C. D. LAKE.

PRINTING TABULATOR.

APPLICATION FILED DEC. 29, 1919.

1,379,268.

Patented May 24, 1921.

19 SHEETS—SHEET 1.

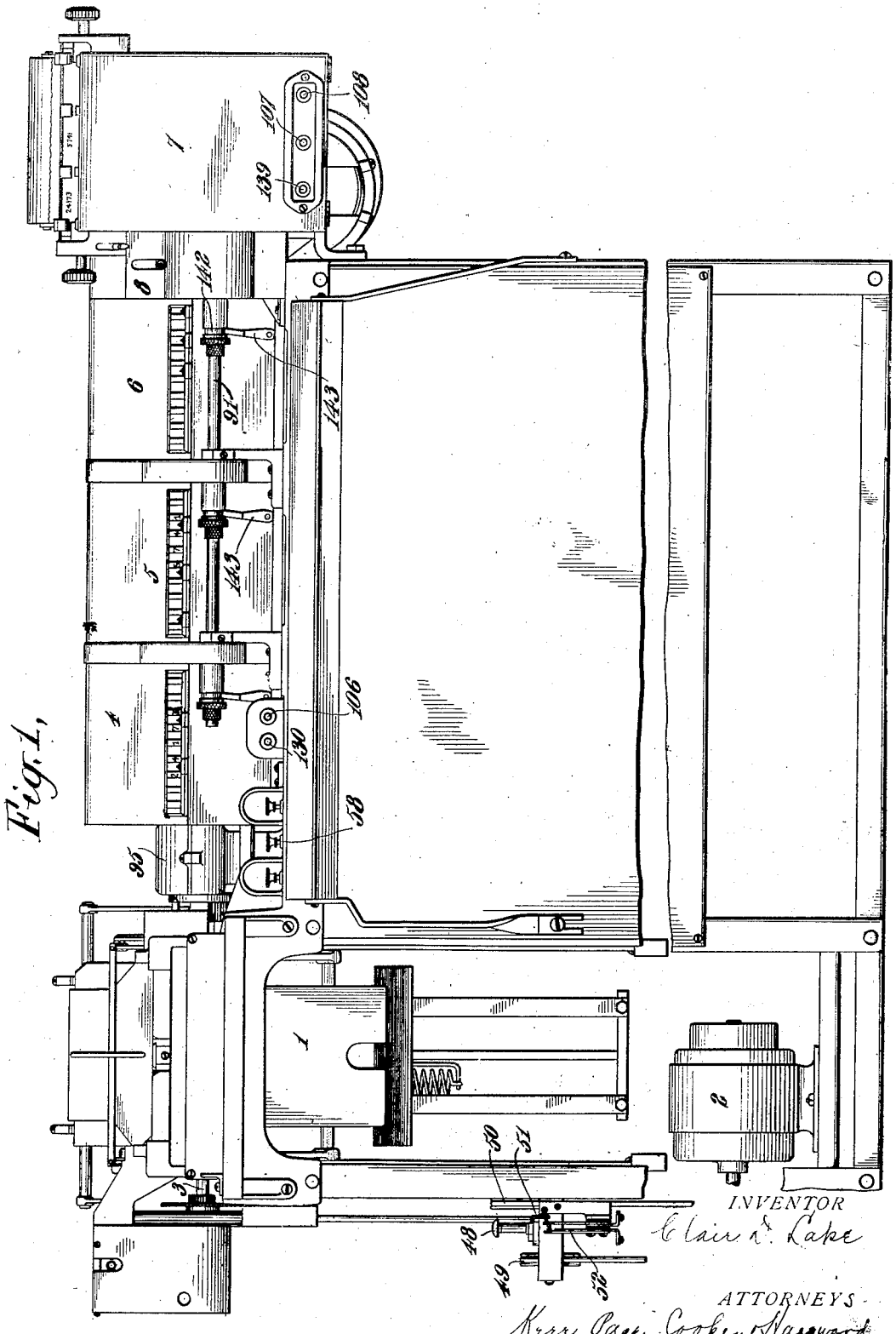


Fig. 1.

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19 SHEETS—SHEET 2.

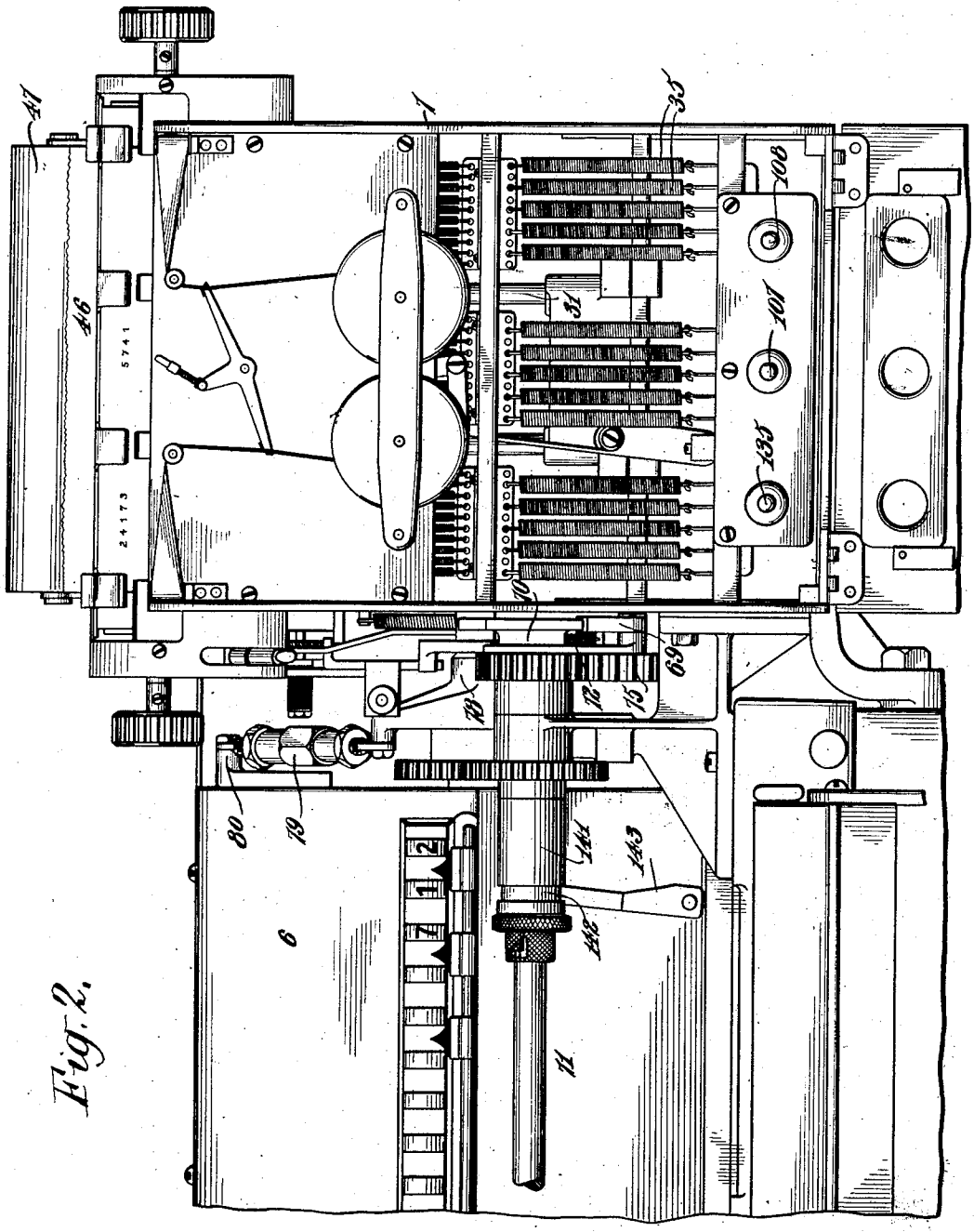


Fig. 2.

Clair D. Lake
INVENTOR

BY Kerr, Page, Cooper & Hayward
ATTORNEYS.

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19 SHEETS—SHEET 3.

