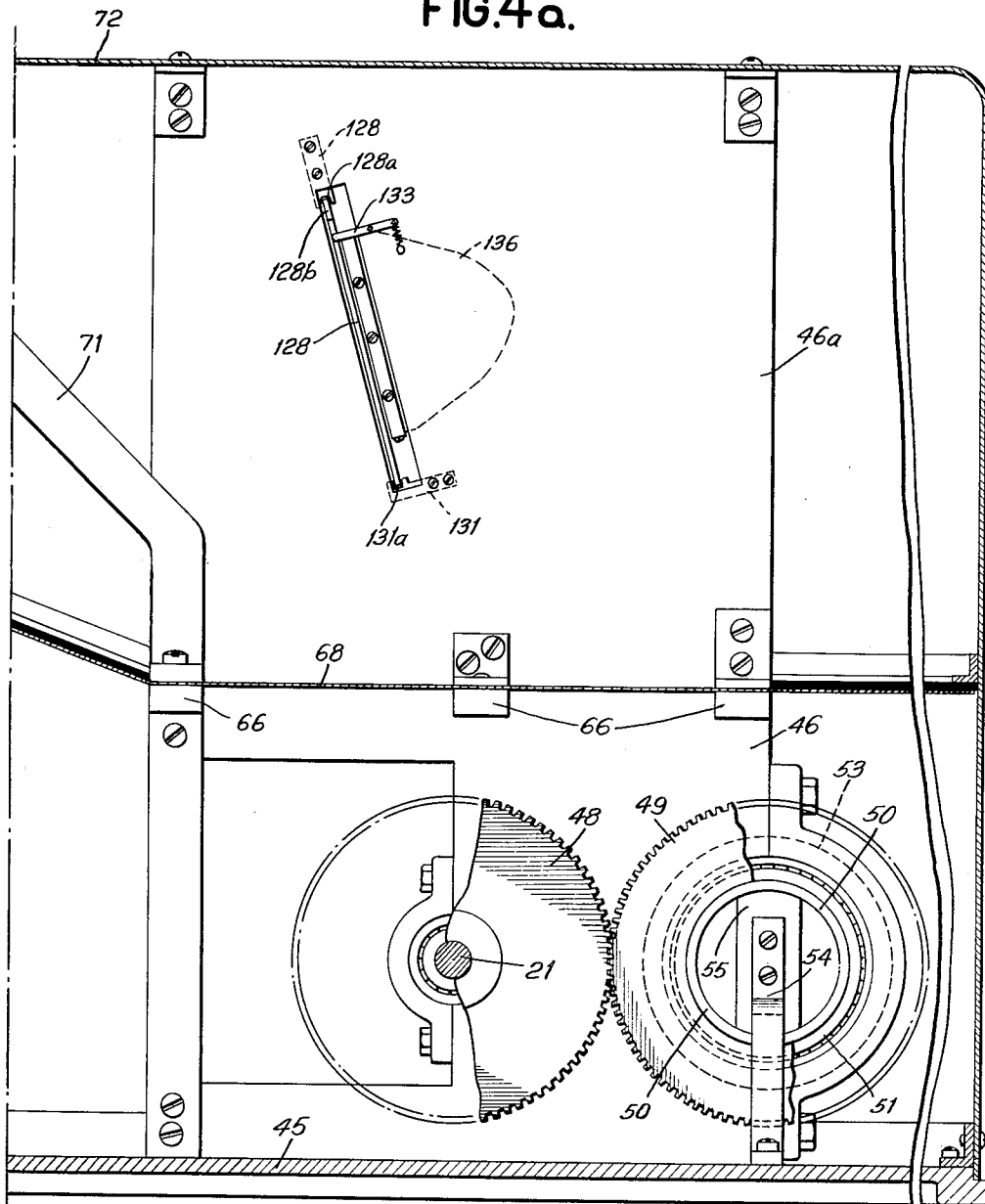
2,364,188

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Filed April 1, 1942

24 Sheets-Sheet 7

FIG. 4a.



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2,364,188

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Filed April 1, 1942

24 Sheets-Sheet 8

FIG. 5.

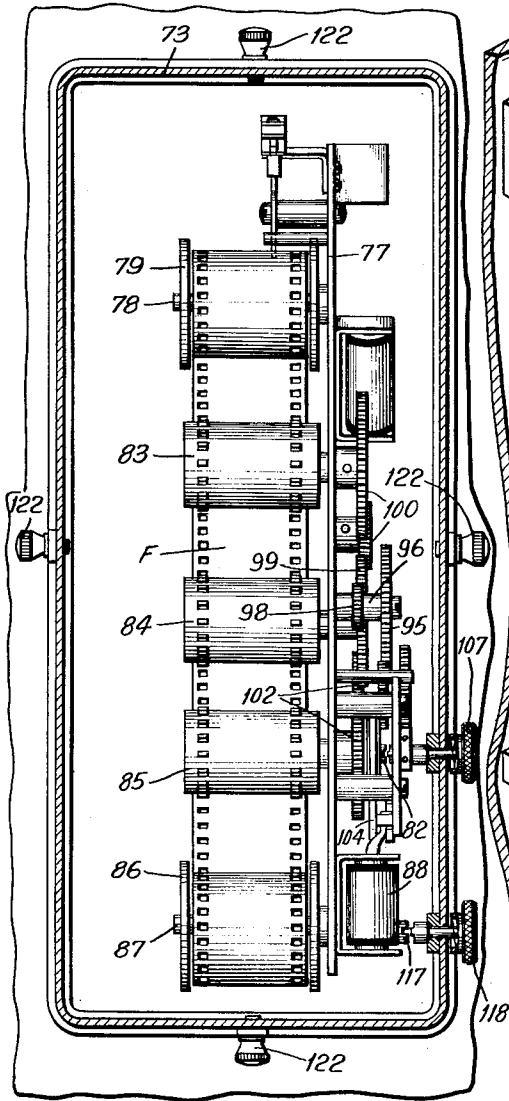
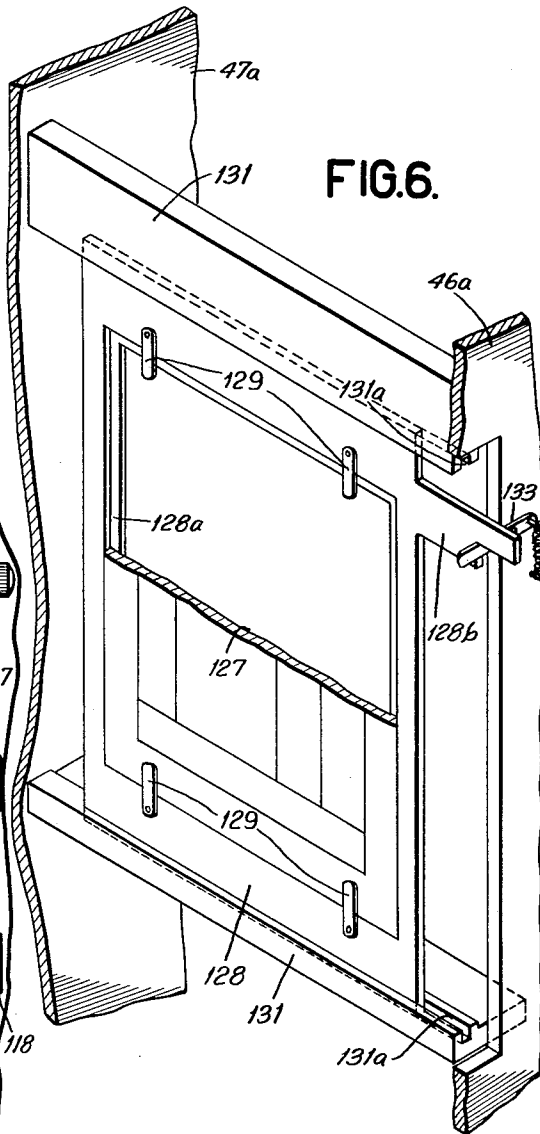


FIG. 6.



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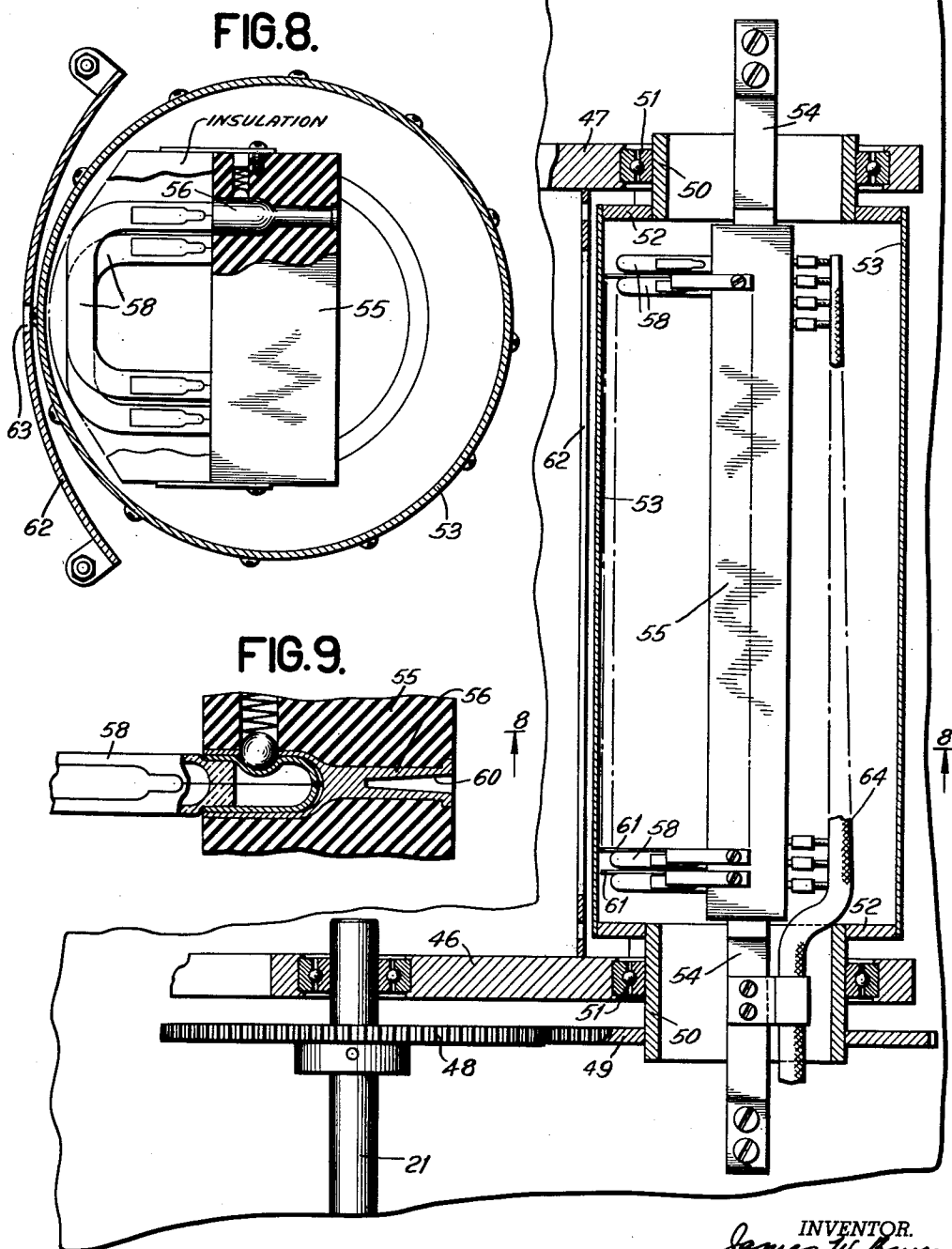
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 9

FIG. 7.



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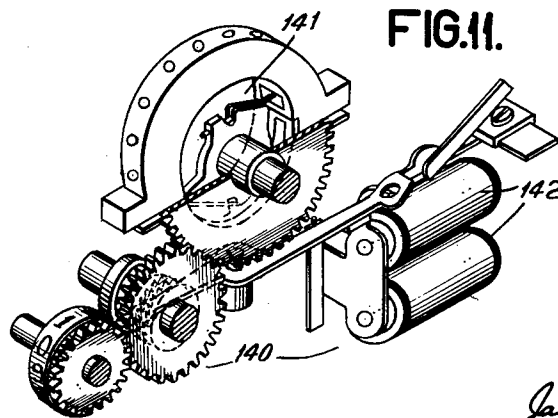
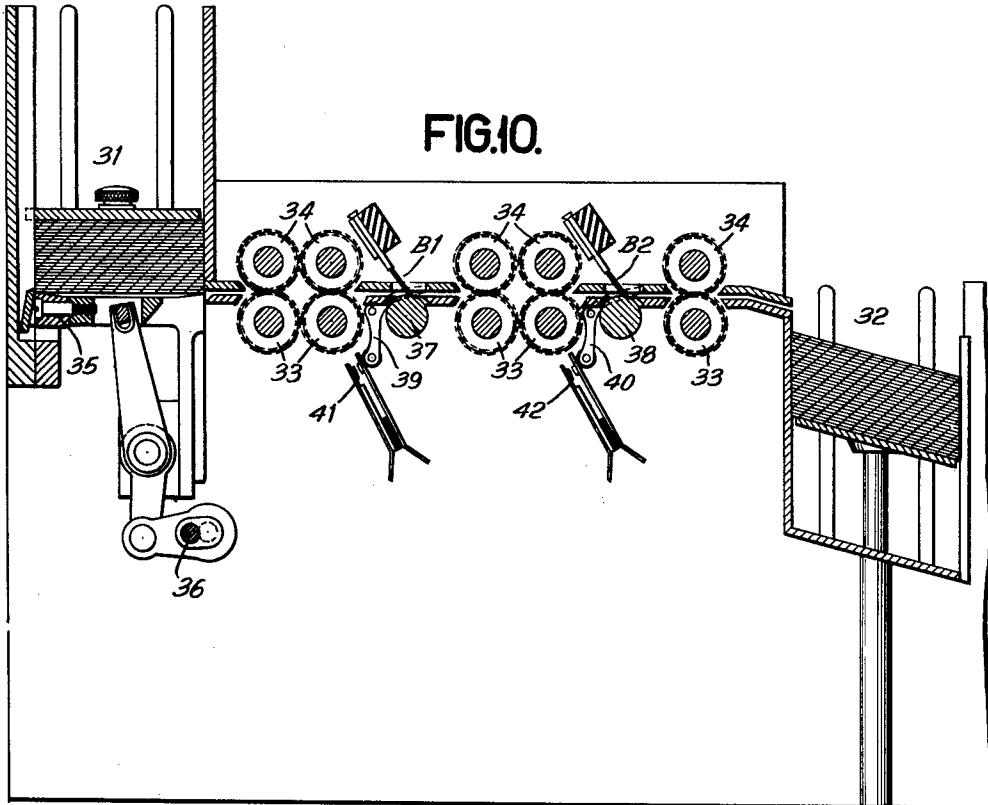
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 10



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2,364,188

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24 Sheets-Sheet 11

FIG.13.

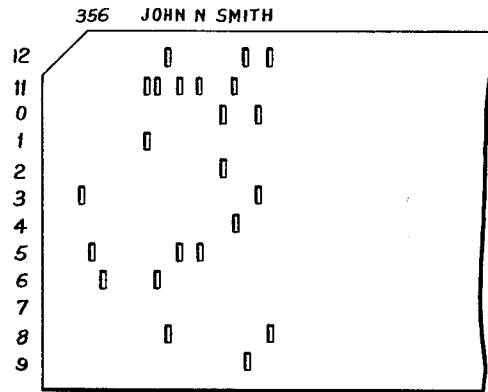
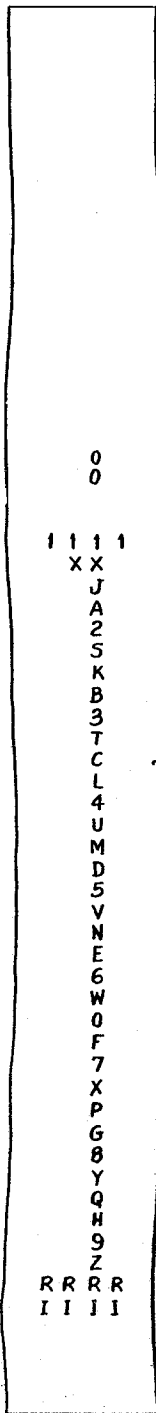


FIG.15.

FIG.14.

DIGIT OR INTRAZONE VALUES

	0	1	2	3	4	5	6	7	8	9
12		A	B	C	D	E	F	G	H	I
11		J	K	L	M	N	O	P	Q	R
0	0		S	T	U	V	W	X	Y	Z
NONE		1	2	3	4	5	6	7	8	9

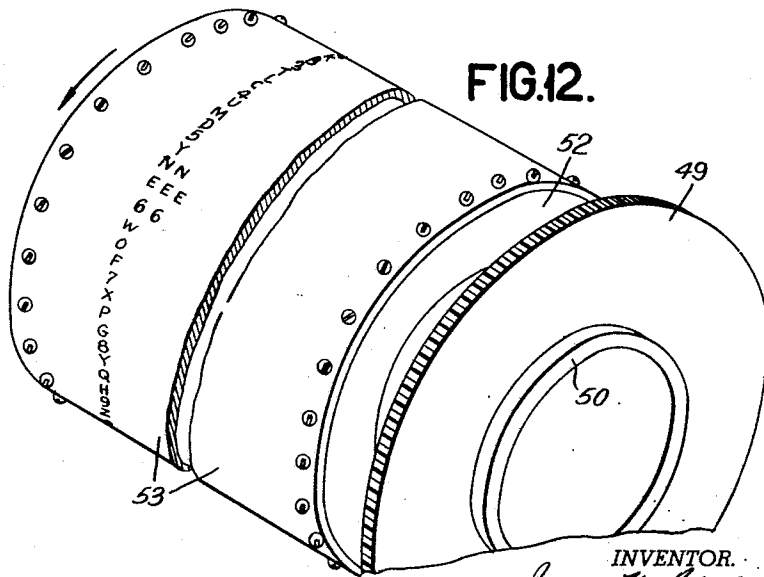


FIG.12.

BY

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2,364,188

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Filed April 1, 1942

24 Sheets-Sheet 12

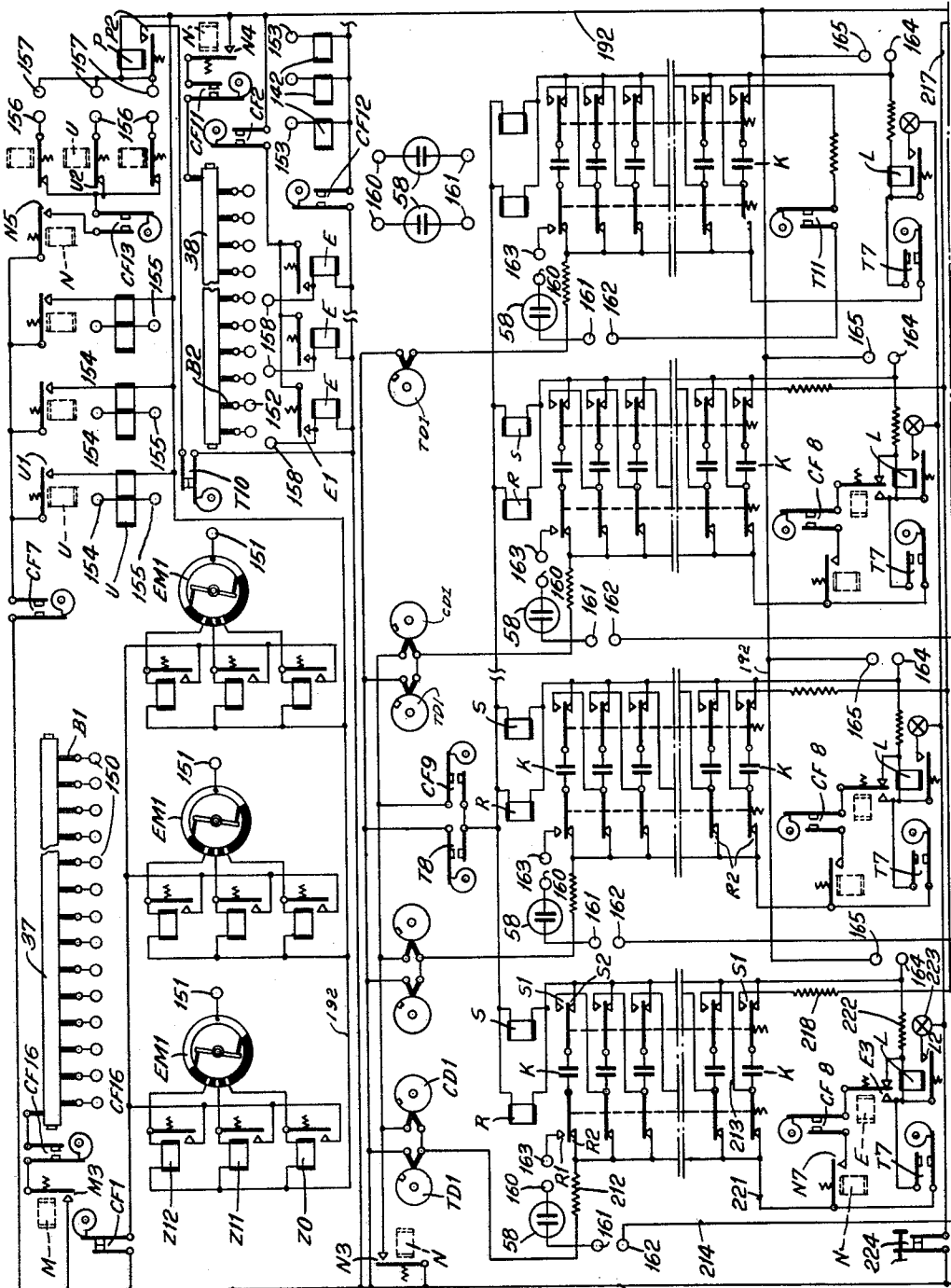


FIG. 16a

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2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 13

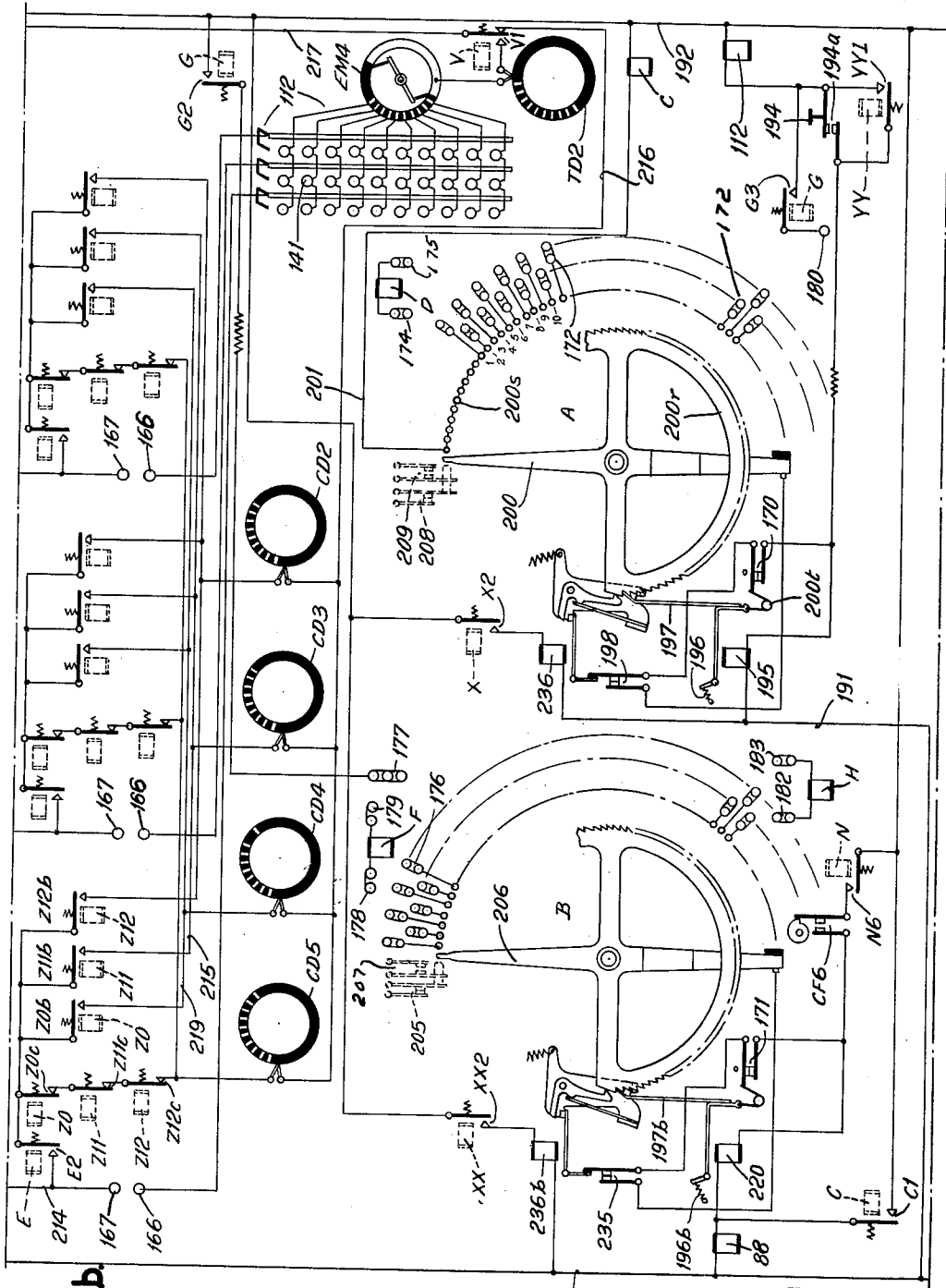


FIG. 16b.

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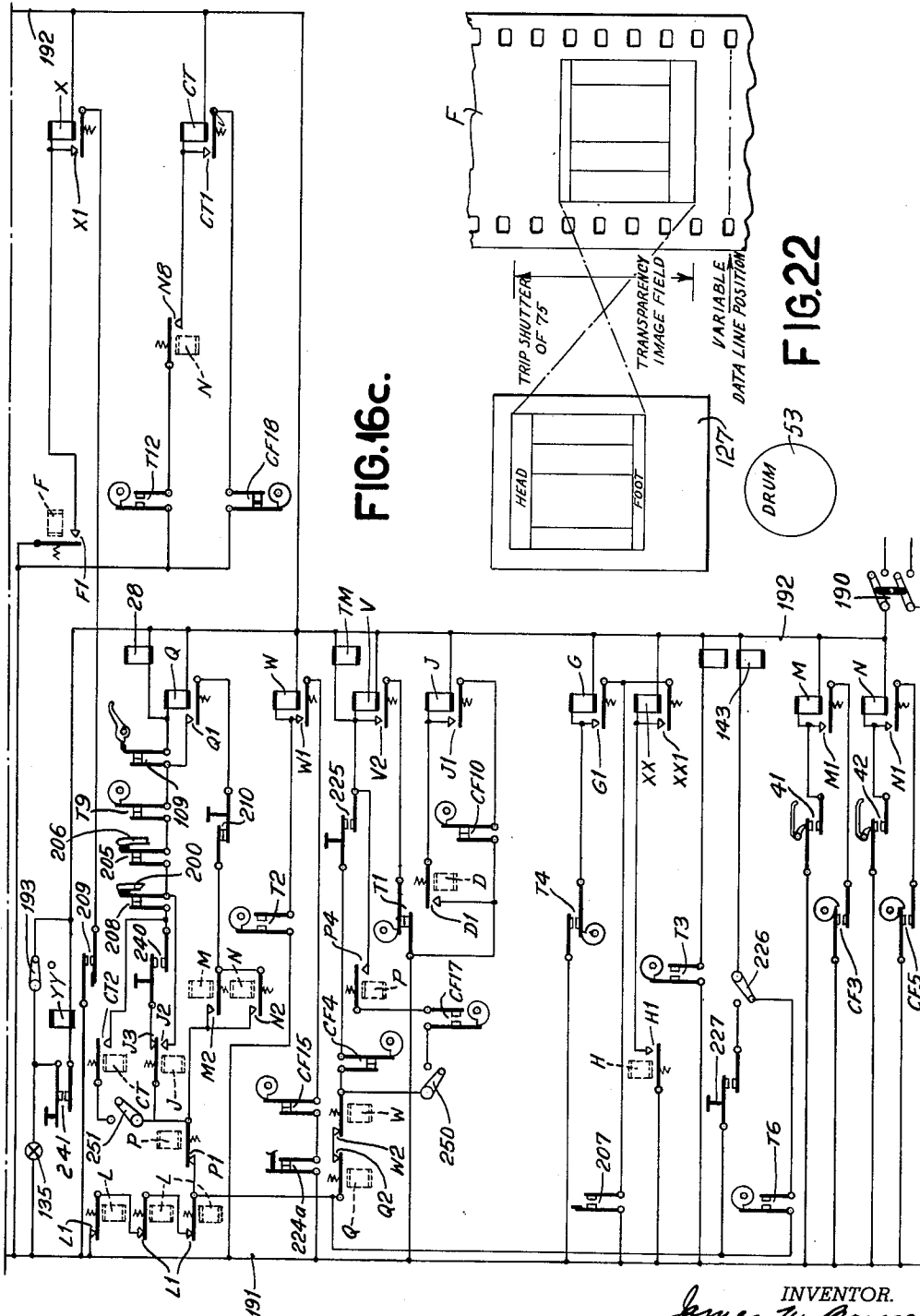
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 14



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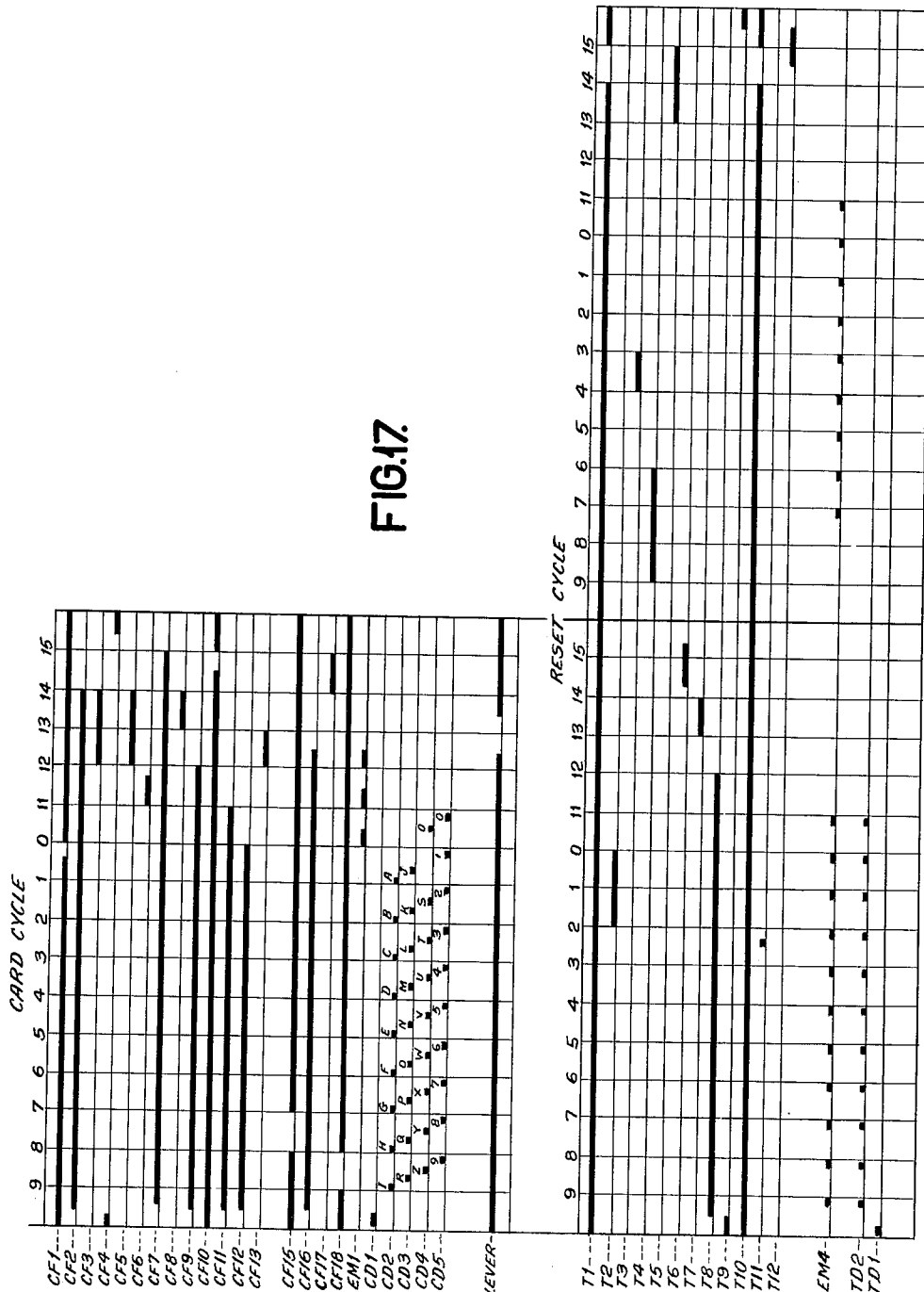
2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 15

FIG. 17.



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2,364,188

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Filed April 1, 1942

24 Sheets-Sheet 16

FIG. 18.

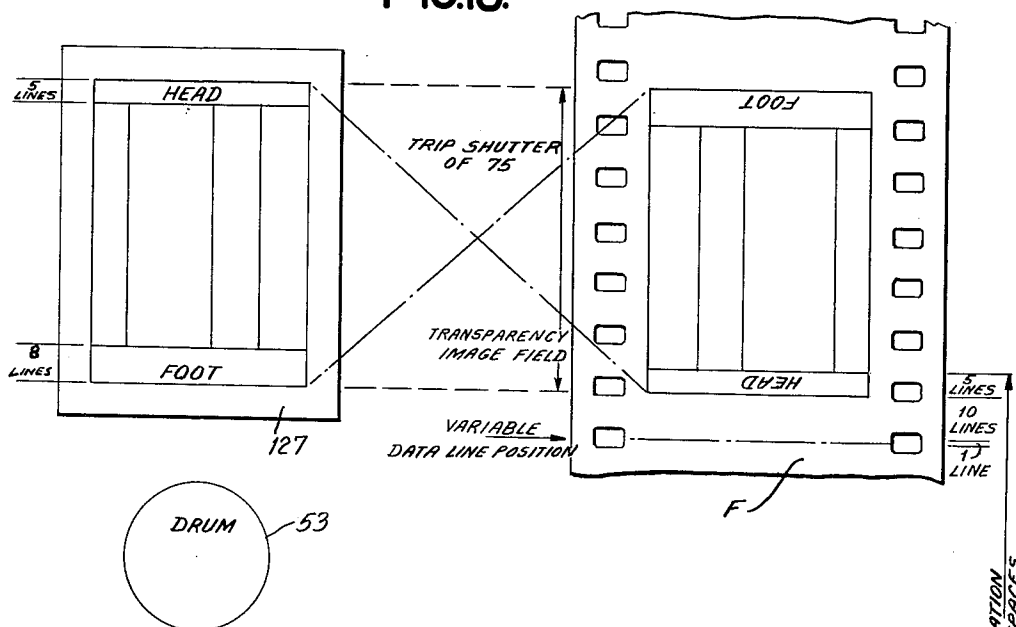
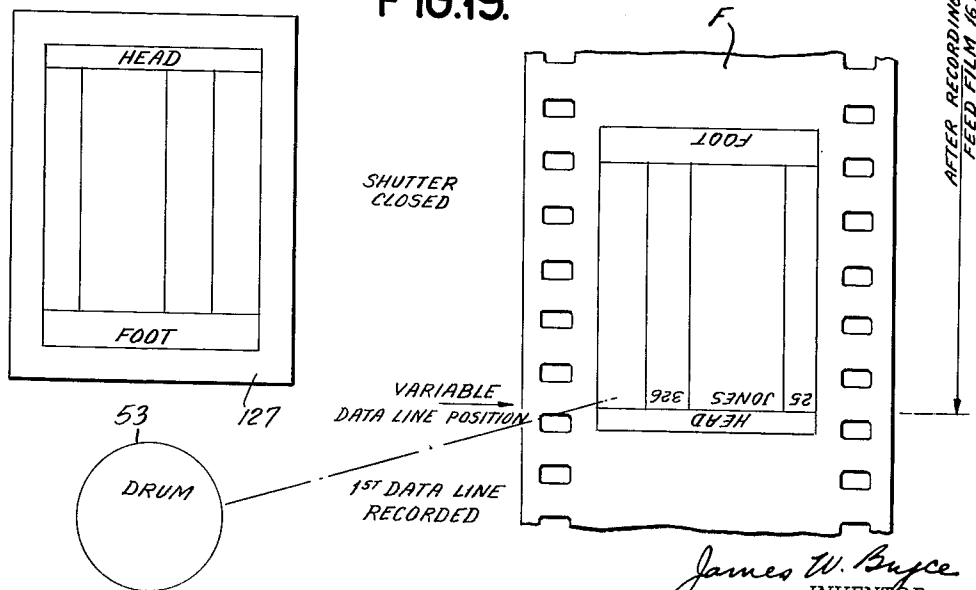


FIG. 19.



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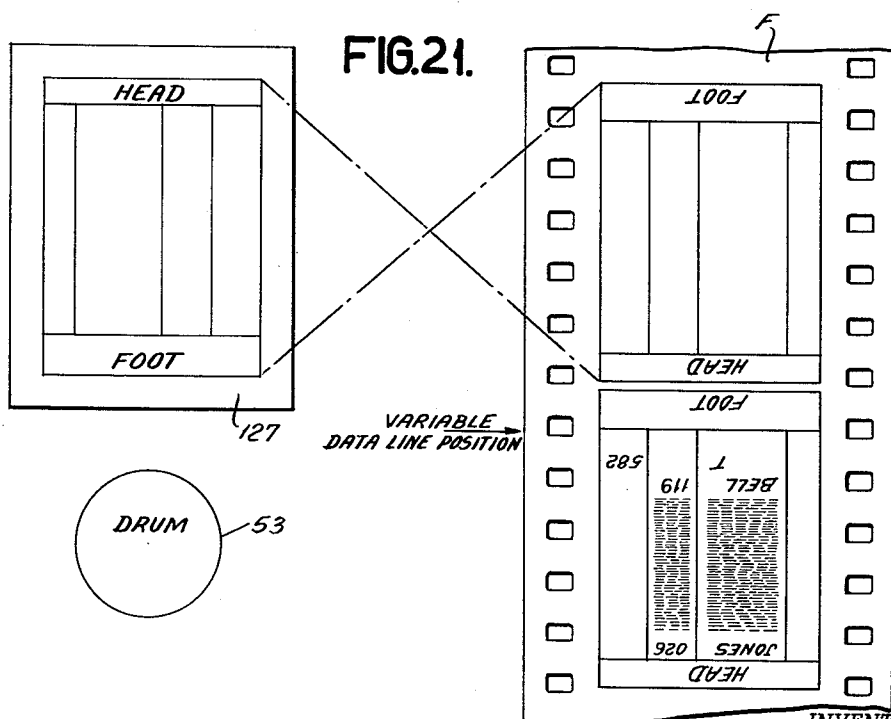
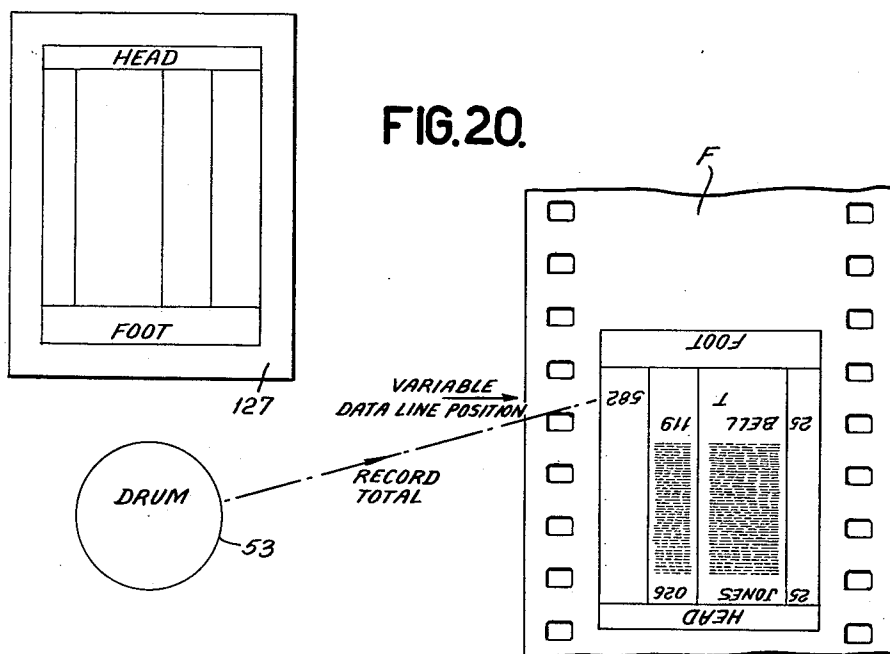
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2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 17



INVENTOR.
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2,364,188

24 Sheets-Sheet 18

FIG.23.