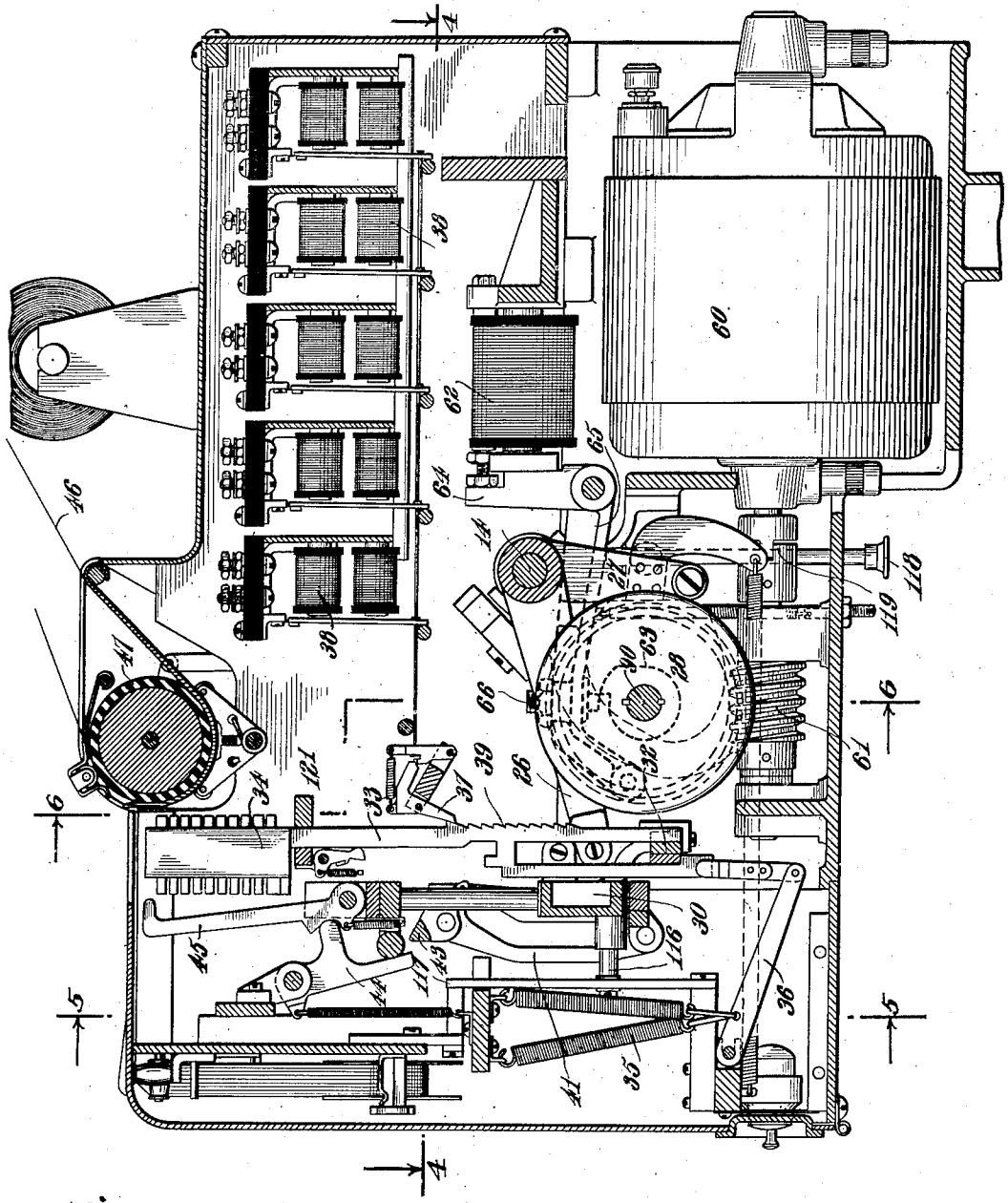


Fig. 3.

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PRINTING TABULATOR.

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19 SHEETS—SHEET 4.

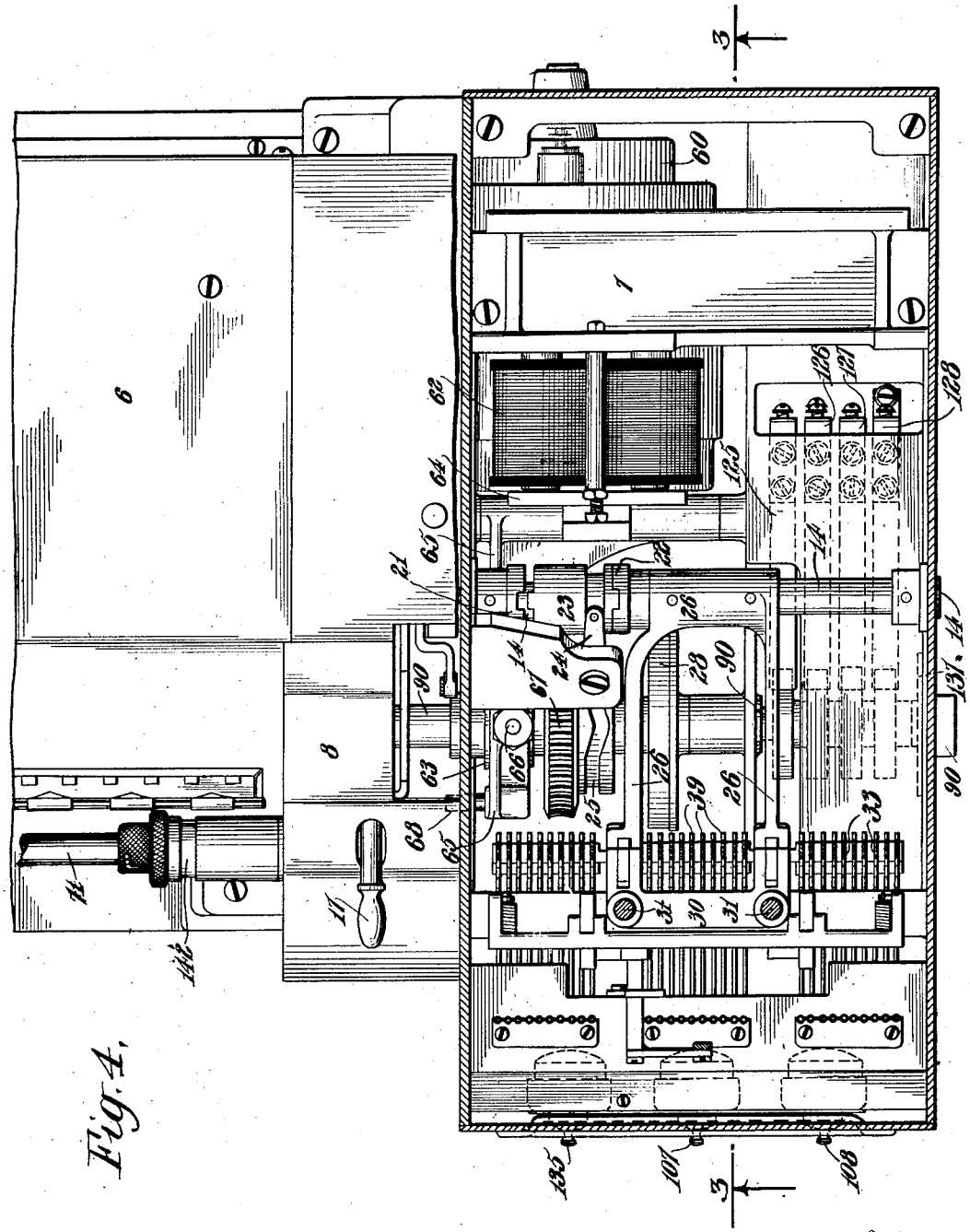


Fig. 4.

Blair D. Lake
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19 SHEETS—SHEET 5.

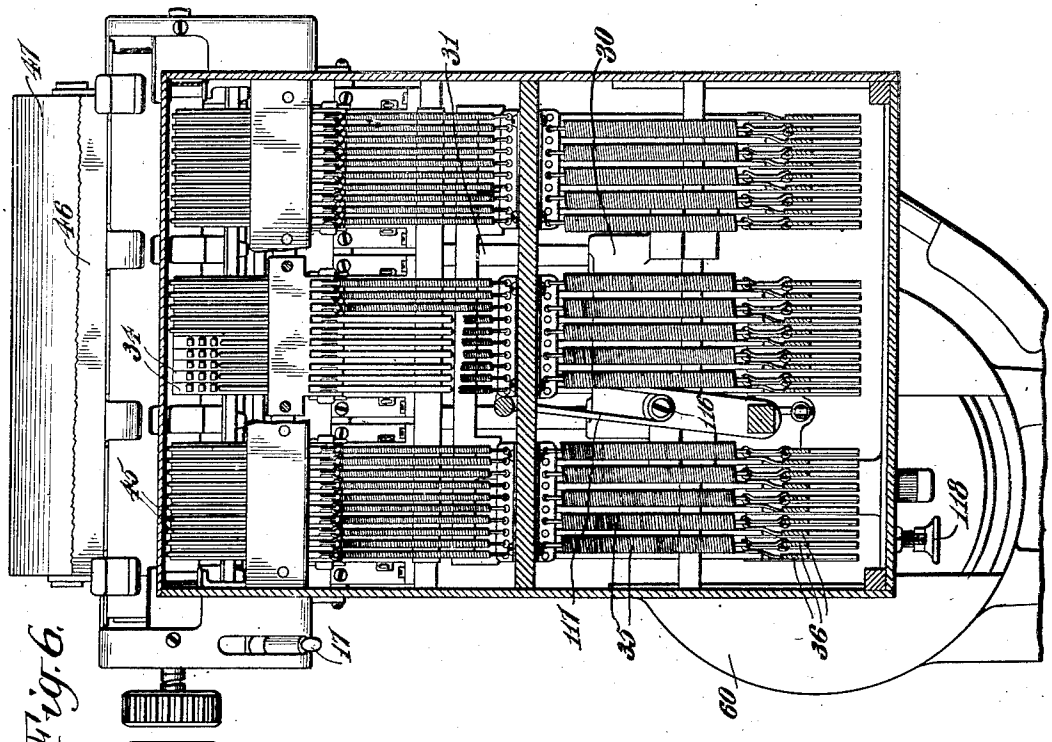


Fig. 6.