FIG. 23.

THE ROW CHEMICAL CO.					
BLANK CITY U.S.A.					
DEPARTMENT WAGE REPORT					
DEPT.	EMPLOYEES NAME	WAGES			
35	SMITH JOHN	32	50		
35	JONES ROBERT	32	50		
35	BERRY THOMAS	30	00		
35	PETERS GERALD	45	00		
35	THOMAS JOHN	31	00		
35	SMITH FRANK C.	36	00		
				657	50

CHECKED BY _____

APPROVED BY _____

TO BE PLACED IN FILE _____

THE ROW CHEMICAL COMP					
BLANK CITY U.S.A.					
DEPARTMENT WAGE REPORT					
DEPT.	EMPLOYEES NAME	WAGES			
27	DAVIS PETER	67	85		
27	JOHNSON ROBERT	72	50		
27	HARRISON JOHN	61	00		
27	JONES THEODORE	61	00		
27	SMITH HAROLD	85	50		
27		63	00		
27		95	00		
27		105	00		
27		25	50		
27					
27					
27					
27					
27					
27					
27					
27					

INVENTOR
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2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 19

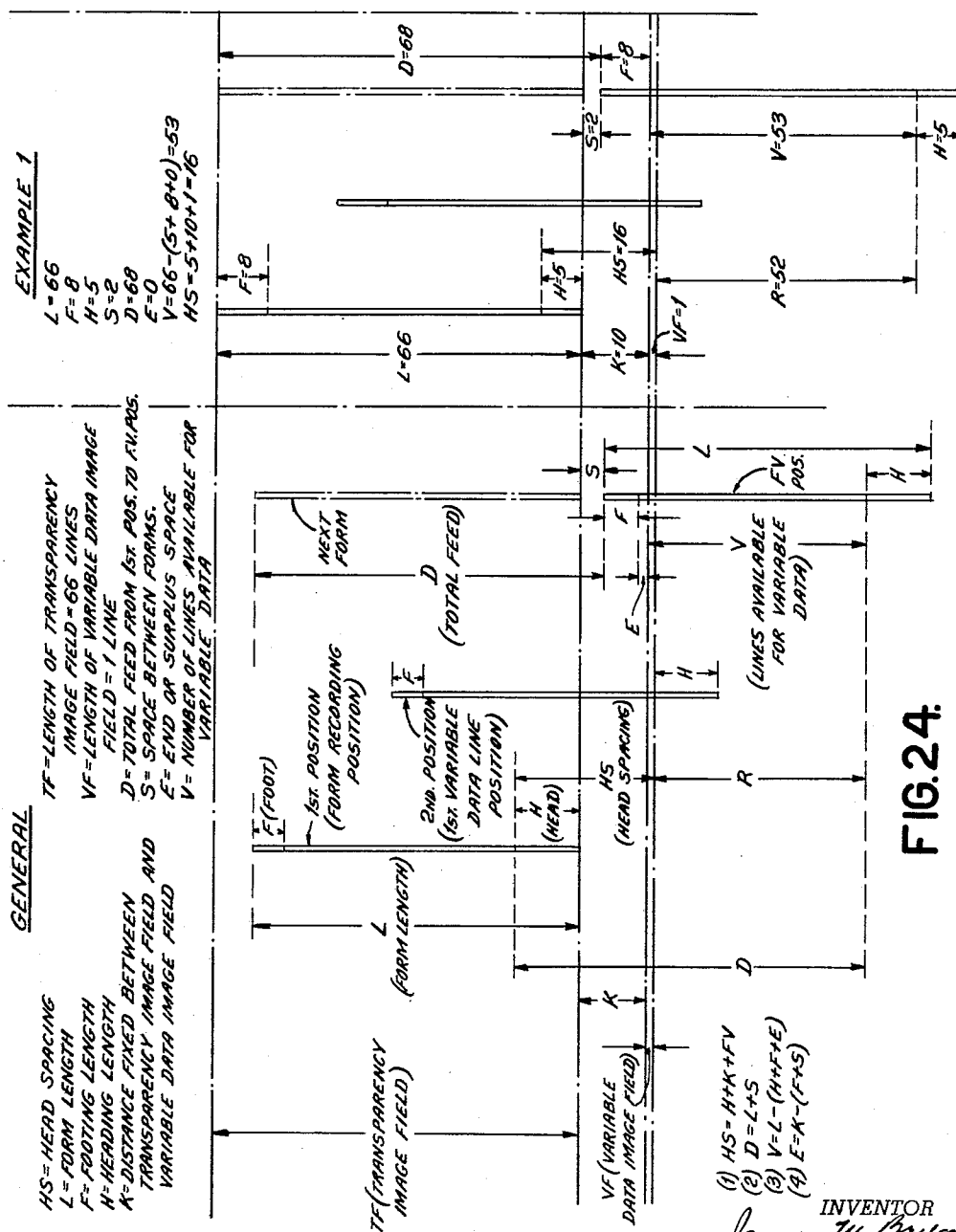


FIG. 24:

BY

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INVENTOR
James W. Bryce
John C. Kerr
ATTORNEY

ATTORNEY

Dec. 5, 1944.

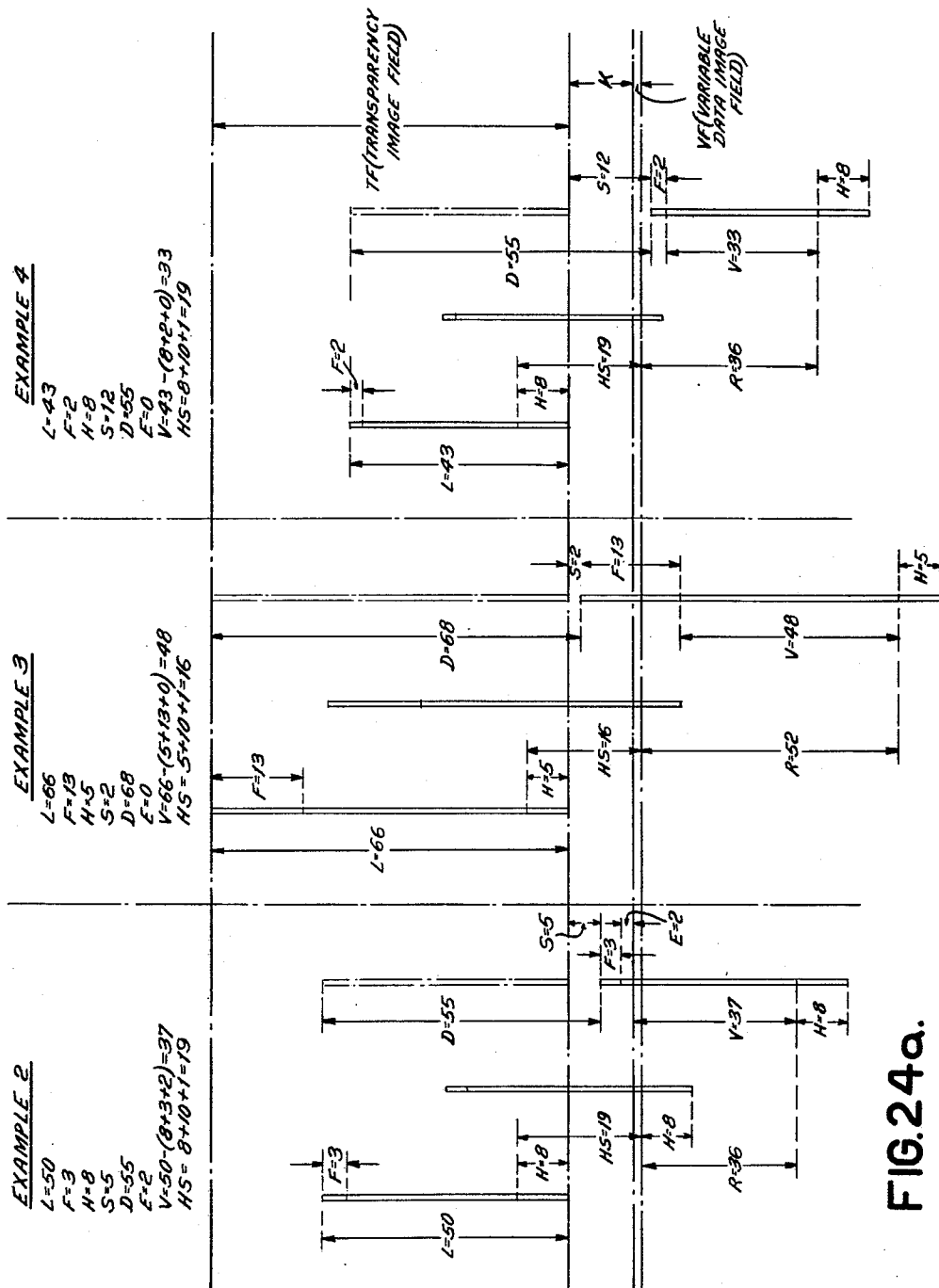
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 20



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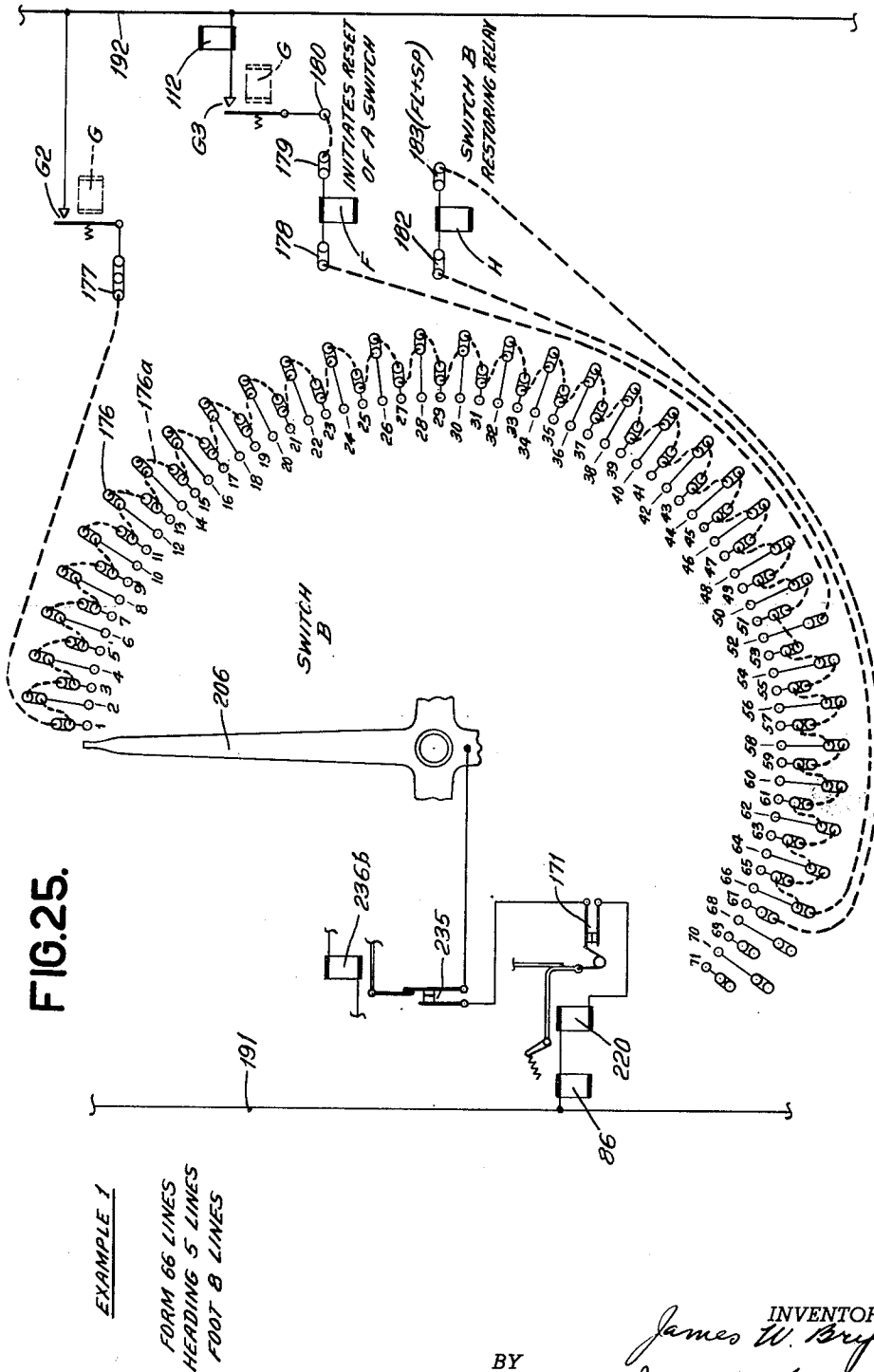
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2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 21



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INVENTOR.
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Dec. 5, 1944.

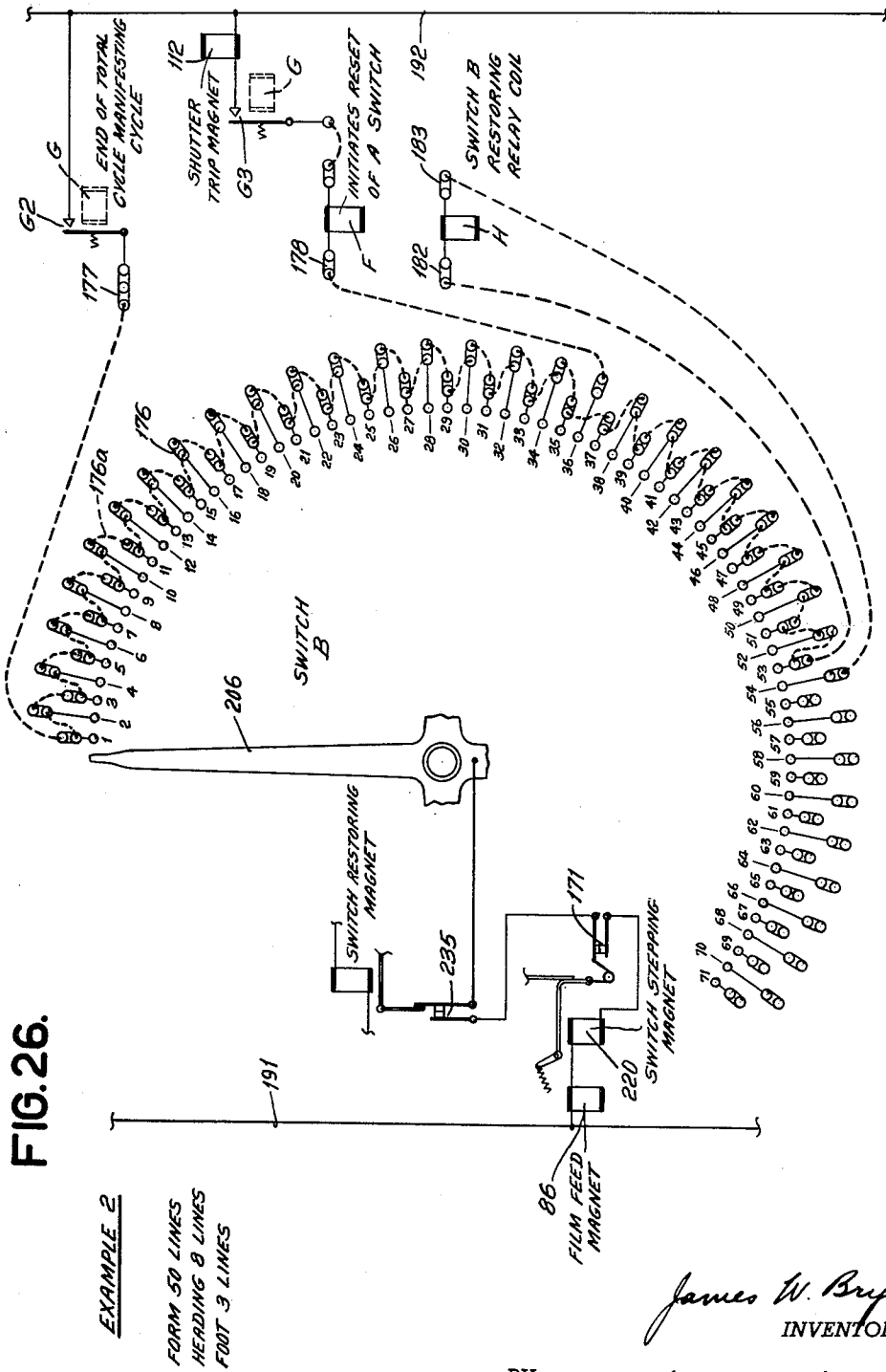
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 22



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James W. Bryce
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2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 23

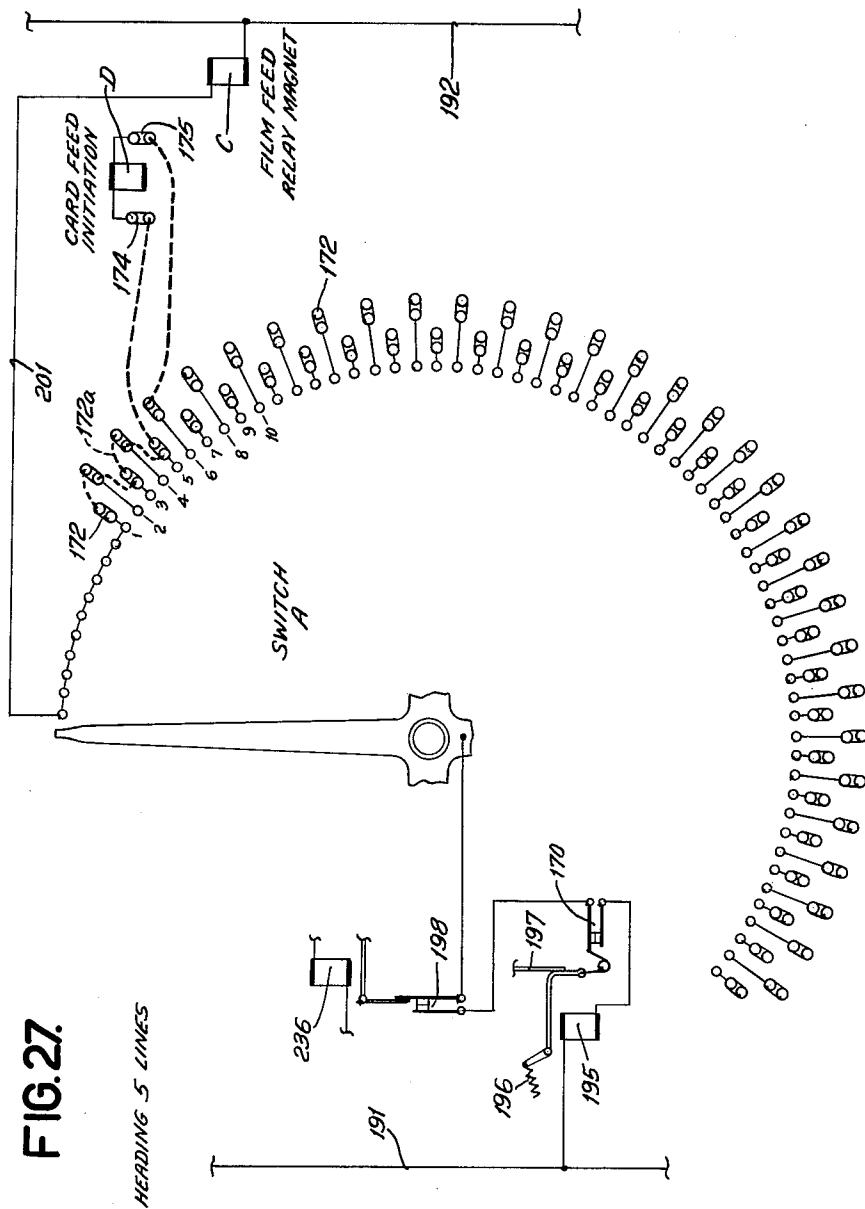


FIG. 27.