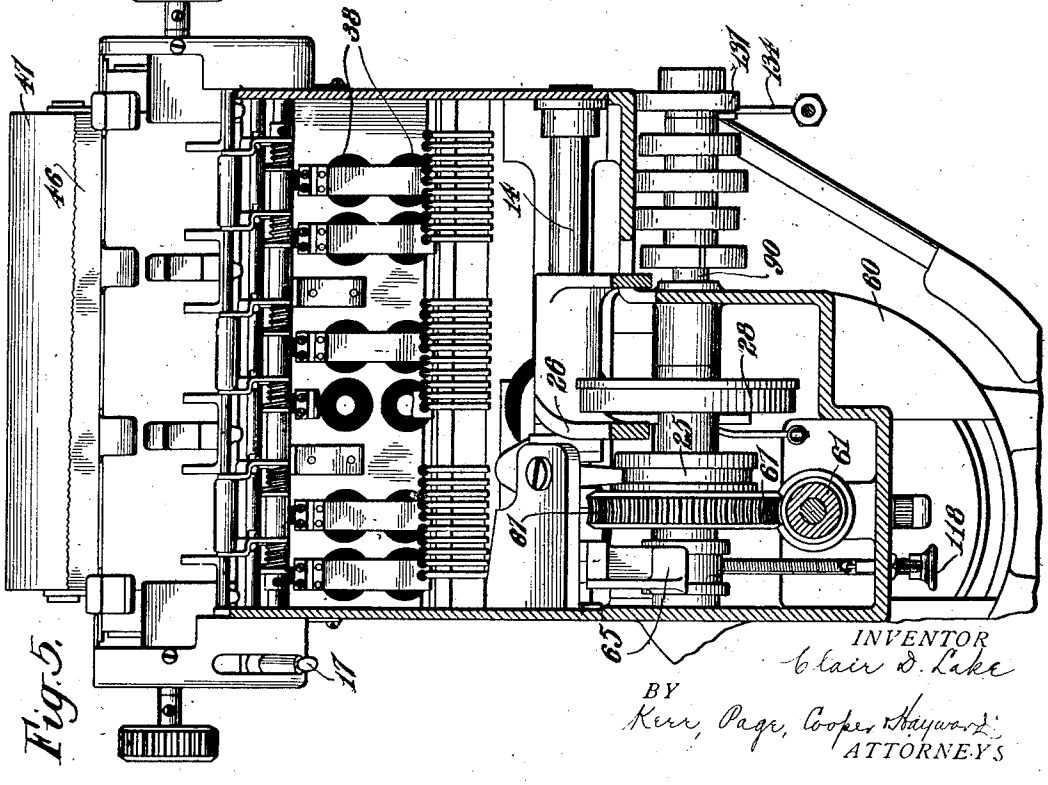


Fig. 5.

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19 SHEETS—SHEET 6.

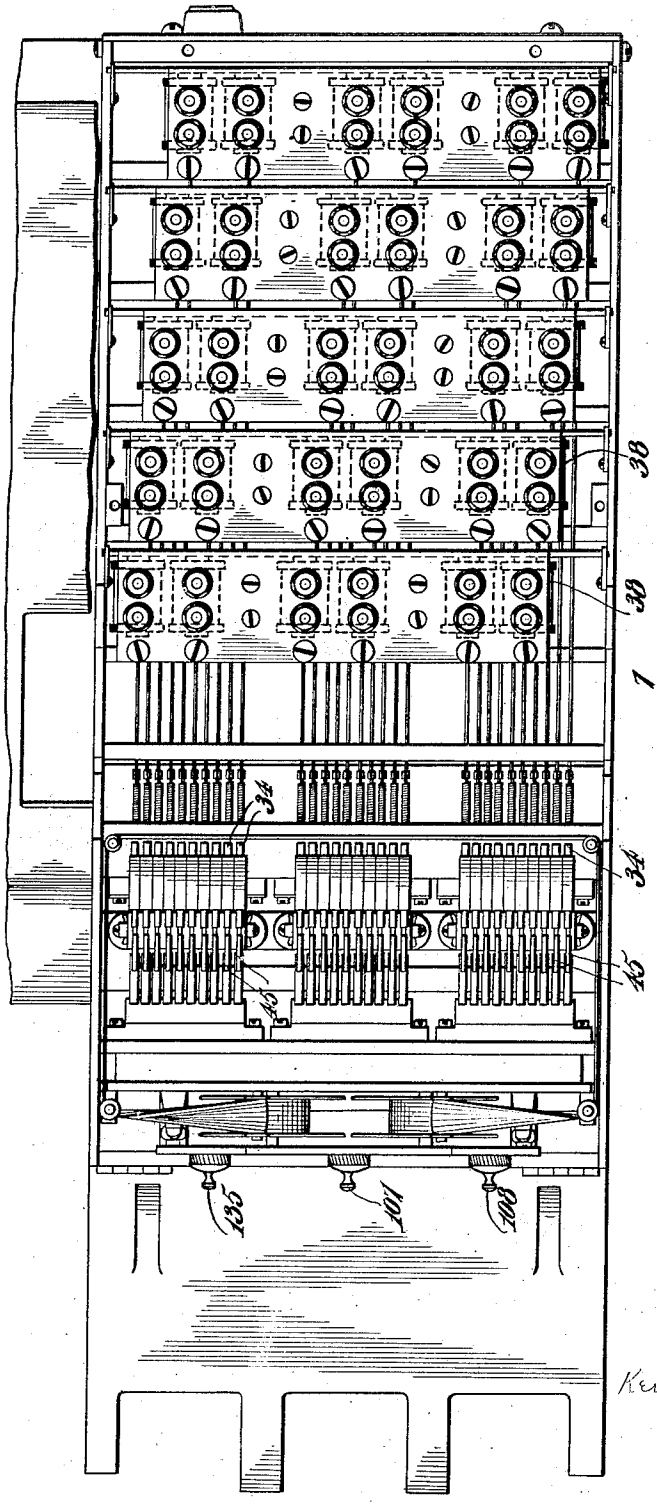


Fig. 7.

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C. D. LAKE.

PRINTING TABULATOR.

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19 SHEETS—SHEET 7.

Fig. 10.

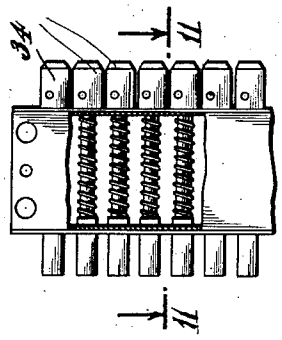
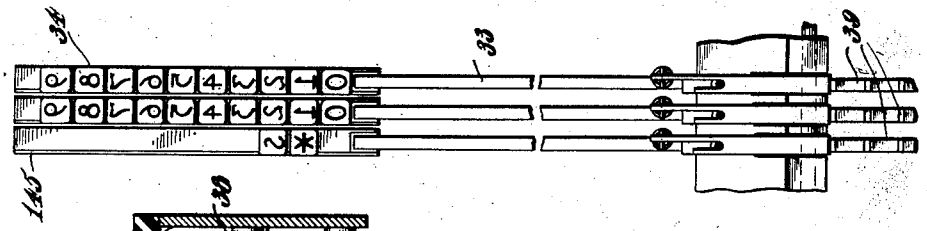


Fig. 11.



Fig. 9.



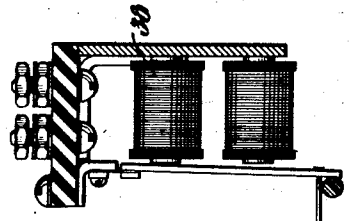


Fig. 8.

Fig. 8a.

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Fig. 12.

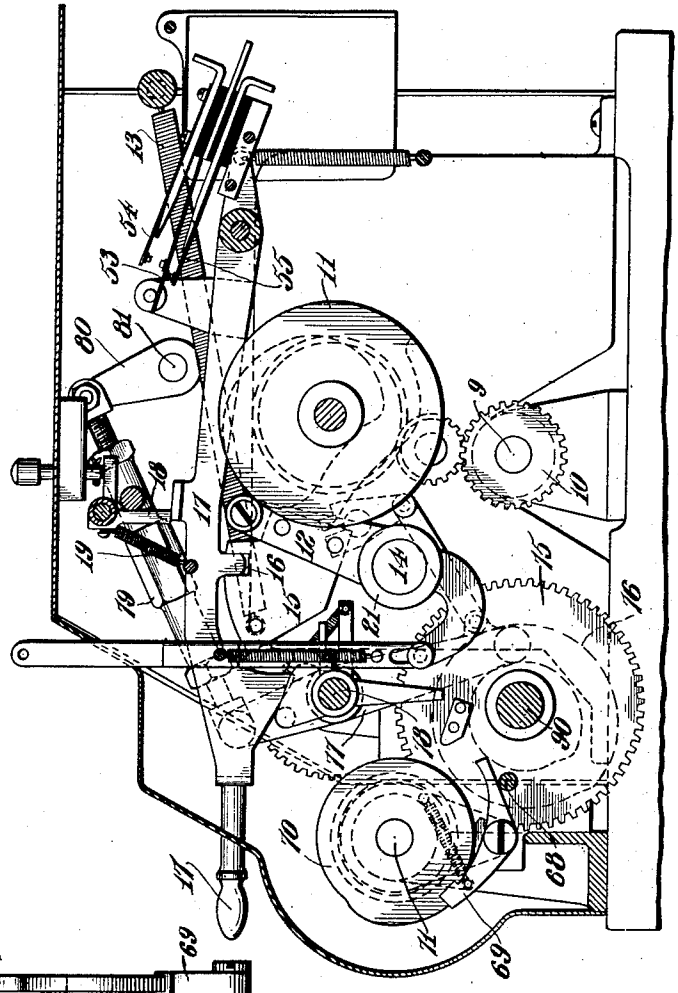
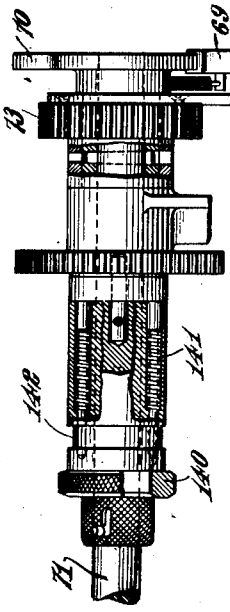


Fig. 13.



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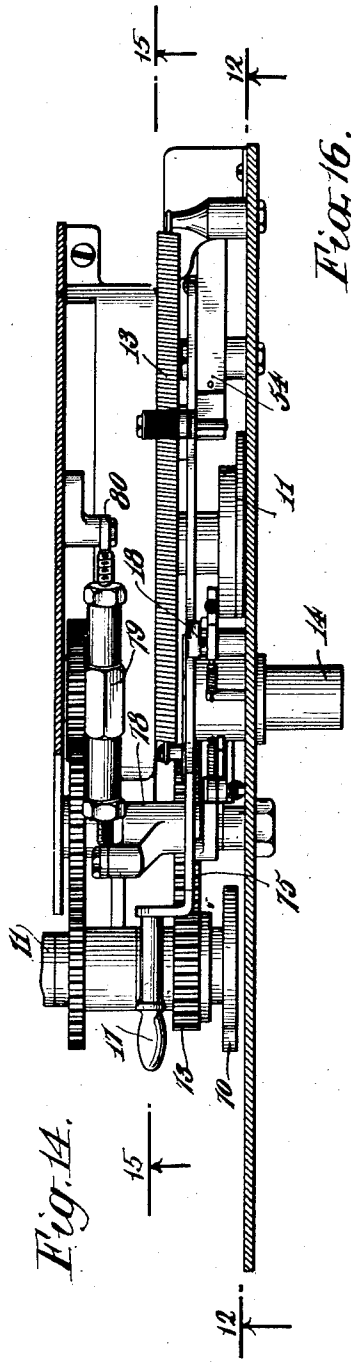


Fig. 14.

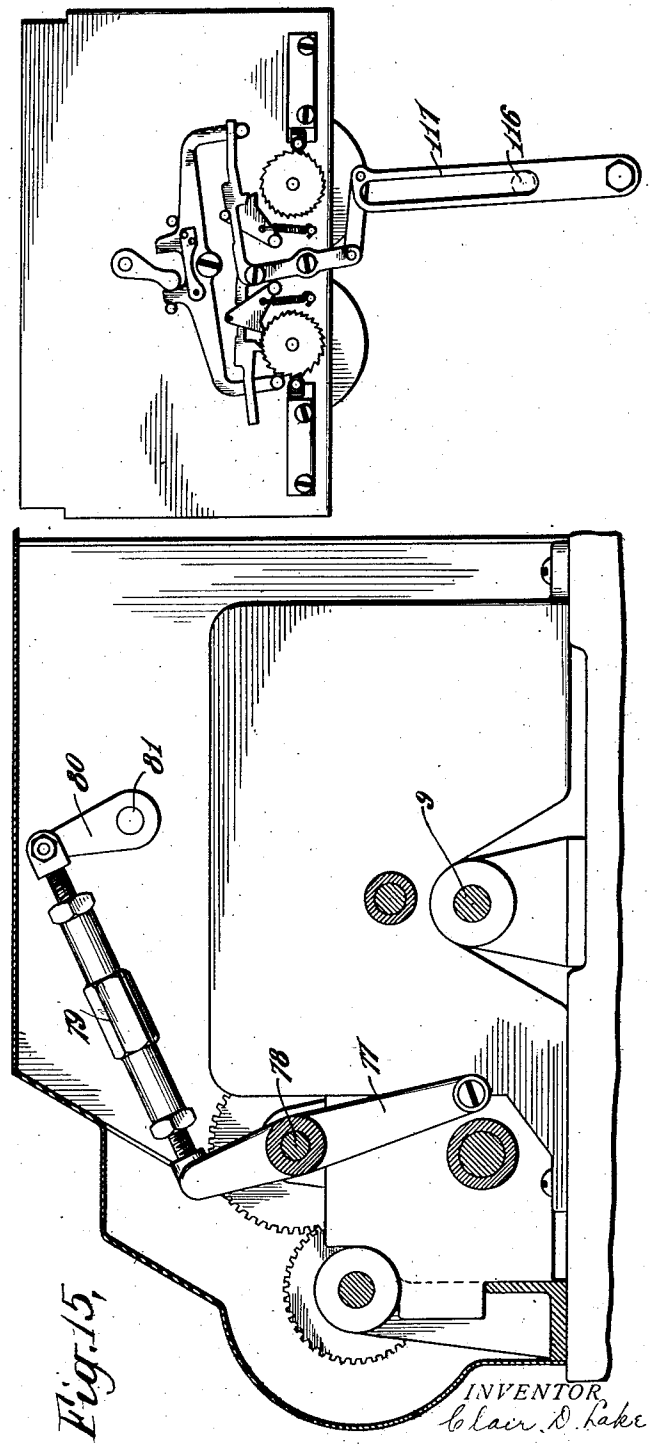


Fig. 15.

Fig. 16.