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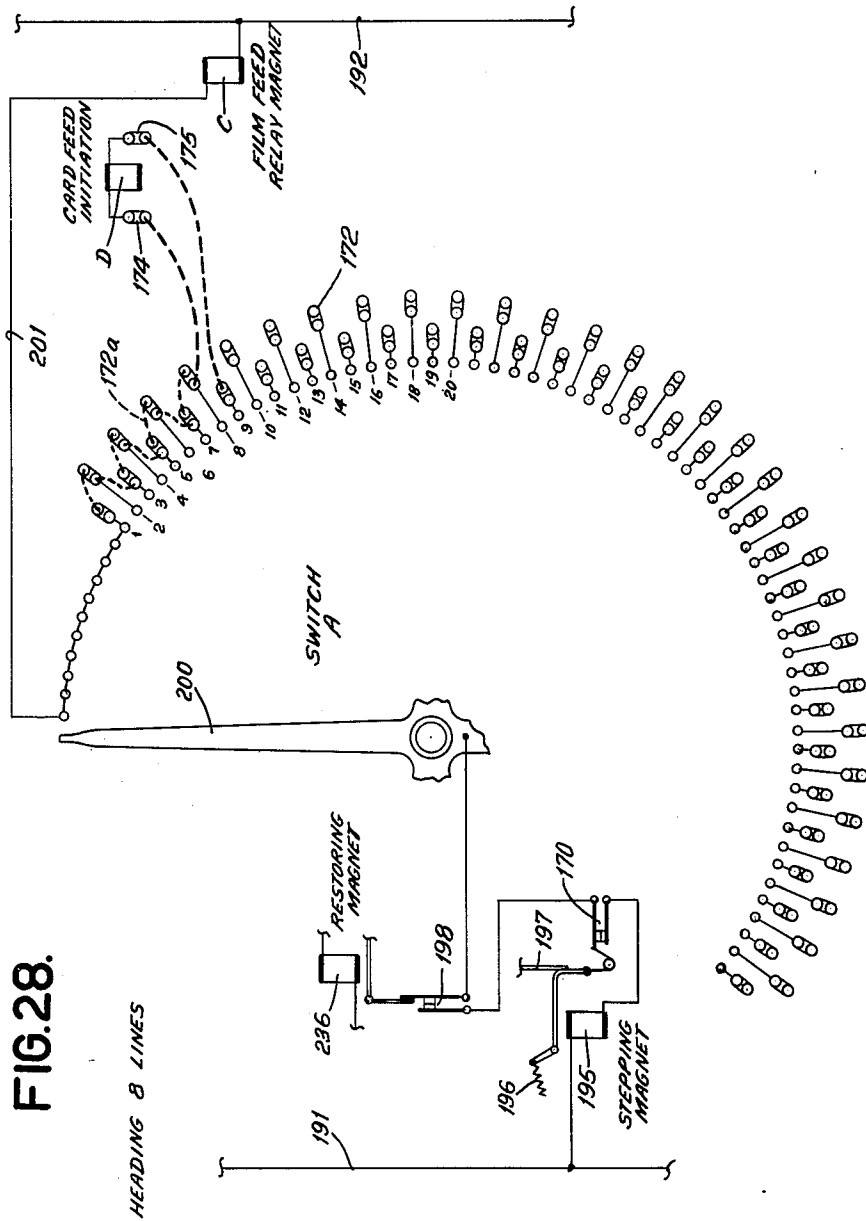
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PHOTOGRAPHIC RECORDING APPARATUS

Filed April 1, 1942

24 Sheets-Sheet 24



James W. Bryce
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UNITED STATES PATENT OFFICE

2,364,188

PHOTOGRAPHIC RECORDING APPARATUS

James W. Bryce, Glen Ridge, N. J., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application April 1, 1942, Serial No. 437,249

16 Claims. (Cl. 88—24)

This invention relates to an accounting machine provided with improved photographic recording apparatus.

In previous machines of this general type provision has been made for recording variable data on a photographic film. This data was derived from records and from the accumulating devices of the accounting machine.

In accounting machines provided with printing devices, variable data is frequently printed on pre-printed forms. Such forms may comprise separate bill heads, ledger sheets or the like or they may be continuous forms wherein a plurality of forms are provided disposed in succession on a continuous web of paper. Obviously such forms have to be pre-printed and this necessitates keeping on hand a relatively large store of different forms.

Difficulty is experienced in maintaining alignment of the pre-printed forms with printed variable data. Furthermore, the paper spacing operations are time consuming because of the length of movement which is necessary. It is frequently desirable to provide for head spacing and to provide adjustability of paper feed for different lengths of heads. These factors detract from the operating speed of the machine.

According to the present invention prepared forms are wholly dispensed with and in lieu thereof the form data is recorded during the operation of the accounting machine and in conjunction with the recording of variable data.

A further object of the present invention resides in the provision of a recording apparatus adapted for recording of forms wherein form changing may be readily effected.

In lieu of recording on paper, it is an important object of this invention to provide for the recording of both the forms and variable data on a film by photographic exposure.

It is a further object of the present invention to provide for photographic recording on a film of form data and of variable data in relation to the form data.

A further object of the present invention resides in the provision of a photographic recording apparatus wherein form data is first recorded on a film and wherein variable data is thereafter photographically recorded in proper relation to the exposed classifying form data on the film.

Another object resides in the provision of a photographic recording machine adapted for form recording in which forms are derived from form patterns carried by members which may be

readily and conveniently interchanged to provide for the recording of different forms.

A further object of the invention is to provide for photographic recording of a complete form upon a film and to record variable data within the area of the recorded form.

More specifically, an object of the invention is to photographically record by a single exposure a complete form which may include a heading and a footing and to record variable data on the film between the heading and footing.

Another object of the invention resides in the provision of means for determining the extent of film feed with relation to one form and to the recording of variable data thereon and to enable recording of the next form to take place at a certain point of such film feed.

Another object of the invention is to provide means for recording forms in succession on a film and for recording variable data derived from a separate group of records within the confines of each form.

Another object of the invention resides in the provision of a record controlled accounting machine with a recording apparatus having means automatically effective upon group change of the records to cause form recording.

A further object of the present invention resides in the provision of a photographic recording apparatus with novel film feed controls.

A further object of the present invention resides in the provision of a photographic recording apparatus with novel initiating controls for causing form recording.

A further object of the present invention resides in the provision of automatic means for causing recording of forms.

In the drawings:

Figures 1 and 1a, taken together, with Fig. 1a to the right of Fig. 1, show a perspective view of the improved machine;

Fig. 2 is a top plan and part sectional view of a portion of the recording unit but with the cover removed. The view is taken substantially on the plane 2—2 of Fig. 1;

Figs. 3 and 3a, taken together with Fig. 3a to the right of Fig. 3, show a sectional view of the recording unit. The section is taken substantially on line 3—3a—3—3a of Fig. 1;

Figs. 4 and 4a, taken together with Fig. 4a to the right of Fig. 4, show another sectional view of the recording unit taken on a different plane, i. e. on plane 4—4a—4—4a of Fig. 1;

Fig. 5 is a sectional view of the camera unit, the section being taken on line 5—5 of Fig. 4;

Fig. 6 is a perspective view of the form carrier which is used in the recording mechanism;

Fig. 7 is a detail sectional view showing the pattern carrying drum and the drive train therefor. This section is taken substantially on line 7-7 of Fig. 3a, but the view is drawn on a larger scale;

Fig. 8 is a detail sectional view taken on line 8-8 of Fig. 7 and shows the neon tubes within the drum and the mounting therefor;

Fig. 9 is a detail view of the tube mounting shown on a somewhat larger scale than Fig. 8;

Fig. 10 is a detail sectional view of the card feeding section of the machine. The section is taken substantially on line 10-10 of Fig. 1a;

Fig. 11 is a perspective view showing certain elements of the accumulator together with the readout device associated therewith;

Fig. 12 is a perspective view of the character carrying drum;

Fig. 13 shows a development of the drum for one complete column of characters;

Fig. 14 shows a code table denoting the manner of manifesting the different numerical and alphabetical characters by different characters of index point designations;

Fig. 15 is a fragmentary view of a typical tabulating card with certain index points perforated to indicate numerical characters and other index points perforated to denote perforations of alphabetical characters;

Figs. 16a, 16b and 16c, taken together and arranged vertically in the order named, show the circuit diagram of the machine;

Fig. 17 shows a timing diagram;

Figs. 18 to 21 inclusive, are diagrammatic views showing various steps of recording operations and the manner in which forms and item data and the like are recorded on the film during successive operations for one typical example of form and data recording;

Fig. 22 is a diagrammatic view generally corresponding to Fig. 18, but pertaining to a different example of form recording;

Fig. 23 shows an enlarged detail view of a portion of the film after development;

Fig. 24 is a diagrammatic view illustrating form positions generally and for one typical example;

Fig. 24a is a similar view of three more examples;

Fig. 25 is an enlarged detail view of the stepping switch shown in the left hand portion of Fig. 16b. This figure further shows the plugging of this stepping switch for a particular example of form recording.

Fig. 26 is a similar view of the same switch shown in Fig. 25, but shows the manner in which the switch is plugged for a different typical example of form recording;

Figs. 27 and 28 are enlarged views of the stepping switch shown in the right hand portion of Fig. 16b. In one view the stepping switch is plugged up for one example and in the other view it is plugged up for a different example of form recording.

General description

The machine in general comprises an accounting section wherein record cards are taken successively from a supply magazine, passed under sensing brushes and delivered to the usual discharge magazine. Data from the records is read by the sensing brushes, and certain numerical data is entered into the accumulating section of the machine. Such numerical data and other

data is also sensed and utilized to control the recording section of the machine.

According to the present invention recording is effective by means of photography. For this purpose the machine is provided with a photographic recording section including a camera unit which has means for properly supporting and feeding a film. The recording section includes a form exposing station. At this station form data which may comprise a heading, a footing, any desired rulings either vertical, horizontal or both or any of these elements is photographed upon the film. The form data is derived from a form pattern which is carried on a plate or transparency supported in a holder. These plates or transparencies are interchangeable at the will of the operator. After the film has received exposure of the form data the film is advanced to what may be termed a variable data exposing station. At this station variable data is exposed on the film, this variable data being derived from a character carrying drum. Selective exposure of the characters on the drum is effected under control of the record cards or alternatively under control of the accumulating elements of the accounting machine. Provision is made to expose one or more lines of the variable data on the film and this variable data is super-exposed on the area of the film which has been pre-exposed with form data. Usually each form will contain the variable data from one complete group of cards and when the exposure is complete the variable data will be disposed on the film within the confines of the form.

Suitable controls provide for film feed for the head space, for the variable data including the total, the footing, the space between forms, etc. Generally the filled in forms are recorded in succession on a run of film. After exposure the film is removed and developed and from this film any desired number of copies can be made.

Generally, in the operation of the machine the cards are arranged in groups and data from a single group of cards is exposed within a single form. The variable data may occupy a part or the whole of an allocated area on the form. If a blank space is left at the end of a form, provision is made for advancing the film to bring it in position in which a new form may be exposed. Such exposure occurs automatically.

Machine operations may be effected with certain manual initiating controls or alternatively with automatic initiating controls. If desired, total-taking may be effected by depression of a total key and re-starting of operations pertaining to a following group may be effected by depression of a start key. Alternatively these operations may be automatic, that is to say, on change of a card group a total will be automatically taken leading eventually to the automatic resumption of card feed.

The present application comprises an improvement on the constructions shown and described in my copending applications, Serial No. 426,550, filed January 13, 1942, and Serial No. 430,597, filed February 12, 1942.

The present improvements are directed particularly to the provision of a machine for exposing a film with form data and in addition exposing variable data on the film within the confines of the form.

The constructions disclosed in the aforesaid applications do not have provision for the recording of form data but merely record variable data. The variable data recording means per se is

claimed in the aforesaid copending applications.

Referring now particularly to Figs. 1 and 1a, the machine in general comprises a record handling and reading unit which is shown in the extreme right in Fig. 1a. At the left of Fig. 1 there is shown the recording section or recording unit. The machine also includes an accumulating section, the location of which is shown diagrammatically in Fig. 1 just to the right of the recording section.

Referring to Fig. 1, 20 designates the driving motor which drives the main drive shaft 21.

Referring to Fig. 1a, fast on the shaft 21 is a gear 22 which drives a gear 23. Fast to gear 23 is a one-revolution clutch element 24 which is freely rotatable on a shaft 25. Clutch dog 26 is carried by a member 27 which is fast to shaft 25. The dog 26 is tripped into engagement with the notch in the clutch element 24 upon energization of card feed clutch magnet 28. Shaft 25, through suitable gearing drives the rotatable brush elements of the distributing commutators generally designated EM1. One of these commutators is provided for each column of alphabetical data to be recorded. Also fast to the shaft 25 are a number of card feed cams CF1 to CF18. The shaft 25 also drives distributors CD1 to CD5.

Gearing generally designated 29 drives the main drive shaft 30 of the card handling unit. This unit (see also Fig. 10) includes the usual card supply magazine 31 and discharge magazine 32. The unit includes card feed rolls 33 driven from shaft 30 by the helical gearing shown in Fig. 1a. Cooperating with the driven rolls and geared thereto are the upper feed rolls 34. 35 designates a conventional picker driven from the picker drive shaft 36 which shaft in turn is driven from the shaft 30 by the helical gearing shown in Fig. 1a.

Referring to Fig. 10, B1 are the advance sensing or analyzing brushes. B2 are the regular or main sensing brushes. Such brushes cooperate with contact rolls 37 and 38. 39 and 40 are the usual card levers, which close card lever card contacts 41 and 42 respectively. When the card feed clutch magnet 28 is energized, shaft 30 is set in rotation, picker 35 withdraws a card from the magazine 31 and advances it into the bite of the first pair of feed rollers. Thereafter the train of feed rolls advances the card first to the advance brushes B1, thereafter under the regular brushes B2, and ultimately the card is fed to the discharge magazine 32.

Referring to Fig. 1a, gear 22 also drives a gear 23a which is fast to a clutch element 24a which is provided with two notches. Fast to shaft 25a is an element 27a carrying a clutch pawl 26a. This pawl is tripped into engagement with either notch of the element 24a upon energization of total clutch magnet TM. The shaft 25a drives a number of T cams T1 to T12. The shaft 25a also drives two distributors TD1 and TD2 and an emitter EM4.

Accumulator

Referring to Figs. 1 and 11, 140 generally designates the customary Hollerith type of accumulator which is driven in the usual way from the main driven shaft 21. 141 is the customary readout (see Fig. 11). 142 is the usual accumulator magnet and 143 is the reset magnet for the accumulator. For further description of the accumulator unit, reference may be had to Lake and Daly U. S. Patent No. 1,976,617. The reset drive is provided in any suitable manner as by the Geneva drive generally designated 144 (Fig. 1). Full description of the operation of this reset

drive may be found in United States Patents Nos. 2,045,437 and 2,049,690.

Recording section

Referring to Figs. 3 and 3a and 4 and 4a, 45 designates a base. Fast to the base are a pair of side plates 46 and 47 (see also Fig. 2). Suitable bearings in plate 46 (see Fig. 7) afford a journal for one end of drive shaft 21. This drive shaft through the gear 48 is adapted to drive a drum driving gear 49. The driving ratio of gears 48 and 49 is one to one. Gear 49 is fixed to one of the end hubs 50 of the character carrying drum. The hubs of the drum are rotatably mounted in bearings 51 in frame plates 46 and 47. Fast to the hub section 50 are annular members 52 which support the character carrying drum 53. The drum is made of suitable light pervious material such as a transparent plastic. The drum is preferably rendered opaque on its surface except at the character displaying portions where the drum is transparent or translucent. In the drawings for clarity of illustration, the characters are shown opaque and the drum transparent but in actual practice the characters would preferably be transparent and the background surface opaque. The drum is provided with a plurality of columns of characters, one complete column being shown in the developed view (Fig. 13). This column of characters comprises the entire alphabet and the digits 9 through 0 inclusive, with the alphabetical characters interspersed between the successive digital characters. The various characters are so disposed that each different character has a predetermined differential position around the periphery of the drum. It may be mentioned that the drum makes one complete revolution during one card cycle, and with the drum in continuous rotation, i. e. rotating in the direction of the arrow (Figs. 12 and 13) the various characters are successively presented to exposing position. With the drum in normal or home position no character would be in exposing position; thereafter the various characters I, R, Z, etc. successively present themselves to exposing position. The drum is also provided with two zero characters (see Fig. 13) for reasons explained in the circuit description. For simplicity of illustration, only one complete column of characters is shown on Fig. 13 and other columns partially indicated. In practice there is a plurality of complete columns depending upon the columnar capacity of the machine.

Disposed within the drum and for trans-illuminating the characters thereon there are a plurality of gaseous discharge tubes such as neon tubes. These tubes are normally extinguished and when it is desired to record the character high potential is applied to a neon tube or tubes at the instant the desired character or characters are in exposing position. The tube will then be fired, the drum will be trans-illuminated and the particular character or characters which are at the exposing position will be recorded on a film, which film is disposed in a camera unit.

It may be mentioned that an individual neon tube 58 is provided for each column of characters. Inasmuch as the drum hubs are hollow, support for the neon tubes within the drum may be provided from outside the drum, the supporting parts extending through the hollow hubs of the drum. The hollow hubs also permit the passage into the drum interior of a cable for supplying the firing current to the various tubes.

Referring now to Fig. 8, 58 designates one of the neon tubes. Such tubes are generally U-shaped and their terminal ends fit into conductive socket elements 56, which are fixed in a block of insulating material 55. The block 55 is supported by brackets 54 which extend through the hubs of the drum to a support outside the drum. The rear of each socket element 56 is provided with a plug receiving portion 60 (see Fig. 9) which receives the plug tip connected to a wire in cable 64. It will be understood from Figs. 7 and 8 that there are a plurality of neon tubes disposed side by side, one being provided for each character column of the drum. Insulating separators 61 are provided between adjacent tubes to prevent illumination from one tube related to one column affecting other columns. A suitable mask 62 is provided which has a central slot 63. This mask is interposed between the drum and camera unit so that only a single line of characters will be exposed at a time.

It may be explained that the recording section of the machine has provision to record on the same film both form data and variable data and that the variable data is derived from the character carrying rotatable drum 53, described above.

The side frame members 46 and 47 of the recording section carry cross bars 66 (Figs. 2, 3a and 4a). Supported on these bars 66 are upper side frame members 46a and 47a and also supported thereby is a horizontal separator plate 68 which divides the interior of the recording section into upper and lower enclosures. Also carried by the base 45 is a left hand frame plate 69 (see Figs. 3 and 4) to which the front frame plate 70 of the camera unit is suitably secured. Inclined braces 71 are provided between the plate 69 and the left hand cross bar 66. A cover 72 is carried by the base 45 and by the frame plate 69. The recording section may be considered as including three units. One unit is the camera unit which is provided with a housing 73 secured to frame plate 70. Another unit is the form data unit which is the unit above the separator plate 68 (Figs. 3a and 4a) and from which the form data is derived. The third unit is the variable data unit including the drum 53 which is disposed below the separator plate 68. The camera unit will now be described in detail.

The camera unit includes two vertically spaced lens and shutter assemblies generally designated 75 and 76 (Figs. 3 and 4). To the left of these assemblies is the film supporting and film feed assembly which is mounted on the support plate 77. Plate 77 is secured to frame plate 70 and carries a stud 78 rotatably mounting a film supply spool 79. Plate 77 also rotatably mounts three shafts 80, 81 and 82, having fixed thereon film feed sprockets 83, 84 and 85. These sprockets are adapted to feed the film generally designated F in Fig. 3, which film is provided with the usual sprocket holes. A takeup spool 86 for the film is mounted on a rotatable stud 87.

Film feed is effected upon energization and subsequent de-energization of a film feed solenoid 88 (Fig. 4). Energization of solenoid 88 lowers a linkage 89 which carries a feed pawl 90. This pawl is engaged with a ratchet wheel 92 which is rigid with the pinion 93. The rigidly connected gear and ratchet are rotatably mounted on a stud 94. The pinion 93 meshes with a gear 95 having a hub 96 (see also Fig. 5) which is rotatably carried on a stud 97. Also fixed to the hub 96 is a pinion 98 which is meshed with a gear 99 fixed to the shaft 81, which drives sprocket 84 (Fig. 3).

Gearing 100 between the gear 99 and the upper sprocket shaft 80 transmits the rotation of the sprocket shaft 81 to sprocket shaft 89. Gear 99 fixed to the shaft 81 also through gearing 102, drives the lower sprocket shaft 82 and to which sprocket 85 is rigidly mounted. The lower sprocket shaft 82 also carries a pulley 103 which, through a belt 104, drives a pulley 105 fixed to the takeup spool shaft 87. Energization of the solenoid 88 lowers the linkage 89 and the pawl 90 carried thereby. Upon de-energization of the solenoid 88 a spring 106 restores the linkage and pawl to normal position. During restoring motion of the pawl the pawl rotates the ratchet wheel 92 for one step of advance. Such step of advance through the drive connections previously described, advances the film one line space.

Shaft 82 which carries the lower sprocket 83 is slotted at one end (see Figs. 4 and 5) to receive a winding key 107 normally disposed in retracted position as shown. This key is used to manually wind up the film F when the film is being inserted and removed from the camera unit.

Referring to Fig. 3, within the camera unit there is provided a lever 108 which is spring pressed and in contact with the film on the supply roll 79. When the film supply on the supply roll is substantially exhausted, member 108 swings to a clockwise position in which it enables contacts 109 to spring open. In the manner to be subsequently explained, the opening of these contacts interrupts the operation of the machine.

The shutter and lens assembly 75 (Fig. 4) is adjusted for a high speed snap exposure. This snap exposure is effected each time shutter trip 110 is moved up by the upward stroke of the plunger 111 of a shutter trip solenoid 112. Energization and de-energization of the solenoid 112 reciprocates the plunger and causes actuation of the shutter. The shutter and lens assembly generally designated 76 is adjusted for a so-called bulb exposure. This shutter is intended to be open and left open during recording and is intended to be manually closed when the recording unit is open for inspection or repair or for form changing. The shutter of this assembly 76 is opened by moving a shutter operating element 114 upwardly and is closed upon return of the element to lower position. Element 114 abuts the top of a slide 115 having a pin and slot connection to a lever 116. This lever is fastened to a pivot 117 (see also Fig. 5). One end of this pivot is slotted for engagement with the key 118. With the parts in the position shown in Fig. 4, lever 116 is at its counterclockwise limit and the connected slide 115 is in upper position in which it holds the element 114 in shutter open position. In the other position of the parts, lever 116 is at its clockwise limit and connected slide 115 is in lower position in which it permits element 114 to move to shutter closing position. A spring actuated impositive detent 119 coacts with the left hand end of lever 116 to maintain it in either of its two positions. Operation of the lever 116 and its related parts is effected by manual manipulation of key 118. By pushing the key in and turning it to rock the lever 116 clockwise from its position in Fig. 4, the slide 115 is lowered permitting 114 to move down and close the shutter. After the lever 116 has been thus rocked to its clockwise limit, it is held in position by detent 119. To return the lever 116 and related parts to shutter opening position the key 118 is pushed in and turned to rock the lever counterclockwise causing the parts to take the position shown in

Fig. 4, in which the shutter assembly 76 is open. The detent 119 again maintains the parts in this position until the key 118 is again turned.

The housing 73 of the camera unit is detachably secured to frame plates 70 by a pair of thumb screws 122 at the top and bottom and by a pair of thumb screws 123 at the sides (see Fig. 1).

Referring to Figs. 3 and 3a, form data is exposed on the film F through the lens and shutter assembly 75. This form data is derived from a form pattern which is insertible into the form unit which is shown on Fig. 3a. The variable data derived from the character bearing drum is exposed on the film through the lens and shutter assembly 76. This variable data is alphabetic and numeric data selected under control of the record cards and the accumulator section of the machine. The general procedure is to first expose the form data on the film by a snap exposure of the shutter and lens assembly 75. The variable data derived from the character drum is subsequently exposed on the film through the lens and shutter assembly 76 which remains open during all recording. The exposure of the variable data is effected in the manner previously explained, that is by firing individual gaseous discharge tubes 58, these tubes being disposed within the character bearing drum and selectively trans-illuminating the characters on the drum and effecting exposure on the film.

Form unit

The form unit provides for the recording of form matter or form data on the film. Such form data which is to be exposed on the film has to be changed from time to time. For this purpose a set of interchangeable form transparencies are prepared. These prepared form transparencies resemble lantern slides. The operator of the machine selects the desired transparency from the previously prepared set and places it in a slide carrier in the form unit.

Referring to Fig. 3a, a transparency plate 127 bears the form pattern. This plate is made of transparent material which may be in the form of a plate or film. In practice the plate or film is opaque except where the form matter appears. For purposes of illustration, however, the plate or film is shown transparent and the form matter opaque. A slide 128 of open rectangular construction and formed with a recess 128a (see Fig. 6) bounding the opening is adapted to carry the form bearing plate or transparency 127. The plate fits into the recess 128a and is held in place by spring clips 129 mounted on slide 128. The slide 128, mounting the transparency plate, is slidably insertible in upper and lower horizontal bars 131 formed with guide channels 131a for slidably receiving the upper and lower edges of the slide 128. The ends of the bars 131 are suitably secured to the side frames 46a and 47a (also see Fig. 2). The left ends of the channels 131a (Fig. 6) are closed to abut the left side of the slide 128 and limit its insertion into the bars 131. The right hand ends of the channels are open so that the slide may be insertible from the open end. To retain the slide in inserted position a lever 133 is spring-urged into position against a shoulder on a projection 128b which forms part of a handle integral with the slide 128.

Access to the interior of the form unit housing is provided by removing a closure plate 134 (Figs. 1 and 2), detachably fastened to the right side of casing 72 of the recording section. To remove the slide 128, together with a form plate 127 car-

ried thereby, from its position in the guide, the closure plate 134 is removed and lever 133 rocked downwardly in Fig. 6 to remove it from the path of the slide. The slide may then be freely retracted from the channel bars 131 and removed. The transparency plate 127 may then be taken off the slide and a different plate mounted thereon. To insert the slide the lever 133 is again held out of the way and the slide is inserted in the channel bars 131. After the slide is fully inserted the lever 133 is released and snaps into slide retaining position. The form plate 127 when in recording position is adapted to be trans-illuminated by a light source 135 located within a reflector 136 (see Figs. 2 and 3a). Any desired type of form matter or pattern may be delineated on the transparency 127. Such form pattern may be, for example, that shown to the left of Fig. 18, provided with a heading and a footing and vertical field-defining lines. The form pattern will be photographed on the film and a plurality of lines of variable data may be recorded thereafter within the area of the recorded form. It will be understood that while the different interchangeable transparency plates 127 are of the same size, the form patterns on these plates may be of different sizes (see Figs. 18 and 22). Different form patterns are employed to provide for different form data and different sizes of forms to accommodate different number of lines of variable data recording. The operator selects a form which is large enough for the maximum number of lines to be recorded within the form. In the further description, the term "form" may refer to the recorded form on the film, the term "form pattern" may refer to the form matter on the transparency plate 127, the term "form data" may refer to the form matter on the plate 127 or on the film, and the term "form record" may refer to a form within which variable data has been photographed.

When form data is to be recorded on the film, the entire form pattern is exposed at a single operation. The magnet 112 (Fig. 4) will be energized to cause a single snap exposure to take place for each successive form to be recorded on the film. As will be understood from Fig. 18, the entire form is photographed at once on the film section, the recording being effected on the section of the film which extends between sprockets 83 and 84 (Fig. 3).

After the film has received an exposure of form data the film is fed downwardly and lines of variable data derived from the character carrying drum are successively exposed on the film within the area of the form. Referring to Fig. 18, this shows the exposure of a form pattern of maximum length and recording of its inverted image on the film. After this exposure the film is fed down a number of line spaces and then the first line of variable data is photographed from the character carrying drum 53 as is diagrammatically indicated in Fig. 19. Successive variable data recordings may now occur, line spacing being effected before each recording operation. Ultimately total data, also considered as variable data, is recorded on the form as is diagrammatically illustrated in Fig. 20. Here again the total data is derived from the character carrying drum. When the form record has reached a certain known position and variable data recording thereon has been completed, an unexposed section of the film is in position between sprockets 83 and 84. The shutter 75 is then again operated to expose the form pattern and record the

next form on the film. This operation is diagrammatically indicated in Fig. 21.

Plugging

Plug connections are effected from the desired 150 sockets (Fig. 16a) of the pre-sensing brushes B1 to the sockets 151 connected to the related EM1 emitters. These connections prepare sensing circuits for closure when the related brushes B1 sense the zone indicia in related card columns. The brushes B2 which sense the intra-zone designations are wired to plug sockets 152. From these sockets plug connections are made to sockets 153 which connect to the accumulator magnets 142. For the usual group control operations, plug connections are made from sockets 150 of brushes B1 to sockets 154 and from sockets 155 to sockets 152 of brushes B2 in the proper columns for group control data. Further plug connections for group control purposes are made from sockets 156 to sockets 157. Other plug connections will be made from the desired ones of the sockets 152 of brushes B2 to sockets 158 which connect to relays generally designated E. It will be understood that one of these relay coils E is provided for each column in which recording is to be effected and for simplicity in the circuit diagram only a few of such coils E are shown.

It may be explained that with the present machine the neon tubes are fired with relatively high voltage and it is desirable that such high voltage be isolated from the relatively low voltage designation sensing or firing control circuits. Accordingly, the related E relay coils are utilized, these being energized by the low voltage sensing circuits. The relays E and other controls in turn are utilized to connect up the neon tubes to receive high voltage current and to connect such tubes for recording as will be subsequently explained. Each neon tube has its opposite terminals wired to a pair of plug sockets 160 and 161 (Fig. 16a). To place a neon tube in a firing circuit, a plug connection is made from a 161 socket to a 162 socket and a connection is made from a socket 160 to a socket 163. It will be understood that as many neon tubes are utilized as are necessary for the required number of columns to be recorded. As stated before, there will be one neon tube for each column of characters on the drum and while only a few neon tubes have been shown on the circuit diagram for simplicity of illustration, it will be appreciated that many more could be provided. Other plug connections are made between sockets 164 and sockets 165. These connections are made for the purpose of providing charging circuits for certain condensers. The purpose of these condensers will be subsequently explained.

To provide for alphabetical recording, zoning circuits must be plugged up. These circuits include the previously described plug connections between the sockets 150 of brushes B1 and the sockets 151 of emitters EM1. In practice there will be as many emitters EM1 plugged up as there are columns of alphabetical characters which are to be recorded.

For total recording, plug connections are made between sockets 166 and 167 (Fig. 16b). Sockets 166 are wired to the readout generally designated 141 and sockets 167 are wired to the sockets 162 (Fig. 16a). Referring to Fig. 16a, it may be mentioned that the right hand bank of condensers with the related neon tube 58 is utilized to record a total symbol on the film. Such bank of condensers has the socket 162 wired to one side of a

pair of T11 contacts which are closed on a total-taking operation.

In practice it will be understood that as many banks of condensers are provided and as many neon tubes are provided as required for the number of columns to be recorded on the film. Four banks of condensers are shown on Fig. 16a with four neon tubes directly associated therewith. Two additional neon tubes have also been shown on the circuit diagram. In practice as many banks of condensers and as many neon tubes will be provided as required.

Total data may be recorded in the same columns in which numerical data is listed. If desired, the plug connections from the total recording sockets 166 can be plugged to condenser banks and related neon tubes which are not utilized for item recording so that a total may be recorded in columns offset from the list of items pertaining to the total.

Film feed control means and related plugging

Means are provided to control film feeding so as to bring sections thereof into form recording position and into variable data recording position. The film feed control means here comprise two stepping switches A and B diagrammatically shown in Figs. 16b and 25 to 28. These stepping switches are of the type shown in United States Patent No. 1,569,450 to Bohlman and have the same general mode of operation. Each stepping switch includes a stepping magnet and a release magnet. The stepping and release magnets of switch A are designated 195 and 236, respectively. The stepping and release magnets for switch B are designated respectively 220 and 236b. For reasons peculiar to the present case each stepping magnet armature has a spring toggle actuated contact associated therewith, i. e. contact 170 for switch A and contact 171 for switch B. These contacts do not snap open until the stepping magnet armature has moved substantially all the way down and also do not reclose until the armature is substantially restored. Each switch has a contact arm adapted to successively engage contact segments. Referring to switch A, the contact arm is designated 200 and the segments are generally designated 200s. Arm 200 is rigid with a ratchet toothed segment 200r which is engaged by a stepping pawl 197. When stepping magnet 195 is energized, it depresses the pawl and concomitantly opens contacts 170. The stepping magnet is then de-energized and permits pawl 197 to return to upper position during which movement it advances segment 200r and connected contact arm 200 one step. When arm 200 is in home position, it holds contacts 208 closed and contacts 209 open. As soon as the arm receives its first step of advance, it permits contacts 208 to open and contacts 209 to close. At the end of the first step of advance of arm 200, it engages the first of the connected segments 200s. Thereafter successive steps of advance of the arm move it from one segment to the next. Energization of the release magnet 236 of switch A will release arm 200 and connected segment 200r for spring actuated return to home position. Certain ones of the segments of switch A are numbered (see Figs. 27 and 28) and these are wired to plug sockets designated 172.

Switch B is advanced and released in the same way as switch A. The stepping pawl of switch B is 197b, the contact arm is 206 and in home position it closes contacts 205 and opens contacts 207. Connected to each segment is a plug socket gen-

erally designated 176 and which may further be referred to by the same number as the connected segment. For example, the socket "53" (see Fig. 26) refers to the plug socket generally designated 176 which is connected to the 53rd segment.

Before describing the plugging and circuits pertaining to film feed, the factors involved in form recording, variable data recording and film feed will be explained. For this explanation, reference will be made particularly to Figs. 24 and 24a.

It is desired to provide for recording of successive forms and for recording of variable data in relation to each form. The variable data related to each form are to be derived from a separate group of records. Such variable data will comprise one or more lines of information, alphabetic or numeric or both, each line derived from a different record of the group. In addition, the variable data may include a total line for recording a total of numerical values accumulated from the records of the group.

The form itself is a photograph of the form pattern depicted on the transparency plate 127 which has been inserted in the form recording unit (Figs. 3a and 6). The form is recorded on film between sprockets 83 and 84 upon snap exposure through the lens and shutter assembly 75. At the time it is recorded, the form is in form recording position designated 1st pos. in Fig. 24. The variable data is recorded through lens and shutter assembly 76 upon the flashing of selected neon tubes to expose character patterns upon drum 53.

It should be noted that the objectives of lens and shutter assemblies 75 and 76 cause reversed images of the form pattern and variable data to be photographed upon the film. Thus, the bottom of the form recorded on the film is a picture of the top of the form pattern and the first line of the recorded form is its bottom line. The term "transparency image field" will be used for convenience, to denote the field of the film which would receive an image of a form pattern of maximum length. While the interchangeable transparency plates are of the same size, the form patterns thereon may be of different sizes. In all cases, however, the form patterns are so arranged on their carrying plates as to have their upper ends in the same position relative to the carrying plates. Further, by such arrangement and due to the image reversal, the bottom of the recorded form, in all cases, is in the same relation to the transparency image field, i. e., at the bottom of this field, as may be understood from Figs. 18, 22, 24 and 24a. The term "variable data image field" is used, for convenience, to denote the image field of a line of variable character data derived from character bearing drum 53.

Three fixed factors are to be considered in relation to form and variable data recording and film feeding. One fixed factor is the length of the transparency image field designated TF (Figs. 24 and 24a). In the present embodiment TF equals 66 lines which is the limit of the length of form which may be recorded. A second fixed factor is the 1 line length of the variable data image field designated VF. The final fixed factor is the fixed distance from the transparency image field to the variable data image field. This distance is designated K and is here equal to 10 lines.

Fig. 24 at the left indicates the recording and film feed relations generally without reference to a specific example. H symbolizes the length of the heading, if any, which is part of the form. F designates the length of the footing, if any,

which is also part of the form. L designates the overall length of the form. S represents the spacing between successive forms; E indicates the surplus space, if any, between the last available variable data line and the footing; HS denotes the head spacing; i. e. the distance required to feed the film to bring the heading below the variable data image field and to present the first variable data line of the film in variable data recording position. V denotes the number of lines available on the form for receiving variable data. The form when head spaced from 1st position is brought to 2nd pos. designated in Fig. 24. In this position, the first line of variable data may be recorded on the form. After such recording, the form is fed down one line space and the next variable data line recorded. Successive lines of variable data may thus be recorded and the film line spaced until the form reaches the position designated FV. This position is determined by the desired spacing between successive forms and when the leading form is in this position, the next form may be recorded. Such next form is indicated in Figs. 24 and 24a by dot and dash lines. The total distance which the form feeds from 1st position to FV position is designated D. R denotes the number of lines of film feed required to move a form from the 2nd pos. to the FV pos. It is obvious that after the form has been head spaced (the distance of HS) to 2nd pos., the remaining distance R to the FV pos. will equal the total movement D minus HS. It may be understood that the variable factors are L (form length), F (footing), H (heading), V (available number, of variable data lines), S (space between forms), HS (head spacing), E (surplus space, if any), D (the total feed of the form from 1st to FV position), and R (the feed of the form from 2nd to FV pos.). The relations of the various factors may be formulated as follows:

(1) $HS = H + K + VF$ or the feed distance to bring the form from 1st position to 2nd position equals the heading length plus the fixed distance from transparency image field to variable data image field plus the length of the latter image field.

(2) $D = L + S$ or the total film feed to bring the form from 1st pos to FV pos. equals the form length plus the space between forms.

(3) $V = L - (H + F + E)$ or the number of lines of the form available for variable data equals the form length minus the sum of the heading length, the footing length and the surplus space, if any.

(4) $E = K - (F + S)$ or the surplus or blank space left between the last variable data line available on the form and the footing is equal to the fixed space between transparency and variable data image fields minus the sum of the footing length and the space between forms and may exist only as a positive quantity.

(5) $R = D - HS$ or the number of lines which the form feeds from 2nd pos. to FV pos. equals the total feed D minus the head spacing.

The presence in some cases of surplus space E is explained by the fact that no further variable data recording is to take place on a form after it is fed down from FV position and by the further fact that the footing may not occupy the entire length of the portion of the form projecting within the space K when the form is in FV position. Obviously, such surplus space will not exist if the footing length occupies the entire length of the portion of the form projecting into space K when the form is in FV pos. nor will it exist if the spacing between forms equals or is greater than space K.

The above formulas will be applied to the four examples illustrated in Figs. 24 and 24a.

Example 1.—The maximum length of form is used and L equals 66 lines. The heading H is 5 lines; the footing F is 8 lines; and the desired space S between forms is 2 lines. Applying Formula 1 to find the head spacing, it is seen that HS equals $H(5) + K(10) + VF(1) = 16$ lines. From Formula 2, it is found that the total feed D of the form from 1st to FV position equals $L(66) + S(2) = 68$ lines. Formula 4 gives the surplus space E as 0 since $F(8) + S(2)$ equals $K(10)$. According to Formula 3, the number of lines V available for variable data equals $L - (H + F + E)$. Substituting the values in Example 1, it is found that V equals $66 - (5 + 8 + 0)$ or 53 lines. By Formula 5, R (the distance of feed from 2nd to FV pos.) equals D (the total feed) minus HS (the head spacing). Substituting the values of D and HS obtained for Example 1, it is seen that $R = D(68) - HS(16) = 52$ lines.

In Example 2, the form length L is 50 lines, the footing is 3 lines, the heading is 8 lines and the space between forms is 5 lines. Applying the formulas to this example, it is found that:

- (1) HS equals $H(8) + K(10) + VF(1)$ or 19 lines;
- (2) D equals $L(50) + S(5)$ or 55 lines;
- (3) V equals $L(50) - H(8) - F(3) - E(2)$ or 37 lines;
- (4) E equals $K(10) - F(3) - S(5)$ or 2 lines;
- (5) R equals $D(55) - HS(19) = 36$ lines.