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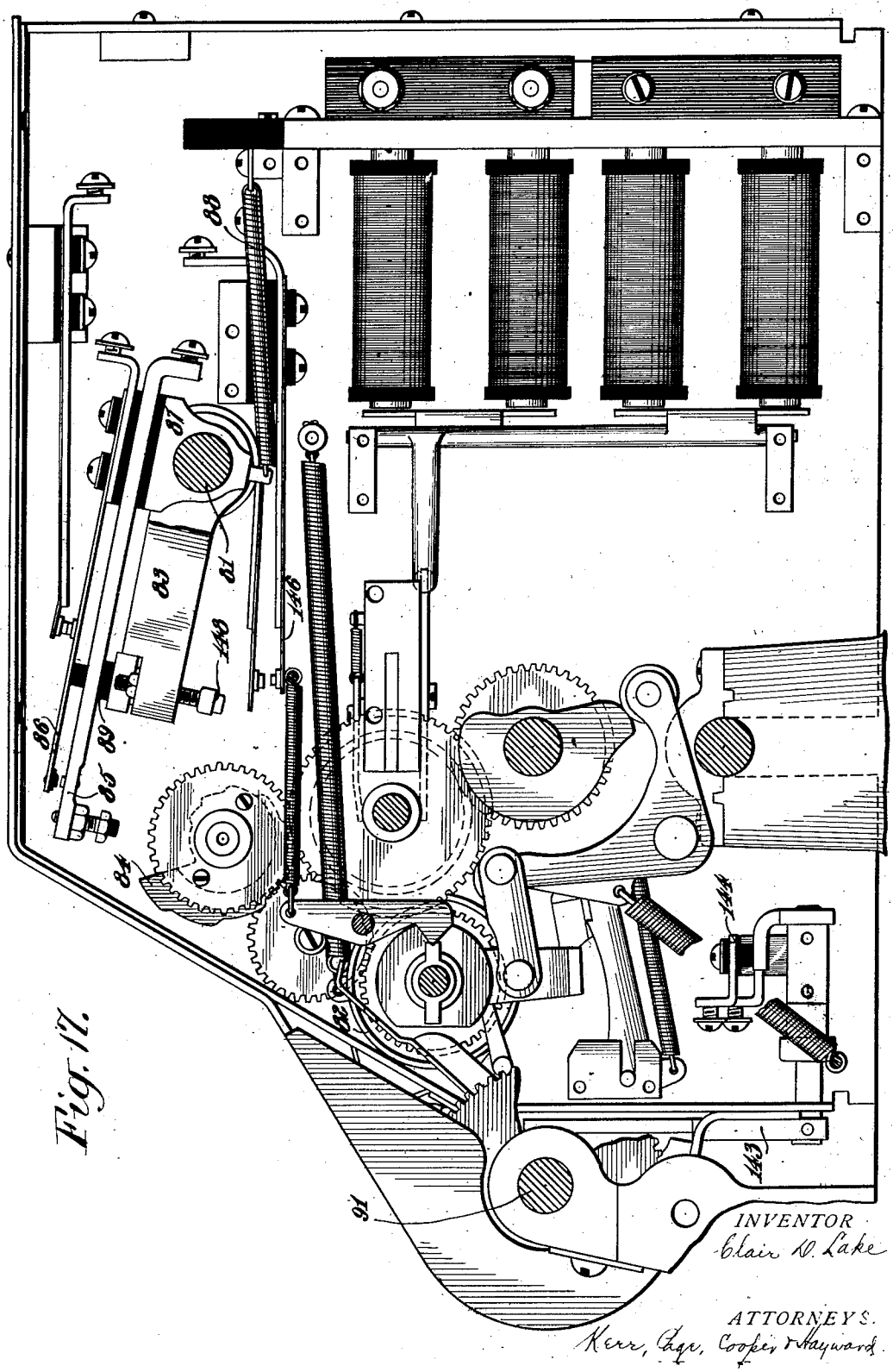


Fig. 17.

INVENTOR
Blair D. Lake

ATTORNEYS.
Kerr, Page, Cooper & Hayward.

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19 SHEETS—SHEET 11.

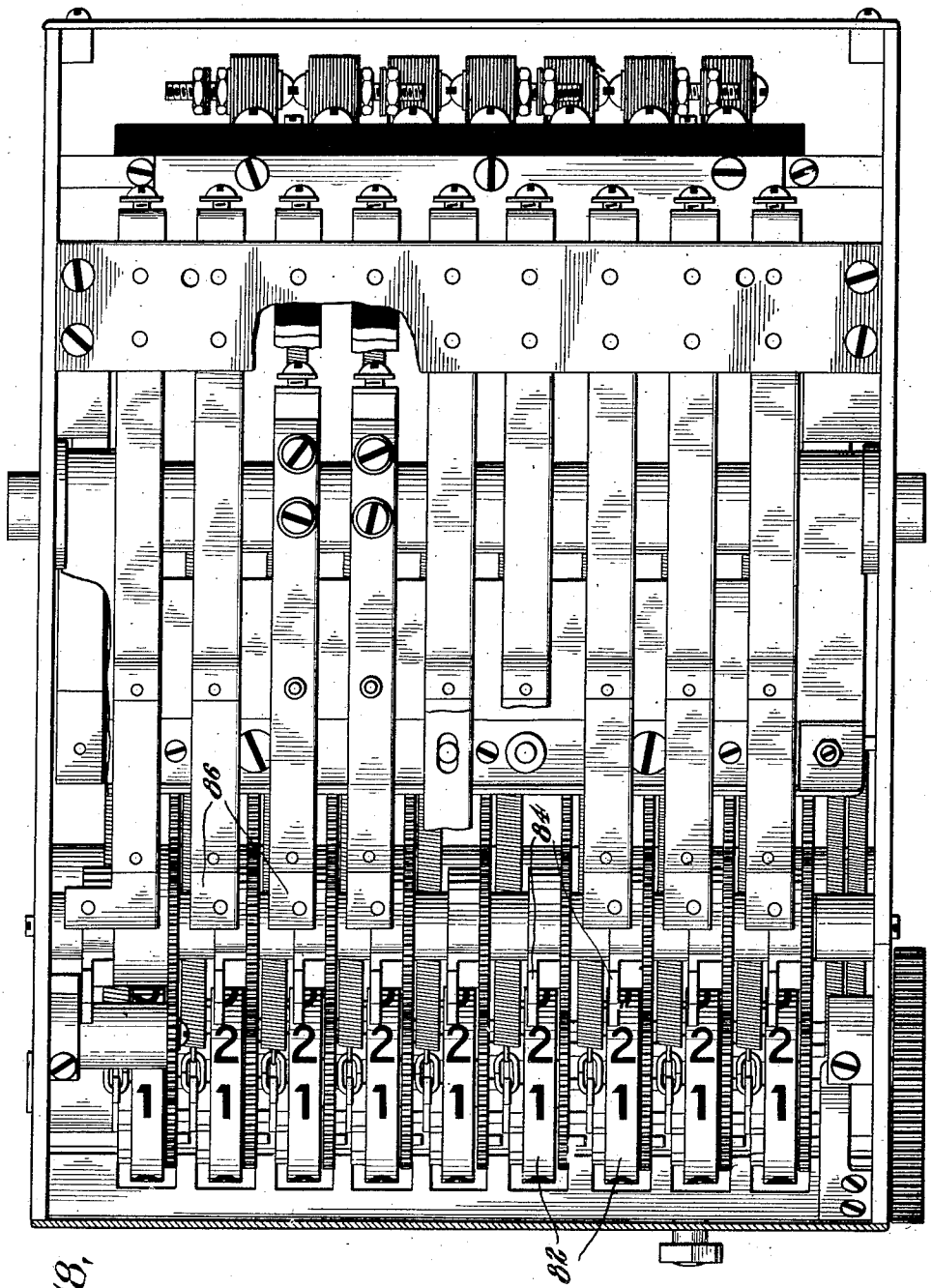


Fig. 18.

Clair D. Lake
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BY
Kerr, Page, Cooper & Hayward
ATTORNEYS.

C. D. LAKE.

PRINTING TABULATOR.

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19 SHEETS—SHEET 12.

Fig. 20.

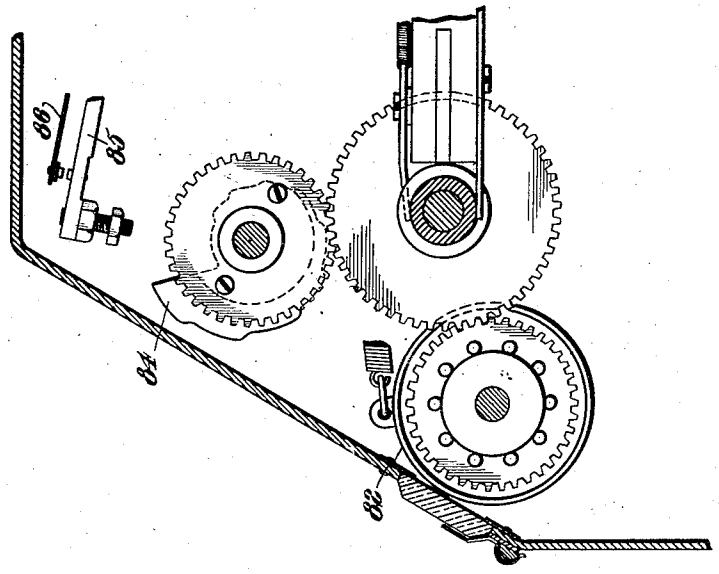
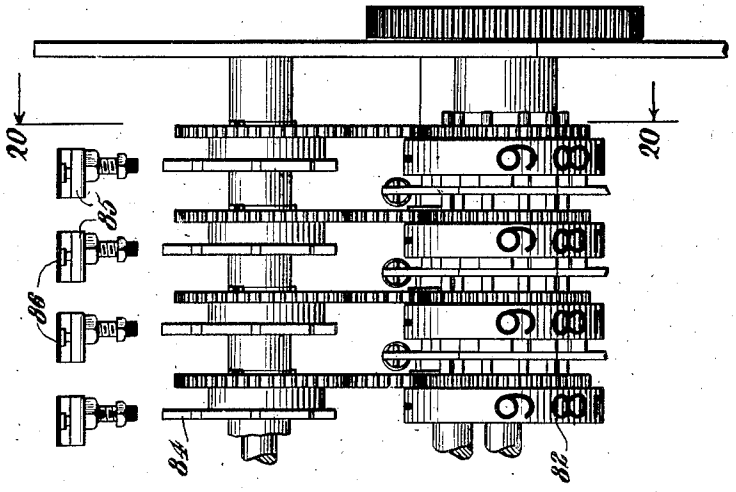


Fig. 19.