In Example 3 (Fig. 24a), L is 66, H is 5, F is 13, and S is 2. The head spacing HS is the same in this example as in Example 1 and is equal to 16 lines. Likewise D is the same as in Example 1 and is equal to 68 lines. Formula 4 gives E, the surplus space as a negative amount since $F + S$ equals $13 + 2$ or 15 which is greater than K which is only 10 lines. When E is negative, it does not exist and V then equals $L - H - F$. Substituting the values of Example 3, V equals $66 - 5 - 13$ or 48 lines. $R = D(68) - HS(16)$ or 52, the same as in Example 1 where D and HS also equal 68 and 16, respectively.

In Example 4 (Fig. 24a), L is 43, H is 8, F is 2, and S is 12. Substituting these values in the formulas, it is seen that HS equals 19 lines just as in Example 2. Further D equals $L(43) + S(12)$ or 55 lines, the same as in Example 2. With $D = 55$ and $HS = 19$, then $R = 36$, the same as in Example 2. Obviously, E is not present so that V equals $L(43) - H(8) - F(2)$ or 33 lines.

It may be explained that the number of lines available for variable data recording exceeds by 1 the limit number of record cards which may be contained in a group of cards from which data are to be recorded within the form. This is so because one variable data line is reserved for the total. Further, the total is to be recorded on the line immediately following the last recorded line of variable data derived from the last card of the group. The actual number of cards in a group may be less than the limit number in which case the film will be line spaced after the total has been recorded until the form reaches the FV position. At this point, the next form will be recorded and the film will be line spaced further to eject the leading form and to head space the next form to 2nd position. At this stage, the recording of variable data may start and the new group of records fed through the record reading means. In all cases, the feed of a group of records and recording of variable data selected thereby is to be initiated after the form

has reached 2nd pos. In the present embodiment of the invention, the card feed may be initiated manually or automatically except for the first group of records the feed of which is always automatically initiated in a special manner as will be brought out in the circuit description. Further, group control means are provided to detect a change in card group or to detect the exhaustion of a group and to thereupon interrupt card feed. Initiation will then be effected of a total cycle during which the total will be recorded. If the total record is made on the form while the form is in FV position, then recording of the next form will occur as an incident of the total cycle and before the film is advanced from the total recording position. If the total is recorded on the form while the form is in a position intermediate 2nd pos. and FV pos., further feed of the film will be initiated during the total cycle. During continuation of the film feed when the form reaches FV pos., the recording of the next form will automatically take place and following this operation, the said next form will be fed to 2nd pos. When the next form has reached this position, film feed will stop and may be initiated only as a result of operations on a new group of records.

Each form transparency may be kept in an envelope suitably marked with the variable factors related thereto. The operator will select the proper form pattern suitable to the data to be derived from the cards to be operated upon. Further, a form pattern will be selected to provide for recording of a form which will have sufficient number of variable data lines available for receiving data from the limit number of cards in any card group and for receiving the additional total.

From Formula 1, the operator may obtain the required head spacing factor. It will be noted that the head spacing equals the length of the heading plus a fixed amount of 11 lines, such fixed amount being the sum of the factor K lines (10) between the transparency and variable data image fields and the length VF of the variable data image field (1 line).

Having been instructed on the desired spacing between forms the operator need only add this amount to the form length to obtain the factor D from Formula 2. From Formula 4, the operator will obtain the factor E if existent. To obtain space E, the operator need only subtract the sum of the footing length and the space between forms from the fixed factor K (10). Having ascertained E, the operator may use Formula 3 to obtain the number of lines V available on the selected form for variable data. To obtain this factor V, the operator subtracts the sum of the lengths of footing, heading and E (if positive) from the overall length of the form. From Formula 5, the operator may obtain distance R or the film feed distance from 2nd to FV pos. To calculate R, it is merely necessary to subtract HS from D. Preferably, all these factors may be calculated in advance and given on the envelope enclosing the form pattern or on a sheet accompanying the form pattern. Such information will include the form length L, the heading length H, the footing length F, the space to be observed between forms or S, the distance D, the head spacing HS, the distance R, and the number of lines available for variable data or V.

To plug the machine so as to provide the necessary film feeds, the operator need know only the factors D, R and H. The control of film feeding

and next form recording is effected by means including stepping switches A and B described before. Switch A is used only in connection with the recording of the first form of a new run of forms and then only to control head spacing for this first form. The switch A after it has controlled head spacing for the first form automatically initiates feed of the first group of cards and film feed is then continued with concomitant operation of switch B until the first form of a new run of forms is again to be recorded.

Fig. 27 shows the plugging of switch A for controlling a head spacing of the first of a new run of forms through 16 lines, as required for both Examples 1 and 3 (Figs. 24 and 24a). Switch A is so constructed and arranged that the operator is required to know only the heading length in order to plug up the switch properly. Thus in Examples 1 and 3, the heading length is 5 lines, and the operator plugs up the socket 172 of the segment numbered 5 to a socket 174. The preceding sockets, i. e., those wired to segments 1 to 4 are then plugged in series with each other and with the socket of segment 5 by plug wires 172a. In addition, the operator plugs the socket of segment 6 to a socket 175.

Fig. 28 shows the plugging of switch A to provide for a head spacing of 19 lines, as required for Examples 2 and 4 (Fig. 24a). The heading in both these examples is 8 lines. Accordingly, the socket of segment 8 is plugged up to socket 174, the sockets of segments 1 to 8 are plugged up in series by plug wires 172a and the socket of segment 9 is plugged up to socket 175.

In general, to plug up switch A, the operator plugs the socket 172 of the segment whose number is equal to H (the heading length) to the socket 174 and then plugs up this socket 172 and the preceding sockets 172 in series. Finally, the socket 172 following the socket of the segment whose number equals H is plugged up to the socket 175. This completes the plugging of switch A.

Switch B does not operate until after switch A has controlled feed of the first form to 2nd pos. (Fig. 24) and has concomitantly initiated card feed. Switch B arm 206 then advances step by step from home position as the film is fed line by line to FV pos. At this point, recording of the next form takes place and after such operation, the switch arm continues its advance, step by step, and controls line by line feed of the newly recorded form to head space it to 2nd pos., meanwhile causing ejection of the first form. The switch arm then returns to home position preparatory to a new cycle of film feed operations. Each such film feed cycle involves feed of a form from 2nd pos. to FV and feed of the next form from 1st pos. to 2nd pos. Obviously, regardless of the order in which these successive feeds of the film during the stated cycle occur, they add up to amount D which is equal to L (form length) + S (spacing between forms) and is also equal to HS (head spacing) + R (spacing from 2nd to FV, pos.). The factor D serves as an index number to determine completion of such cycle of film feed operations. At this time, it should be stated that the total advance of the switch B arm 206 from home position to final position involves a number of steps of advance which is one less than the advance of the film during the film feed cycle. As will be brought out in the circuit description, when the switch arm 206 reaches its final position, it initiates a further line space advance of the film which is the last line space of the film

feed cycle but the arm itself returns from final position directly to home position. Accordingly, while the film advance during a film feed cycle equals D, the total extent of advance of the switch arm 206 from home position to final position is less than D by unity. Thus, the total advance of the switch arm from home position to final position must equal D-1 and the resulting number is used to select the plugging for determining the final position of the switch arm from which it is restored to home position.

Referring, for instance, to Fig. 25, the switch B here is plugged in accordance with Examples 1 and 3 shown in Figs. 24 and 24a. In these examples, D equals 68. Accordingly D minus 1 equals 67. Hence the operator connects the socket 176 wired to the 67th segment of switch B to a socket 183 which leads to one side of a switch arm restoring control magnet. The other side of the restoring control magnet is connected to a plug socket 182 and the operator connects this socket by plug wire to the socket 176 wired to the 66th segment of the switch, i. e. the segment the number of which is equal to D minus 2. In Fig. 26, switch B is shown plugged for Examples 2 and 4 (see Figs. 24 and 24a). In these examples the factor D equals 55 and thus D minus 1 equals 54 and D minus 2 equals 53. Accordingly, the operator connects by plug wires the sockets 176 of the segments 53 and 54 to the sockets 182 and 183 of the restoring control magnet. Such plugging takes care of the final position of the arm 206 of the switch B.

Another factor which the operator must consider in plugging switch B is the factor R. It will be recalled that this factor was derived by Formula 5 and is equal to D minus HS (head spacing). As described before in Examples 1 and 3, the head spacing equals 16 lines and D equals 68 lines so that factor R equals 52 lines. This factor it will be recalled is equal to the number of lines of feed required to bring a form from 2nd position to FV position. With the leading form in this position, the next form is to be recorded. Accordingly, referring to Fig. 25, since R for Examples 1 and 3 is equal to 52, the operator connects by plug wire a plug socket 178, which is connected into circuit with the shutter trip magnet 112 of the form recording unit, to the socket 176 wired to the 52nd segment of switch B. When arm 206 has reached the 52nd segment then the form has been advanced 52 line spaces from second position to FV position and at this point the circuit to the shutter trip magnet 112 may be completed in a manner described later in the circuit description. In addition to these pluggings, the operator in all cases connects the socket 176 of the first segment on switch B to a plug socket 177 and then serially connects by plug wires 176a the following sockets, skipping over the socket of the segment 52 (corresponding to R), down to the socket related to the D minus 2 segment, e. g. 66th segment for Examples 1 and 3.

For Examples 2 and 4 the plugging is shown in Fig. 26. In these examples the factor R equals 36. Accordingly, the operator plugs up the socket 176 wired to the 36th segment to plug socket 178. The socket 176 of the first segment is again plugged up to socket 177 and serial pluggings 176a are made in the manner indicated before, skipping the 36th socket, and terminating at the 53rd socket. This completes the plugging for switch B.

In the disclosed embodiment, total-taking is effected by either automatic or manual depression of a total key and upon a total-taking operation the B stepping switch advances forward and causes film feed to advance the film to an extent necessary to cover the distance between the total recording position to the end of the form and causes additional film feed to a sufficient extent to bring the film to a position in which recording may be effected of variable data upon the next following form. In addition, this B stepping switch causes form exposure to occur on the film when the film has been advanced to a sufficient extent to present unexposed film in position for receiving an exposure of a following form without overlapping the exposure on the previously exposed form.

Summarizing, the B stepping switch makes one step of advance for each line of variable data that is recorded until the machine stops for a total-taking operation. After the total is recorded under manual key control, the switch continues to advance step by step during which time film feed is being continued. When the previously recorded form has moved out of form recording position this switch completes a circuit to cause recording of the next form. Stepping operations then continue to control the feed of the newly recorded form to a position to receive variable data under record card control, and the B stepping switch is restored to home position in which it permits initiation of card feeding operation pertaining to the next card group under a start key control or under an alternative automatic control.

Circuit diagram and operation

Assuming perforated cards are in the supply magazine, the operator first closes main line switch 190, supplying current to lines 191 and 192 (Fig. 16c). Current supply available on lines 191 and 192 illuminates the lamp 135 (see Figs. 16c and 3a). The circuit is from line 191 through lamp 135 and the switch 193 in the position shown, to line 192. The transparency plate 127 in the form recording section of the machine is now trans-illuminated and the form pattern appearing on the plate may be recorded on the film as the first of a new run of forms in the following manner.

It will be assumed that the camera unit has been properly loaded with film prior to this operation. The operator depresses a key 194 (Fig. 16b, lower right) which may be termed a "new form key" and which key is always used to initiate operations when a form is recorded on the film for the first time. Depression of key 194 closes its contacts and establishes a circuit from line 192, through shutter trip magnet 112, through the key controlled contacts 194a, through stepping magnet 195 for stepping switch A and back to the other side of line 191. The energization of the shutter trip magnet 112 (see also Fig. 4) causes exposure and recording of the trans-illuminated form pattern upon the film. When the key 194 is released, magnet 195 is de-energized and the spring 196 restores the armature and the actuating lever 197 of the stepping switch so that the stepping switch A is advanced from home position to the first unnumbered segment position. A circuit to re-energize magnet 195 and film advanced relay C is completed as follows: from line 191, through stepping switch magnet 195, a set of armature controlled contacts 170, a set of contacts 198, through stepping

switch arm 200, through the first unnumbered segment, via a circuit 201 to relay C and back to line 192. Energization of relay C closes contacts C1 (Fig. 16b, lower left) to provide a circuit from line 191, through film advance magnet 88, back to line 192. Relay C is, however, only momentarily energized since actuation of the armature of magnet 195 opens contacts 170, thereby causing relay C and stepping magnet 195 to be de-energized and permitting actuating lever 197 to restore and advance stepping switch arm 200 to the next position. After relay C is de-energized and while the switch arm 200 is advancing to the next segment, relay contacts C1 open causing de-energization of film advance magnet 88, whereupon the film is advanced one line space. Relay C is again energized and another step of advance of the film is effected upon subsequent de-energization. This succession of stepping movements of the switch A, arm 200 continues and the film is advanced a number of line spaces equal to the number of steps of advance of the switch arm 200 from each segment to the next segment.

In the present machine the first ten unnumbered segments and the first numbered segments are connected by fixed wiring to take care of the fixed film spacing of 11 lines required to bring the first form from form recording position to a position in which its first line is at variable data recording position. In addition, a further film advance equal to the height of the form heading must be effected. Referring to Fig. 27, for a heading 5 lines high, the additional spacing is provided for by plugging the segments numbered 1 to 5 in series by plug wires 172a and by the plug connections between sockets "5" and "6" to sockets 174 and 175, as explained before. Hence the number of line spaces which the film has been advanced at the time the switch arm reaches the segment spot designated "5" is 14 line spaces, the switch arm 200 advances thereafter from the 5th segment spot to the 6th and this advance is accompanied by line spacing of the film so that at this stage 15 line spaces of film advance has been effected. Then when the arm of stepping switch contacts the segment marked "6" a circuit is completed from line 191 (Fig. 27), stepping switch magnet 195, contacts 170, contacts 198, switch arm 200, the segment marked "6" to the related 172 plug socket. From this plug socket a circuit is completed to a plug socket 175 which is in turn connected to a relay coil D to energize it. The circuit from this relay coil extends through the 174 socket back by plug connection to socket 172 pertaining to the 5th segment. From this socket the circuit is completed back through the several serially connected sockets and segments to the first unnumbered segment, thence by circuit 201 to relay coil C, and back to line 192. The above circuits provide for the energization of relay coils C and D. The energization of relay coil C and its subsequent de-energization results in the feed of a film for an additional line space. At this point the film has advanced a total of 16 line spaces and the first line of the form following the heading is in position to receive variable data from the drum. This general relation is shown in diagrammatic view, Fig. 19. Relay D may be termed a card feed initiating relay and when this relay is energized it closes its contacts D1, to energize relay coil J (see Fig. 16c). This relay may be termed the card feed initiating holding relay. The circuit is from line 191, through contacts D1 now closed, relay coil J, back to line 192. Relay

J is maintained energized by a circuit through cam contacts CF10 and stick contacts J1. Closure of relay contacts J2 (Fig. 16c, upper left) completes a circuit to energize the card feed clutch magnet 28 as follows: from line 191 (Fig. 16c), through the series of normally closed relay contacts L1, relay contacts P1 now closed, through relay contacts J2 now closed, through contacts 205, now closed (such contacts being closed with arm 206 of stepping switch B in normal home position), cam contacts T9, film lever contacts 109 (see also Fig. 3) and in parallel through a relay coil Q, and card feed clutch magnet 28 to line 192. Energization of card feed clutch magnet 28 (Fig. 1a) causes the card feeding mechanism to function and cards are fed one by one from the supply hopper. Reference has just been made to a set of contacts 205 associated with the arm 206 of stepping switch B. Referring to Fig. 16b, it will be seen that these contacts are closed when the arm 206 of the B stepping switch is in home position and such contacts 205 open when the stepping switch moves from home position to any one of the segment positions. When the switch arm 206 moves away from home position another set of contacts 207 also close. Similarly, when the arm 200 of stepping switch A moves away from home position contacts 208 open and contacts 209 close.

It has been mentioned previously that cards are fed from the supply magazine one by one. During the first card feeding cycle the card lever contacts 41 (see Fig. 10) close and energize advance relay coil M (Fig. 16c). Relay M is maintained energized by a circuit through stick contacts M1, and cam contacts CF3, when the card lever contacts 41 open between cards. Relay contacts M2 close to complete a circuit from line 191, series relay contacts L1, relay contacts P1, contacts M2, stop key contacts 210, relay contacts Q1, film lever contacts 109 and in parallel through magnet 28 and relay coil Q to line 192. Thus as long as cards are feeding and card lever relay coil M remains energized, the card feed clutch magnet 28 will remain energized to keep the card feed in operation. During the following cycle the zoning designations derived from the record are set up on relays for the control of recording operations on the next succeeding cycle.

Assume an "11" zoning hole is punched in a record. Under such conditions the circuit for energizing a zone relay coil is as follows: from line 191 (Fig. 16a), relay contacts M3, cam contacts CF16, contact roll 37, through the 11th hole in the record, through one of the brushes B1, through one of the plug sockets 150, through a plug connection to socket 151, emitter EM1, out via the 11th segment of this emitter, through the corresponding zone relay coil Z11 and back to line 192. Contacts Z11a close to maintain relay Z11 energized through cam contacts CF1. Near the end of this same card feed cycle card lever contacts 42 (Fig. 16c) close to energize relay coil N which establishes its holding circuit through cam contacts CF5 and relay contacts N1.

Summarizing the operation just described as to card handling; on the first card cycle, a card is withdrawn from the supply hopper 31 (Fig. 10) and advanced to a point in which the leading edge is just under the pre-sensing brushes B1. On the following machine cycle, the card traverses the pre-sensing brushes, and it is during this cycle that the zone designations are sensed and the zoning relay coil or coils set up.

It may be here mentioned that with the pres-

ent machine exposure of variable data from the character carrying drum is effected by firing the related neon tube or tubes at the proper differential times. Such neon tubes required considerable voltage to fire them. In order to provide such voltage, use is made of sets of condensers K, one set of condensers being provided for each column of data to be recorded. The condensers are charged from the relatively low voltage D. C. supply lines with the condensers of each set connected in parallel. When so connected the condensers will be charged to approximately the line potential of the low voltage D. C. supply lines. After the condensers are thus charged, and before recording, provision is made for re-connecting the condensers of each set in a series relation. With the condensers connected in this way a high potential is available for flashing or firing a related neon tube or tubes.

It will be further appreciated that if a neon tube will fail to fire for any recording operation, the result would be that there would be no exposure on the film for that particular columnar order. With such a tube failure, many lines of film might be run through the machine before the tube failure was detected. It would only be after the film had been removed and developed that such tube failure would be detected. To prevent such undesired operation testing and indicating means are provided. The general principle of operation of the testing and indicating means may be explained as follows: If a particular neon tube fails to fire, its related bank of firing condensers K will retain a charge after the tube has failed to fire. This retained charge may be utilized to energize testing relays. If such testing relays become energized an indicating lamp pertaining to that particular column is illuminated and furthermore, machine operation is automatically terminated. On the other hand if the sets of condensers after recording operation retain no charge, the testing relays will not be energized, the indicating lamp or lamps will not be illuminated and the machine operation will then be permitted to continue. Tests have demonstrated that relatively short and small neon tubes can be fired reliably with an applied voltage in the neighborhood of 1000 volts. Tests have also shown that with the direct current supply of 110 volts, the proper firing voltage can be obtained by using 10 condensers each with a capacity of .25 microfarad and with such condensers connected in parallel for charging and in series for firing. Tests have also demonstrated that a character image can be sharply recorded on a panchromatic XX film with a lens system operating with an aperture of F4.5 and deriving light from a neon tube fired at approximately 1000 volts, and with the light of the tube passing through the moving character carrying drum under the following operating conditions. With a drum rotating at a speed of 150 revolutions per minute and with a 16 point cycle machine, four characters will pass the exposing point during each index point position. Under such recording conditions 64 character positions or spaces will pass the exposing position during one machine cycle. Accordingly, with 150 drum revolutions per minute, 9600 character positions will pass per minute or any one character position will pass the exposure position during $\frac{1}{160}$ of a second. Tests have also demonstrated that a neon tube can be fired using a commutator to establish the circuit to the tube and to accurately time the firing circuit with the commutator completing a

circuit for a period of approximately $\frac{1}{1200}$ of a second. With such timing of tube firing, effective exposure was obtained and the film upon development disclosed clearly defined character images, notwithstanding drum movement during exposure.