Clair D. Lake
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19 SHEETS—SHEET 13.

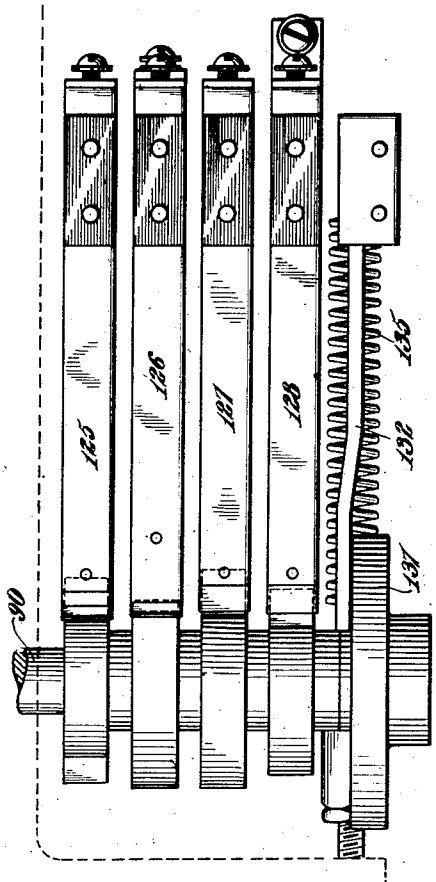


Fig. 21.

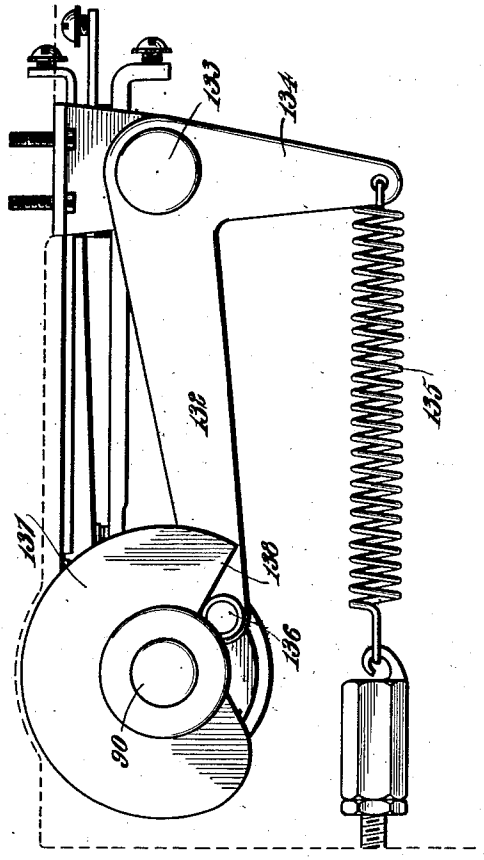


Fig. 22.

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PRINTING TABULATOR.

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Patented May 24, 1921.

19 SHEETS—SHEET 14.

Fig. 24.



Fig. 26.

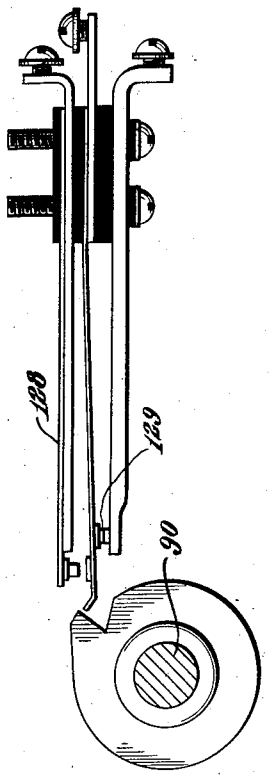


Fig. 23.

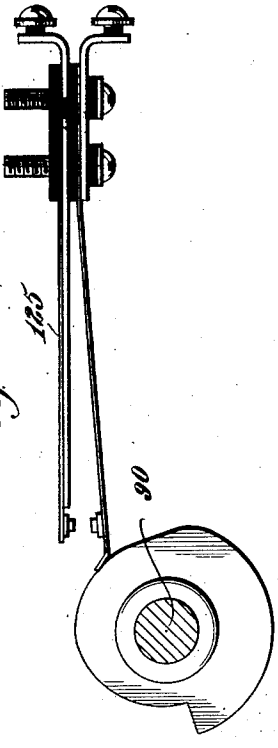
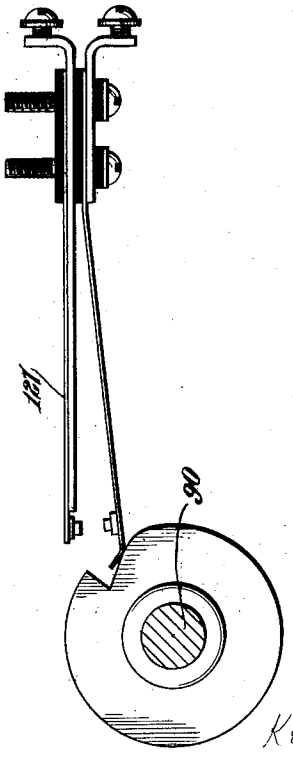


Fig. 25.



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19 SHEETS—SHEET 15.

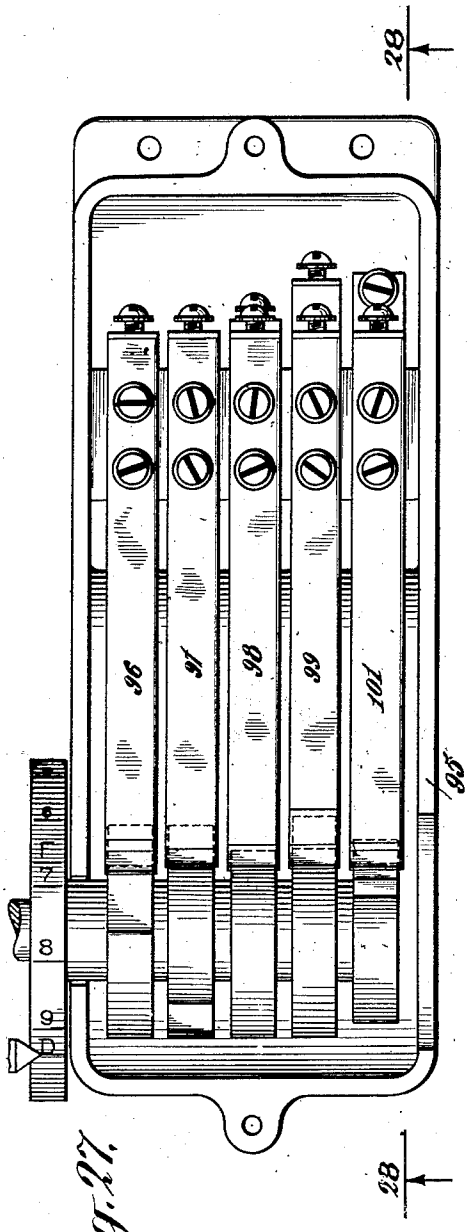


Fig. 27.

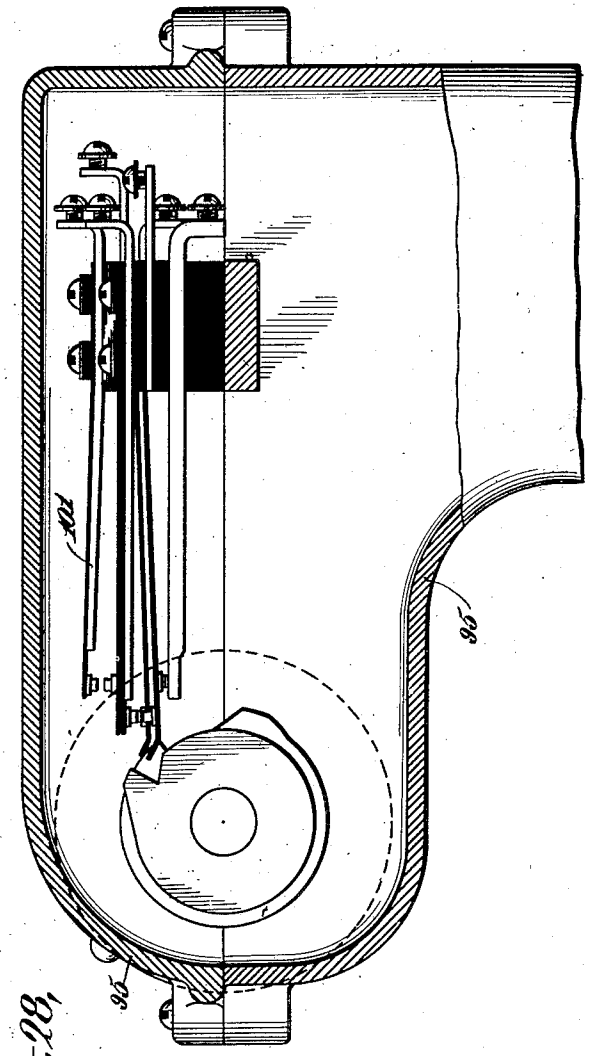


Fig. 28.