Referring now to conditions in the third machine cycle, when the first record passes under the regular analyzing brushes B2, at the beginning of this cycle a bank of condensers K pertaining to a related card column (see Fig. 16a) is charged. The charging circuit is from line 191, relay contacts N3, impulse distributor CD1, resistance 212, in parallel through all of the R2 contacts, through the condensers K, through the S2 contacts, through the plug connection between sockets 164 and 165 and back to line 192.

It may be here mentioned that there is a CD1 timing commutator for each set of a plurality of sets of condensers and that all of these sets of condensers are concurrently charged. The charging circuit for one of the banks of condensers has been described and with such charging circuits established the related sets of condensers are charged to approximately 110 volts.

As soon as the various sets of condensers are charged provision is made for reconnecting the condensers of each set from their parallel relation to a series relation. Closure of cam contacts CF9 at the time shown in the timing diagram, establishes an energizing circuit through relay contacts N3 and cam contacts CF9 for relays R and S. With such relays energized, the contacts R2 and S2 open and the contacts R1 and S1 close. With such latter contacts closed, the various condensers of K of each set are connected in a series relation.

During the third machine cycle, i. e. the cycle in which the first card is traversing the brushes B2, recording control magnets E are energized and the auto-control circuits are set up. Assuming that the cards under the brushes B1 and B2 have agreeing group designating perforations, an auto-control circuit is established as follows: from line 191, through contacts M3, cam contacts CF16, contact roll 37, thence through a B1 brush and the plug connection from socket 150 to socket 154 of a relay U. The circuit is completed through the pickup coil of such relay U as follows: from socket 155, by way of a plug connection, not shown, to socket 152 through a brush B2 to the contact roll 38, thence via the cam contacts CF11, through relay contacts N4 to line 192. The auto-control relays which are of the usual dual winding type are picked up and close the stick contacts U1, to maintain the relays energized through a circuit extending from line 191, through cam contacts CF7. The energized U coils open the related U2 contacts so as to prevent energization of master auto-control relay P.

It may be pointed out that if the cards do not have corresponding agreeing group perforations that one or more of the U2 contacts will remain closed and upon closure of cam contacts CF13 near the end of the cycle, a circuit to coil P will be established via relay contacts N5, cam contacts CF13 and CF7. Coil P will then open contacts P1 to break the card feed clutch magnet circuit (see Fig. 16c).

The relays E are energized under the control of the B2 brushes as they sense intra-zone or zero perforations in the columns where alphabetical recording is desired. It may be assumed that the card had an "11" zone indication in a particular column and let it also be assumed that it had an

intra-zone value of "4" in the same column. At the "4" index point in which the card passes the brushes B2 a circuit will be completed from line 192, through relay contacts N4, cam contacts CF11, contact roll 38, through the hole in the card, through a B2 brush, through the plug connection from socket 152, to 158, relay coil E and back to line 191. Relay E is maintained energized under the control of stick contacts E1 and cam contacts CF2. Inasmuch as the record card had zone designation of "11," relay Z11 will have been energized in the manner previously explained. Closure of contacts E2 (Fig. 16b) completes a circuit during the time the distributor CD3 makes in the 4th cycle point as follows: From the right side of the line, one of the charged set of condensers K, through this condenser to the line 213, thence through the associated now closed contacts S1, through the next condenser K and so on in series through the remaining condensers of the set and through the last one of the condensers through the upper R1 contacts and through plug socket 163. The circuit continues through a plug wire connected (not shown) to plug socket 160, through neon tube 58, through plug socket 161, and via plug connection to socket 162. From socket 162, the circuit is completed via line 214 (see also Fig. 16b), relay contacts E2 now closed, relay contacts Z11b now closed, to common "11" zone line 215, distributor CD3, line 216, through normally closed relay contacts V1, to a line 217 (see also Fig. 16a), via resistance 218, to the terminal of the lowest one of the contacts S1, and thence to the right hand side of lowest condensers K from which the circuit was started to be traced. This circuit is completed at the time the character M is in position to be recorded as will be clear from the timing diagram (Fig. 17). Note the "4" index point and the time of closure of the circuit controlled by distributor CD3. The full potential of the serially connected condensers will be available and applied to the neon tube. Such tube will then be fired and the condensers will be permitted to be discharged. As the neon tube is fired the recording drum will be trans-illuminated and the character M will be recorded on the film. Other characters or digits will be similarly recorded in other columns.

Zoning control

An explanation will be here given of the means whereby the zoning control is capable of selecting any one of four different characters pertaining to a zoning designation. Referring to Fig. 13, it may be explained that in the 9 intra-zone designation set there are four characters reading upwardly I, R, Z and 9. Such characters pass the exposure position in the order named. In accordance with the zone designation or lack of a zone designation in the card column accompanying a 9 intra-zone designation in the same column, one of these four characters will be selected for exposure. The zoning selection is effected through the use of the four distributors CD2, CD3, CD4 and CD5 shown in Fig. 16b. Distributor CD2 has its successive contact segments spaced apart the equivalent of one index point of a cycle, but the first contact segment is engaged by the distributor brush at the beginning of the 9 cycle point. The second segment is engaged one cycle point later at the beginning of the 8 index point and so on (see Fig. 17). Distributor CD3 has its contact segments spaced likewise the equivalent of cycle points apart, but the first contact

segment of this distributor CD3 reaches its distributor brush a quarter of a cycle point later than the first contact segment of the distributor CD2 reaches its brush. Thus as indicated in Fig. 17, distributor CD3 has its effective circuit closing intervals timed to make one-quarter of a cycle point later than the effective circuit closing intervals of distributor CD2. Similarly the segments of distributor CD4 engage its distributor brush one-quarter of a cycle point later than the segments of CD3 engage their brush. Furthermore, the segments of distributor CD5 engage their distributor brush one-quarter of a cycle point later than the segments of CD4 engage their coacting brush.

Reference to Fig. 17 shows that during the 9 cycle point distributors CD2, CD3, CD4 and CD5 successively engage their first segments with their respective brushes at one-quarter cycle point intervals apart. The second set of segments bear the same relation during the 8 cycle point and so on for all the other cycle points.

If the zoning designation in a column was 0, then zoning relay coil ZO will be energized (see Fig. 16a) and its contacts ZO_b will close (Fig. 16b). Referring to Fig. 16b, the contacts ZO_b connect to a common line 219 which is in circuit with the brush of the distributor CD4 so as to select this distributor for controlling the closure of a tube firing circuit. If the intra-zone designation be 9, this exposure or tube firing circuit will be made through the distributor CD4 at the point marked Z (Fig. 17) during the 9th cycle point. At this time the character Z on the drum is passing the exposure position and this character will be photographed as the exposure or tube firing circuit is closed. If the zone designation be 11, contacts Z11_b will be closed (Fig. 16b) and the distributor CD3 would be selected for controlling the establishment of the tube firing circuit. If the intra-zone designation was still 9, the distributor CD3 would engage its brush at the point marked R (Fig. 17). At this point the character R will be passing the exposure position and the closure of the tube firing circuit will occur when the 9 intra-zone position is sensed to thereby photograph R on the film. If the zone designation was 12, zoning relay contacts Z12_b would be closed, selecting distributor CD2 so that upon the sensing of a 9 intra-zone position the exposure or tube firing circuit would be closed at the beginning of the 9 cycle point at which time character I is passing the exposure position and such character accordingly would be photographed upon the film. If a particular column does not contain any zoning designation at all, contacts ZO_c Z11_c and Z12_c (Fig. 16b) will all be closed and the distributor CD5 will be selected for controlling and closing the exposure circuit. The sensing of a 9 index designation in such a card column would serve through distributor CD5 to close an exposure circuit near the end of the 9 cycle point at which point character 9 will be passing through the exposure position and such character 9 would be photographed on the film.

Referring to Fig. 13, it will be seen that each set of characters on the drum includes two zeros. The lowermost zero on the drum will be recorded in cases where a column of the leading card has a zero designation unaccompanied by a designation 9 to 1 and when the corresponding column of the card which immediately follows in the run also has its 0 index position perforated. The

upper zero on the drum will be recorded when a column of the card in a run has a zero designation alone and when the following card in the same columns is not perforated in the 0 position. So far as photographing on the film is concerned, only one zero from the drum will be recorded in either event. When the lower zero of Fig. 13 is to be recorded, the control circuits are established as follows: The relay ZO is energized when the zero on the card is sensed by brush B1. Zoning relays, however, are de-energized before the 0 cycle point of the next cycle in which the same card is traversing brushes B2. While this card is passing brushes B2, the next card is passing brushes B1 and if it has a zero perforation, the ZO zoning relay will be picked up again. At the same time, the zero in the leading card is sensed and the exposure circuit is routed through the E2 contacts, the ZO_b contacts and the CD4 distributor to expose the lowermost zero in the corresponding drum column. The upper zero shown in Fig. 13 will be exposed under the following conditions. Since the card under brushes B1 does not have a zero perforation, the ZO relay will not be picked up as the 0 digit hole of the leading card is sensed by the brush B2. Accordingly, the exposure circuit will be routed through relay contacts E2, the normally closed contacts ZO_c, Z11_c, Z12_c and the commutator CD5. The timing of the exposure circuit in that case is such as to expose the upper 0 in the corresponding drum column.

It may be explained that one purpose of the distributor CD2, CD3, etc. is to provide for a relatively short time interval during which a firing circuit is established to the tube. In practice, the firing circuit is established for a less interval of time than is indicated on the timing diagram (Fig. 17). The somewhat more extended circuit interval is shown in the timing diagram for clarity of illustration of the timing diagram itself. In practice, the circuit is closed for a somewhat shorter interval as has been pointed out heretofore. As stated before, in practice, sharply defined character images have been photographed and the condensers have been fairly completely discharged in the circuit closing interval of $\frac{1}{1200}$ of a second.

Entry circuits to the accumulator are also established during the third card cycle when the card is passing the brushes B2. These entry circuits are traced as follows: from line 192 (Fig. 16a), relay contacts N4, cam contacts CF11, contact roll 38, through the hole in the card, through brush B2, to one of the plug sockets 152, through a plug connection to one of the sockets 153, through accumulator magnet 142, through cam contacts CF12 and back to line.

After the first line of variable data recording has been effected on the film, the film must be advanced one line space and this is effected in the following manner. With card lever relay N energized, its relay contacts N6 (Fig. 16b) are closed and a circuit is completed when card feed cam contacts CF6 close from line 192, relay contacts N6, cam contacts CF6, stepping switch magnet 220 of the B stepping switch, film advance magnet 88 and back to line 191. When cam contacts CF6 open, magnet 220 and 86 de-energize and the film is advanced one step or line space while the arm 206 of stepping switch B moves to the "1" segment.

In a similar manner, variable data from the following cards are recorded on the form. During each card cycle and after recording operation,

the circuit last traced is again made and arm 206 stepped from one segment to the next and the film advanced one line space.

As stated before, provision should be made in the machine of this class to test and ascertain whether a tube has fired or failed to fire. A test circuit is established to determine if the neon tube has actually fired. The manner in which this testing is effected will be first outlined in general and thereafter the circuit will be described in further detail.

If a neon tube due to some defect fails to fire, the set of condensers K will not discharge. After the neon tube firing circuit is completed, the connections to the set of condensers are shifted back to a parallel relation and the terminals of such parallel connected condensers applied to a relay. If there is a charge left in the bank of condensers this will signify that the related neon tube has failed to fire and this retained charge will be utilized to energize a test relay coil. Contacts controlled by this relay may be utilized to stop the machine or to illuminate an indicating lamp or both. The lamp or lamps which are illuminated will denote the particular column of condensers which have retained a charge and these columns of condensers will be related to corresponding neon tubes so that the defective tubes can be located.

After relay coils R and S are de-energized by the opening of cam contacts CF9, a test circuit is established which may be traced as follows: From the left side of the condensers K (Fig. 16a), through relay contacts R2, card lever contacts N7, cam contacts CF8 now closed, intra-zone relay contacts E3, now shifted, relay coil L, resistance 222 and back to condensers K, through contacts S2. If relay L is energized, it is maintained energized by a circuit through stick contacts L2, through a lamp 223, through key controlled contacts 224, to line 191. The other side of relay L is connected back to line through a resistance 222, and the connected plug sockets 164 and 165. If a relay L is energized relay contacts L1 (see Fig. 16c) will open and break the holding circuit to card feed relay Q, thus stopping the machine. Lamp 223 remains illuminated as long as the above mentioned stick circuit is maintained closed. The particular lamp which is illuminated indicates the bank of condensers which has retained a charge and thereby indicates the particular neon tube which has failed to fire. Lamps 222 are shown in Fig. 1 and numbered to correspond with the related condenser banks. By checking up the plugging of the condensers to the neon tubes, the operator of the machine can ascertain which neon tube has failed to fire.

After the operator has noted which of the neon tubes is defective and has taken this tube out in order to replace it, the stick circuit of coil L and the circuit of lamps 222 may be broken by manually depressing the key to open contacts 224.

If any one of the L relays is energized, one of the contacts L1 (see Fig. 16c) will open and break the holding circuit to the card feed relay Q and also break the circuit to the card feed clutch magnet 28. With these circuits broken, machine operations will terminate. If a neon tube has correctly fired, its related test relay will not be energized and the machine will continue to run until there is either a change in control or until the machine runs out of film or cards or until the stop key is depressed. If any par-

ticular column on the card is blank, as for example, to provide for spaces between different names and initials, etc. the relay E for the related column will not be energized and the circuit from the condensers will extend through the normally closed side of relay contacts E3 and the condensers will be discharged through the resistance 222.

It has been previously explained that if the cards do not have an agreeing group designating perforation, relay P will be energized. Relay P when energized will open its contacts P1 (Fig. 16c) and de-energize the card feed relay Q and the card feed clutch magnet 28 and thus stop record feeding operations.

Termination of machine operations may also be effected by depression of the stop key. Depression of the stop key 210 will interrupt the circuit to relay coil Q and to clutch magnet 28. Machine operation will also be terminated in the event that film contacts 109 open upon the machine running out of film. After machine operation is stopped, as for example under group control, and if it is desired to record a total, the operator may depress a so-called total key, closing contacts 225 (Fig. 16c). Closure of these contacts completes a circuit from line 192, then in parallel through total clutch magnet TM, and relay coil V, through total key contacts 225, cam contacts CF4, relay contacts W2, now in the position shown, relay contacts Q2 now closed, then in series through the serially connected test contacts L1 to line 191. It will be understood that the above total circuit will not be completed if any of the neon tubes are defective and fail to fire. Energization of the relay coil V closes stick contacts V2, to maintain magnet TM energized and coil V energized through a stick circuit extending to line through the total cam contacts T1. Energization of the total clutch magnet TM (Fig. 1a) rotates the various T cam contacts, causing rotation of distributors TD1 and TD2 and emitter EM4. The condensers K are charged in the manner previously explained, except that the circuit from line 191 extends through the distributor TD1 instead of relay contacts N3 and distributor CD1. Relay coils R and S are now energized to effect the connecting of the condensers in series. The energizing circuit is from line 191, through cam contacts T8, relay coils R and S and back to line 192, through the plug connection between 164 and 165. Emitter EM4 and distributor TD2 are now rotating and a total readout circuit is established which may be traced as follows: from a plug socket 162 (Fig. 16a), wire 214 (see also Fig. 16b), plug socket 167, via plug wire connection to plug socket 166, to the common strip of the accumulator readout 112, through the brushes of the readout and the segment engaged thereby, through the emitter EM4 and distributor TD2 and via the now shifted V1 contacts to line 217 (see also Fig. 16a). The line 217 extends through a resistance 218, the contacts S1 and condensers K in series and finally through the upper and last condensers K to the contacts R1 now closed, through the plug connections to sockets 160, through the neon tube 158 and from socket 161, via plug connection to socket 162, at which point tracing was started.

The neon tube flashing at the proper time will cause recording of the digit which corresponds to the brush setting on the readout. When totals are to be recorded, it is desirable to record a total symbol adjacent the total data on the film.

This may be conveniently effected by recording the symbol T. Recording of such symbol may be effected from the set of condensers K which are shown to the extreme right in Fig. 16a. Associated with this bank of condensers is a pair of contacts T11 which close during total taking operations. With such contacts closed, the discharge circuit in this particular bank of condensers is established to the related neon tube 58 at the time the T character on the drum is passing the exposing position. This will record the character T on the drum. Tube testing is effected during total recording. There is a special test circuit similar to the one previously traced except that it extends through total cam contacts T7 which shunt relay contacts N1 and cam contacts CF8 and the shifted side of the intra-zone relay contacts E2. To prevent more than one total cycle occurring due to a second or continued depression of the total key, a so-called interlock relay is energized. The circuit for this relay is from line 191, cam contacts T2, relay coil W and back to line 192. A holding circuit for W is established through contacts W1, cam contacts CF15 and key controlled contacts 224a, and back to line 191. It should be noted that the contacts 224 of the testing circuit (see Fig. 16a) and the contacts 224a just mentioned are controlled by the same key. Hence if any of the tubes are found defective during a total cycle showing that a total has not been properly recorded, the operator after replacing the defective tube with a good tube may depress the key to open both contacts 224 and 224a. The opening of contacts 224 breaks the stick circuit of the testing coil L in the lamp 223. The opening of contacts 224a breaks the stick circuit of coil W. Accordingly, contacts W2 in the total circuit which includes the total clutch magnet TM are closed and a new total cycle may be initiated by the depression of the total key. The total may then be properly recorded with all the tubes in operating condition.

The machine having now recorded the total, it is now ready to reset the accumulator and have a new form again recorded properly for listing data from the next group of records.

The accumulator reset initiating circuit is from line 191 (Fig. 16c), through the various L1 contacts, cam contacts T6, switch 226, reset magnet 143, to line 192. Energization of magnet 143 (see Fig. 1) clutches accumulator mechanism to the reset shaft. If manual control is desired, switch 226 is shifted so that upon depression of the manual reset key 227, its contacts will be closed to energize the reset magnet 143.

It will be recalled that in each cycle in which variable data was recorded under control of a record card, arm 206 of stepping switch B was advanced one step and the film was also advanced one line space for each record card. Accordingly, the film will have received first an exposure of the form, thereafter one or more lines of variable data, one line for each card, and finally there will be recorded on the film the total data. It may be further mentioned that after the variable data from the last card of a group has been recorded, a step of film advance is effected so that the total can be recorded on a space on the film following the last line of variable data derived from the last record card.

It will be understood that instances may occur where there are a less number of cards in the group than the available number of lines on the form to receive variable data derived from the

cards. For instance, the form of Example 1 (Fig. 24), to which the plugging illustrated in Fig. 25 applies, has 53 lines available for variable data including the total, so that 52 lines are available for receiving data from 52 cards. Assume, however, that there were only twenty-five cards in the group. This would mean there would only be twenty-five lines of variable data for the card items and an additional line for the total giving an aggregate of twenty-six lines. In such a case after the total was recorded, provision should be made to line space the film to advance it to a new form recording position. This is provided for as follows: With twenty-five record cards, after the twenty-five card items have been recorded on the film the B switch arm 206 will be on the 25th segment spot. The form, however, will have its 26th variable data line in position to receive a total. A total initiating circuit is now established. In brief, the operator depresses the total key 225 (Fig. 16c). This completes a circuit from line 191, through the serially connected L1 contacts, through relay contacts Q2 now closed, through the W2 contacts now closed, through the CF4 cam contacts, through the total key contacts 225 and in parallel through the total clutch TM and the relay V to line 192. Energization of the magnet TM causes a total taking operation.

Referring to Fig. 1a, when TM is energized, the total taking shaft 25a is rotated in the manner previously explained. During the total taking cycle and after the total has been recorded on the film on the 26th line space, cam contacts T4 which are driven by the total taking shaft close and establishes a circuit to energize relay G (see Fig. 16c), the circuit being from line 191, through T4, through relay G to line 192. A stick circuit is provided for relay G, through the 207 contacts of stepping switch B which close when the switch arm 206 is away from the home position, through the G1 contacts and relay coil G to line 192. Energization of relay G closes relay contacts G2 (see Fig. 25) and a circuit is then established from line 192, through the G2 contacts, through the plug connection from socket 177 to the "1" socket 176 of switch B, thence through the serial plug connections 176 to the 25th segment spot. From this point the circuit extends through arm 206 of the switch, through normally closed contacts 235, through contacts 171 of the B stepping switch now closed, stepping magnet 220, film advance magnet 86 to line 191. Energization of the stepping magnet 220 retracts pawl 197b and causes opening of contacts 171. Opening of 171 de-energizes stepping magnet 220 and the film line spacing magnet 88. Upon de-energization of 88, the film is fed an additional line space. Upon de-energization of 220 the pawl 197b of stepping switch B is elevated under the action of spring 196b. This advances the stepping switch arm 206 to the 26th segment spot. At this stage of the operation the G2 contacts (Fig. 25) still remain closed and successive stepping switch actions ensue under control of the stepping switch control circuit just traced, advancing the switch arm 206 around until it reaches the 52nd segment spot. The film is correspondingly advanced. It will be noted, referring to Fig. 25, that the 52nd plug socket 176 is not plugged back to socket 177 so that the circuit last referred to will not be made when the arm 206 is at the 52nd segment position. With the switch arm on the 52nd segment spot the film will be in the 53d variable data line position. This is the same position which the film

would have assumed after a group change if the maximum number of 52 cards in a group had been passed through the machine. In Example 1, this is also the point of the film feed cycle at which the filled in form has advanced amount R (see Fig. 24) equal to 52 line spaces from 1st or form recording position to FV position.

It will be further recalled that when the film is in this position it has been advanced to a sufficient extent to bring unexposed film in position to receive the recording of a new form. Accordingly, with the stepping switch arm in this position provision is made for exposing the next form on the film from the form transparency. This is provided for in the following manner. Relay G at this stage still remains energized. Accordingly, relay contacts G3 (Fig. 25) are closed; therefore a circuit is established from line 192, through the shutter trip magnet 112, through the G3 relay contacts now closed, through the plug connection from 180 to 179, through the F relay coil, through the plug connection from 178 to the 176 socket connected to the 52nd segment spot of the stepping switch, through the stepping switch arm 206, through the now closed contacts 235, through the 171 contacts, through stepping switch magnet 220 and film advance magnet 88 to line 191. Energization of 112 trips the shutter of lens assembly 75 and exposes the form on the film. This operation is diagrammatically shown in Fig. 21. Relay F when energized brings about restoration of stepping switch A to normal home position. Referring to Fig. 16c, relay F when energized, closes contacts F1 establishing a circuit to relay X. The stick circuit for relay X is established through the X1 contacts, through the 209 contacts of switch A which are closed when the switch arm 200 of this switch is away from home position to line 191. Energization of relay X (see Fig. 16b) closes relay contacts X2, which energize release magnet 236 of the A stepping switch. The circuit is from line 192, through the X2 contacts, through 236, and back to line 191. Energization of 236 retracts the retaining pawls and the advancing pawl 197 of stepping switch A from engagement with the ratchet and the switch arm 200 is spring returned to normal position. When in normal home position contacts 209 are open and contacts 208 are re-closed. During return motion of the stepping switch arm 200, contacts 198 are also held open to prevent any circuits being established as the stepping switch arm 200 moves back over the various segments. It may be repeated here that the A switch is only utilized for recording of the first form on a run of film or when forms are changed, and restoring actions at other times are ineffective because the A stepping switch does not advance away from home position.

The film must again be advanced to take into account the heading height of the form and to bring the film and second form to first line variable data recording position. It will be recalled that the circuit previously traced for the shutter magnet 112 was made while contact arm 206 of switch B engaged the 52nd segment, and this circuit extended back to line 191, through the contacts 235, 171, stepping switch magnet 220, film advance magnet 88. The energization and de-energization of 220 and 88 provide another step of advance of switch arm 206 and another line space of advance of the film. Then with the switch arm 206 on the 53d segment, the stepping circuit for further advance of the switch will be back to line 192, through the serially connected sockets 176

and still closed contact G2. It will be noted that socket 176 pertaining to the 53d segment is plugged back with a series connection 176a to socket 176 pertaining to the 51st segment. It may be mentioned at this point when the arm 206 leaves the 52nd segment that the circuit through relay F and the shutter trip magnet 112 is broken. Successive further stepping advances of the stepping switch now ensue until the 67th segment spot is reached. The film advances correspondingly line by line. When the switch arm reaches the 67th segment spot position a different circuit will be established which will be traced as follows (Fig. 25): from line 191 to 86, 220, 171, 235, 206 to the 67th segment spot, thence via plug connection between socket 176, pertaining to this 67th segment to 183, through relay coil H, via plug connection from 182, to the socket connected to the 66th segment spot, thence back via the series connected plug connections to socket 177, through the G2 contacts to line 192. With relay H energized as just described, relay contacts H1 (Fig. 16c) close, providing an energizing circuit for relay XX. A stick circuit for this relay is provided through the XX1 stick contacts and the 207 contacts of switch B which are now closed. With relay XX energized, relay contacts XX2 close to establish a circuit from line 192 to restoring magnet 236b of the B stepping switch. The B stepping switch is now restored to normal position under spring action since the retaining pawls and the advancing pawl 197b of this stepping switch are retracted. Notwithstanding there is no further advance of the stepping switch the film feed magnet 86 upon de-energization will cause an additional line space advance of the film. Such line space advance of the film will complete the head spacing of the newly recorded form and will bring this form to position for receiving the first line of variable data recording. With the operations just described there will be a film feed (head spacing) of 16 line spaces from the position in which the new form was recorded to a film position (2nd pos., Fig. 24) in which a first line of variable data may be recorded on the film. This 16 line spacing represents a fixed machine distance equivalent to 11 line spaces plus 5 additional line spaces, the 5 line spaces being the heading height of the form of Example 1.

Considering Example 3 (Fig. 24a) which differs from Example 1 in providing a footing of 13 lines instead of 8 lines, it will be evident that when using the form of Example 3, only 48 lines are available for variable data instead of the 53 lines of the Example 1 form. Since one line is reserved for the total, the limit number of cards which may be in a group when using Example 3 form is 47 cards. Obviously, Example 3 may be treated as a variation of Example 1 in which no more than 47 cards are contained in any one card group. The operations pertaining to switch B for Example 3 occur in the same manner as described for Example 1 and as though 47 or less cards were in the group.

When using the form of Example 2 (Figs. 22 and 24a) the switches A and B are plugged up as shown in Figs. 28 and 26, respectively, and as previously described. The first form is recorded upon depression of key 194, in the same way as before. For this example, wherein the heading is 8 lines, the coil D (Fig. 28) is energized when switch A arm 200 engages the segment numbered "9." Coil D initiates card feed. Switch B now operates in conjunction with operations on the 75 cards.

At the time a record card is fed the switch arm 206 of stepping switch B is in the position shown in Fig. 26. Data is read from the first card and recorded by the variable data recording unit. During this card feed cycle cam contacts CF6 close and energize the stepping switch magnet 220 and the film feed magnet 88. These magnets subsequently de-energize and the stepping switch arm 206 is stepped to the first segment position. Thereafter successive recording operations follow, the arm 206 being advanced one step for each record card which is read and recorded and the film is correspondingly advanced.

Assume that the group of cards contains a less number of cards than the limit number of 36. For example, assume there are thirty cards in the group. Towards the end of the cycle in which data from the 30th card was recorded, the switch arm 206 has advanced to the 30th segment. Due to a change in group designations the auto-control relay P (Fig. 16a) will be effective to terminate record card feed. The operator now depresses the total key closing contacts 225 (Fig. 16c) and total clutch magnet TM and relay coil V will be energized in the manner previously described. Total recording will be effected in the manner previously described. Total recording will be effected on the 31st variable data line space on the form following the last line of data derived from the record card. During the total recording cycle relay contacts T4 (Fig. 16c) energize relay G which is maintained energized by the stick circuit through G1 and the contacts 207 of stepping switch B now closed. Energization of relay G closes relay contacts G2 (see Fig. 26) and a circuit is completed from line 192, through the G2 contacts, through the plug connection to the stepping switch sockets, through the serially connected stepping switch sockets to the 30th segment, thence back through the stepping switch arm 206, through contacts 235, 171, through the stepping switch magnet 220 and film feed magnet 88 to the other side of the line. The above circuit after being made is automatically interrupted upon the opening of contacts 171. De-energization of 220 and 88 permits one step of advance of the stepping switch arm 206 and a corresponding single line space feed of the film. Switch arm 206 will now be moved to the 31st segment position. The stepping and film feed operations just explained will be automatically repeated until the stepping switch arm 206 reaches the 36th segment spot position. At this point the form has been advanced to the FV position (Fig. 24a).

It may be mentioned that the film will have been moved 36 line spaces from the second position shown on Fig. 24. With arm 206 engaging the 36th segment, a supplemental circuit is established to energize relay coil F (see Fig. 26), relay contacts G3 being now closed, and in addition there is an energization of shutter trip magnet 112. With energization of 112 there is a recording of the next form on a blank space on the film (see Fig. 24a). The circuit through F, G3 and 112 is completed back to line 191, through the stepping switch arm 206, contacts 235 and 171, and through the stepping magnet 220 and film feed magnet 88. Another step of advance of the stepping switch arm 206 ensues with attendant film feed. When the stepping switch reaches the 37th segment the circuit to line 192 is again established through the serially connected sockets, back through the G2 contacts to line. Successive steps of advance of the stepping switch arm 206

and successive film feeds then occur upon successive steps of advance of the arm until the arm 206 leaves the 54th segment. At this time the film will have been advanced so that the 2nd recorded form is in the 2nd position (Fig. 24a). At this time the preceding form will have been fed forward from recording position. When the stepping switch arm is stepped on to the 54th segment spot, the energizing circuit of 86 and 220 also included a relay coil H (see Fig. 26). Relay coil H when energized closes contacts H1 (Fig. 16c) and a circuit is completed to energize relay coil XX. Relay coil XX when energized is maintained energized by a circuit through stick contacts XX1 and contacts 207 of switch B now closed. With relay coil XX energized, relay contacts XX2 (Fig. 16b) close and a circuit is completed to energize the restoring magnet 236b of the B stepping switch. With this magnet energized the stepping switch arm 206 of the B stepping switch is spring restored to initial position. At this stage of the operation, the newly recorded form is in the 2nd position (Fig. 24).

It will be recalled that the first form of a new run of forms in both examples was brought to second position under control of switch A and incidentally thereto coil D (Fig. 16c) was energized. Coil D picked up coil J (Fig. 16c) which shifted contacts J2 to closed position and established a circuit through the card feed clutch magnet. Now with the second recorded form brought to the second position under control of switch B as explained, the starting of card operations on the next group of cards is no longer controlled by coil D but may be initiated by depression of a start key to close contacts 240 (Fig. 16c). Closure of these contacts establishes a circuit from line 191, through the serially connected testing relay contacts L1, through the normally closed auto-control contacts P1, through the J3 contacts now closed, through the start key contacts 240, through contacts 208 of stepping switch A now closed, through contacts 205 of stepping switch B now closed, through the T9 contacts, through the film control contacts 109, through relay coil Q and card feed clutch magnet 28 to line 192. Energization of card feed clutch magnet 28 initiates a new card feed cycle. Energization of Q closes contacts Q1 and a holding circuit is established from line 192, through 28 and Q, through the Q1 contacts, through the stop key contacts 210 now closed, through relay contacts M2 and N2 now closed, through P1 now closed, back to the serially connected L1 contacts to line 191. Operations then continue as before described, the stepping switch B stepping once for each card handled and controlling the feeding of the forms to the different positions.

When using the form of Example 4 (Fig. 24a), switches A and B are plugged the same way as for Example 2. Referring to Fig. 24a, it will be noted that values D and R are the same as for Example 2 but that V, the number of lines available for variable data is 33 lines instead of 37 as in Example 2. Thus, example 4 may be treated as a special case of Example 2 where no more than 32 cards are found in any one card group.

It may sometimes be desired to record only one form and to fill this form with variable data from only one group of records and then to stop further recording operations. In such event, the operator before starting up operations, opens hand switch 193 (Fig. 16c), placing the circuit of lamp 135 of the form recording section under

control of key contacts 241. Operations are initiated by depressing the key to close contacts 241. Closure of these contacts completes a circuit from line 191, through lamp 135 and a coil YY to line 192. Coil YY closes contacts YY1 (Fig. 16b), which shunt key contacts 194 to complete the circuit of shutter magnet 112 and of switch A stepping magnet 195. Magnet 112 upon energization causes recording of the form. The operator releases key contacts 241 as soon as it is certain that magnets 112 and 195 have been energized. Opening of key contacts 241 de-energizes coil YY and extinguishes lamp 135. Contacts YY1 open, breaking the circuit of magnets 112 and 195. De-energization of magnet 195 steps switch A arm 200 to the first segment. Thereafter the switch A operates in the same manner as explained before to control feed of the form of 2d pos. (Fig. 24) and to energize coil D. Coil D initiates card feed. During operations on the cards of the group and during total taking, switch B operates in the manner explained before. However, with lamp 135 now extinguished, further form recording will not take place after the total has been recorded. In the above manner, it is possible to record only one form and to record variable data from only one group of records within the confines of this form and to prevent further form recording after the recorded form has been filled in.

When the machine is operating to record successive forms of a run and to record variable data from successive groups of records on these forms, it is desirable that after the last group of records has run through the machine that further form recording be stopped. Accordingly, before depressing the total key for initiating a total cycle relating to a last group of cards, the operator opens switch 193 (Fig. 16c). This will extinguish lamp 135 so that even though the shutter trip magnet 112 be energized form recording will not be effective.

The foregoing description has described operations wherein total taking was manually initiated by depression of the total taking key which effects closure of contacts 225. Furthermore, according to the previous description, when multiple groups of cards were provided in a run of cards, operations pertaining to a new group of cards were initiated manually by depression of the start key which causes closure of contacts 240. In certain instances, it may be desirable that total taking be automatically initiated on change of card groups and after total taking, the machine should be automatically restarted upon operations pertaining to a new group of cards. To effect such automatic operations certain alternative controls are provided.

Referring to Fig. 16c, a shunt circuit is provided around the contacts 225. When automatic total taking operations are desired, before starting up a run the operator closes a switch 250. When there is a change in control the relay P becomes energized in the manner previously described. With such relay energized contacts P4 close and upon closure of cam contacts CF17 a circuit is established through the shunt path including closed switch 250, contacts P4 and CF17, to the circuit extending to the TM clutch magnet through the path previously traced. By the above automatic alternative control, automatic total taking may be effected.

To provide for automatic restart, a further shunt path is provided around contacts 240. This shunt path includes a switch 251 and relay con-

tacts CT2. When automatic restart is desired, the operator at the beginning of a run closes hand switch 251. Relay contacts CT2 are closed upon energization of relay coil CT. Relay coil CT is energized upon closure of total cycle cam contacts T12 provided the card lever contacts N8 close. A stick circuit for relay coil CT is provided through stick contacts CT1 upon closure of cam contacts CF18. When the circuit is established through the shunt path including closed switch 251 and the closed relay contacts CT2, current supply is available to feed through the path previously traced and including the B switch arm controlled contacts 205 to energize the card feed clutch magnet 208. Accordingly, resumption of card feed automatically occurs. De-energization of CT is effected on the opening of CF18 cam contacts which occurs upon resumption of card feed.

What is claimed is:

1. A machine for recording variable data in determined correlation to associated form matter on a suitable medium, comprising a source of pre-represented form matter, means for recording the form matter derived from said source upon the said medium, a source of variable character data, means to sense character data representations on records in succession, and means controlled by the sensing means in accordance with sensed character representations on successive records for causing recording, in succession, of lines of variable character data derived from the second named source upon the said medium in predetermined correlation to form matter recorded on the said medium.

2. A recording apparatus for accounting machines comprising holding means for a form transparency provided with a heading and a footing and rulings, means to feed a film to a form exposing station and thereafter to a variable data exposing station, means to trans-illuminate the form transparency and expose the complete form upon the film, means to selectively super-expose a variable number of lines of variable data on the film in determined relation to the heading, footing and ruling of the form pre-exposed thereon, and means controlling the film feed means so as to preserve said determined relation.

3. A photographic recording machine comprising a source of form data, means coating therewith to photographically expose such form data upon a film area, source means for pre-arranged, selectable characters, means to select variable data and means under control of said selecting means to photographically and variably compose from the pre-arranged characters of the source means one or more lines of selected variable data on the film in determined and definite relation to the form data film area.

4. A machine for recording variable data and associated form data in contiguous relation upon a sensitized medium, comprising form data photographing means in combination with source means for photographable data, means controlled by data representations on records for selecting from the source means and photographically exposing and transferring therefrom, to the medium, the represented data and means for feeding the said medium into positions for having the form data and the represented data recorded thereon in contiguous relation.

5. A machine for photographically recording variable character data in association with correlated form matter on a film, comprising a source of pre-represented form matter, a source of vari-

able character data, means for sensing character representations on successive records, means controlled by the sensing means for causing photo-transference of selected character data from the variable data source to the film, and control means for causing photo-transference of the pre-represented form matter from the source therefor to the film in a position correlated to the position on the film of the variable data.

6. A photographic recording machine comprising means to expose a form pattern to photograph a form defined thereby upon a film, means for causing operation of the exposing means to expose the form pattern to the film, means for recording variable data on the film within the confines of the recorded form, means thereafter normally effective to cause repeat operation of the exposing means to cause a following form to be recorded, and means whereby the exposing means is ineffective after recording of the first form.

7. A photographic recording machine comprising means to expose a form pattern to a film to cause a form defined by the pattern to be photographed on the film, mechanism to effect line spacing of the film, control means having a cycle during which it moves in synchronism with the line spacing of the film, a source of photographable matter, means for exposing such matter to the film within the confines of a recorded form upon successively presented lines thereof, and means controlled by said control means at a certain point of its cycle for causing operation of the exposing means to expose the pattern to the film.

8. A machine as set forth in claim 7, means for causing said control means to perform successive cycles, and means for determining the point of the cycle at which the control means is to control operation of the exposing means so as to regulate the spacing between successively recorded forms.

9. A photographic recording machine comprising means operable to expose a form pattern to the film to cause a form defined by the pattern to be recorded on the film, means for effecting operation of the exposing means to cause a form to be recorded on the film and after an interval effecting repeat operation of the exposing means to cause a following form to be recorded on the film, mechanism to present successive portions of the film to the exposing means to be exposed with the successive forms, a source of other photographable matter, and means for exposing such matter to each said portion of the film during each said interval elapsing between successive exposures of forms.

10. A machine as set forth in claim 9, and means for determining said interval in accordance with the desired spacing to be observed between successive forms photographed upon the film.

11. A recording machine comprising means to effect successive recordings of forms upon a suitable medium, means to record variable data line by line within the confines of each form, and means to feed the medium a desired aggregate extent between successive form recordings in ac-

cordance with the desired spacing to be observed between forms.

12. A machine as set forth in claim 11, wherein such form may be of one length or another, and wherein means are provided to regulate the said aggregate extent of feed of the medium between successive form recordings in accordance with the length of the form as well as the desired spacing to be observed between successive forms.

13. A photographic recording machine comprising means for interchangeably presenting form patterns of varying lengths at a photographing station, each such pattern regardless of its length having a common indexing line in predetermined position with respect to the photographing station when presented at said station, means to expose the pattern presented at the photographing station to a film to cause the form defined thereby to be photographed upon a film with the counterpart of said indexing line located thereon in a predetermined position, mechanism for feeding the film, and means for regulating feed of the film by said mechanism with reference to said indexing line counterpart.

14. A machine to record lines of variable data and correlating form data therefor upon a common medium, comprising the combination with source means for variably selectable data and record controlled means successively to record lines of variable data composed of data derived from the source means and selected by successive records, of a source for form data and means co-acting therewith to record a single accompaniment of form data to correlate a plurality of lines of variable data.

15. A machine to record lines of variable data and a confining form therefor upon a common sensitized medium, comprising the combination with source means for pre-arranged, variably selectable characters and photographing means responsive to codal designations of variable data for photo-composing lines of variable data in succession, each line composed of characters selected from the source means by their corresponding codal designations, of a source for a confining form and means included in the photographing means for photographically transferring from the source to the medium a single confining form for a plurality of successive lines of variable data.

16. A photographic recording machine comprising means to expose a form pattern to a film to cause a form defined by the pattern to be photographed, line spacing mechanism for the film, control means having a cycle during which it operates in synchronism with line spacing of the film, a source of variably selectable characters, means responsive to codal designations of variable data to expose characters, selected by the codal designations, from the source upon successive lines of the film, one line after another, and means controlled by said control means at a predetermined point of its cycle for causing operation of the exposing means to expose the pattern to the film in predetermined correlation to such lines of variable data.

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