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19 SHEETS—SHEET 16.

Fig. 30.

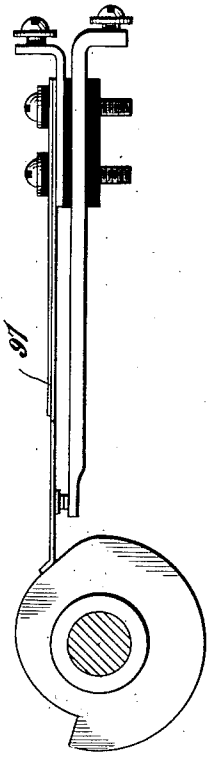


Fig. 32.

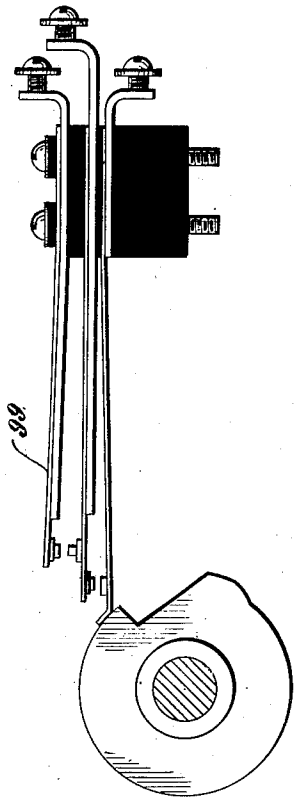


Fig. 33.

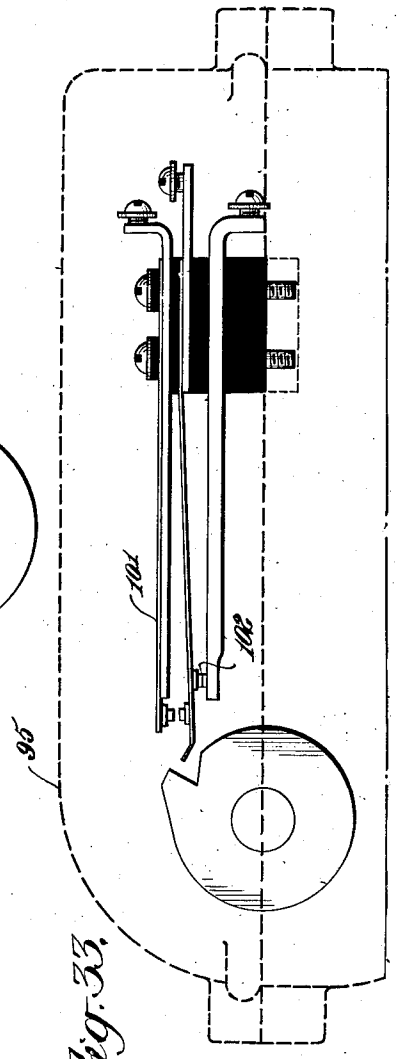


Fig. 29.

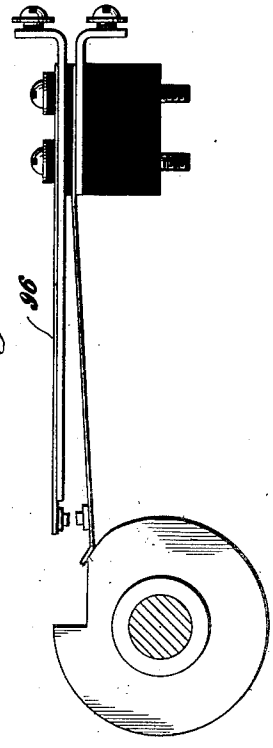
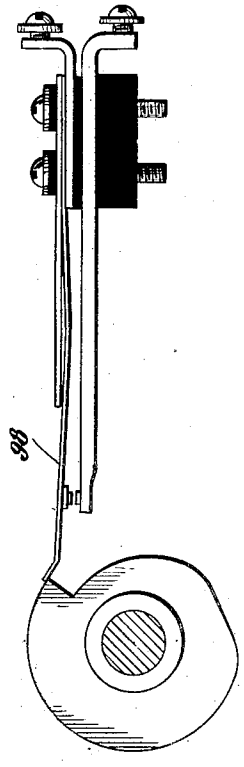


Fig. 31.



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PRINTING TABULATOR.

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Patented May 24, 1921.

19 SHEETS—SHEET 17.

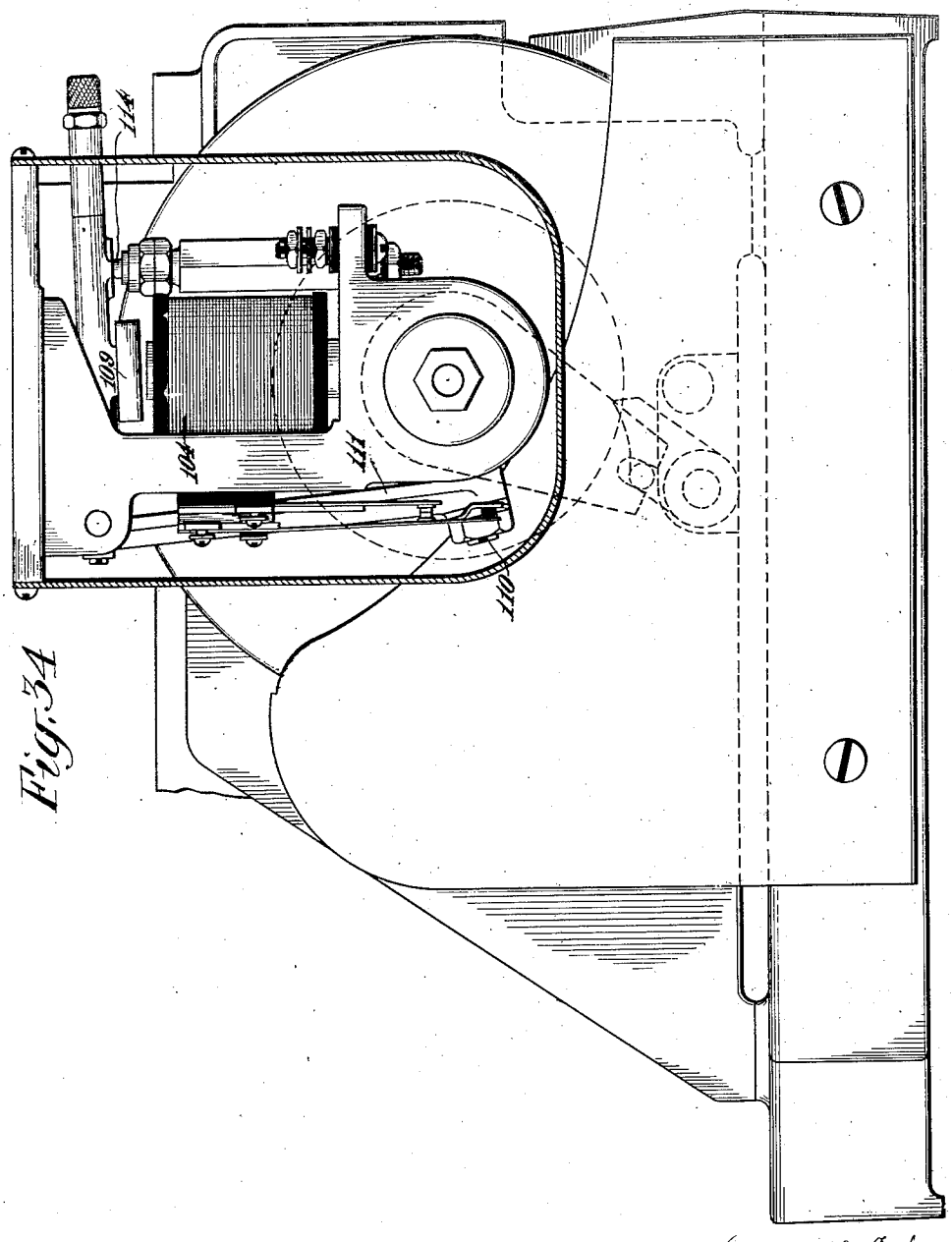


Fig. 54

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PRINTING TABULATOR.

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19 SHEETS—SHEET 18.

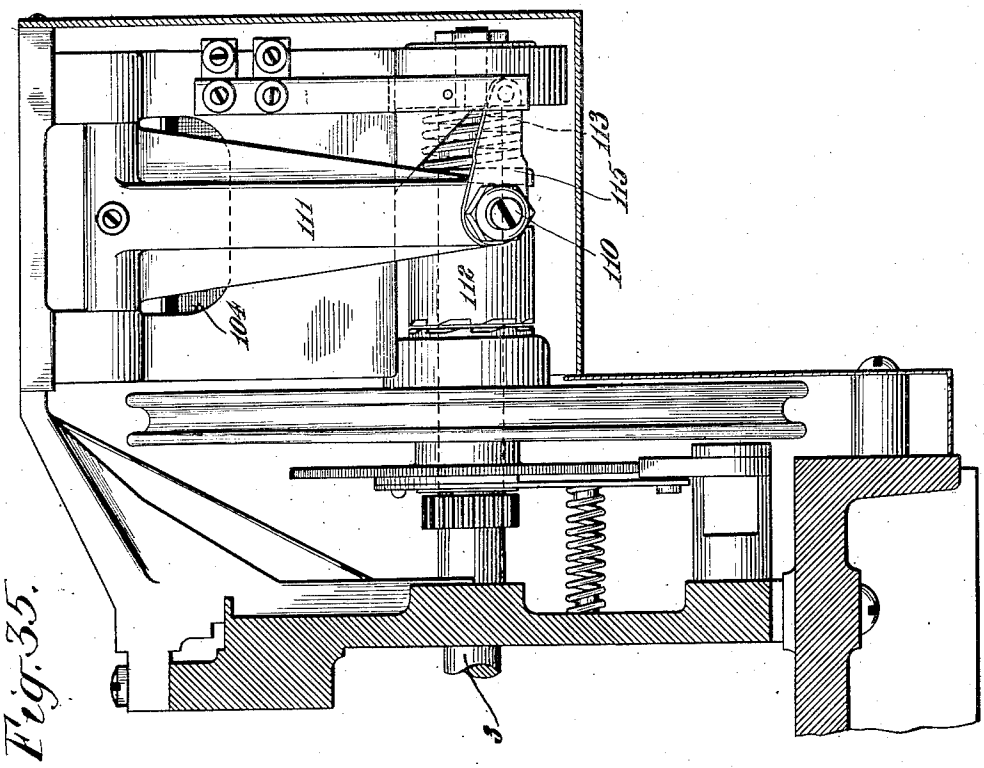


Fig. 35.

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Clair D. Lake

By Attorneys.
Kerr, Page, Cooper & Hayward.

C. D. LAKE.

PRINTING TABULATOR.

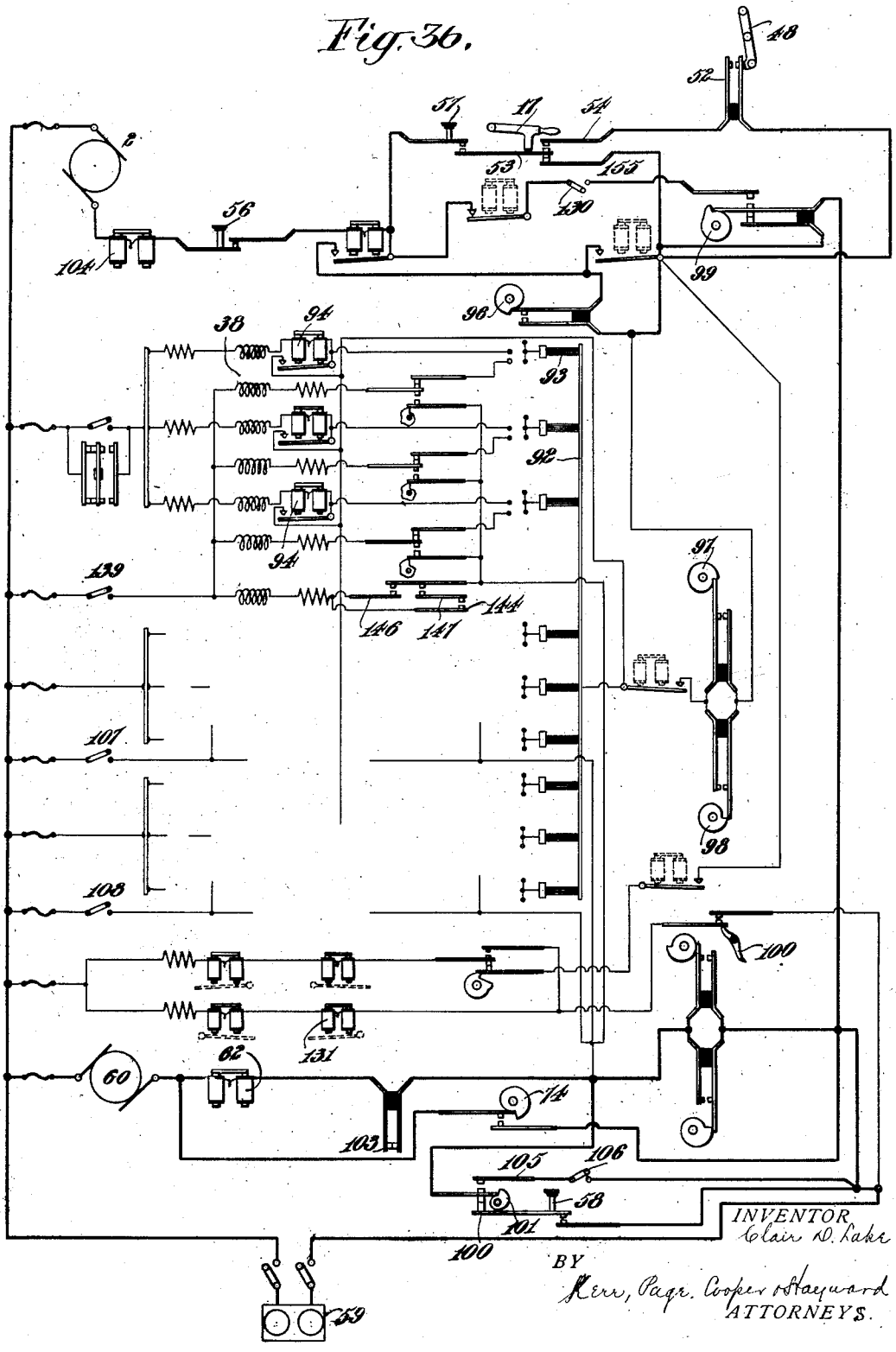
APPLICATION FILED DEC. 29, 1919.

1,379,268.

Patented May 24, 1921.

19 SHEETS—SHEET 19.

Fig. 36.



INVENTOR
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BY
Kerr, Page, Cooper & Hayward
ATTORNEYS.

UNITED STATES PATENT OFFICE.

CLAIR DENNISON LAKE, OF BINGHAMTON, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, A CORPORATION OF NEW JERSEY.

PRINTING-TABULATOR.

1,379,268. Specification of Letters Patent. Patented May 24, 1921.

Application filed December 29, 1919. Serial No. 348,069.

To all whom it may concern:

Be it known that I, CLAIR D. LAKE, a citizen of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Printing-Tabulators, of which the following is a full, clear, and exact description.

The invention which forms the subject of this application for Letters Patent is an improvement in attachments for tabulating machines, more particularly the well known and widely used Hollerith tabulator, which is typical of the general class of machines designed solely for tabulating.

This machine is set forth in numerous patents but is, perhaps, more fully shown and described in Patent No. 685,608, dated Oct. 29, 1901.

In such machines provision is made for passing singly and in rapid succession a stack of perforated cards under a series of brushes or contacts which, encountering perforations, make contact with a conductor over which the cards pass, and thereby energize electromagnets to operate suitably designed and constructed means for indicating the data which the perforations by their number or location represent. Generally speaking, the main function of such machines is to totalize items and when a determined number of cards has been run through, the indicated totals may be read off and taken down. No provision, as a rule, is made for printing or permanently recording the individual items, as this requires more time, and a slower operation of the machine than its normal use will permit. Hence, to list the items indicated by a stack of cards, would involve the reading and recording of each figure displayed by the record wheels.

My purpose has been to extend the field of usefulness of such machines, and to provide means whereby they may be called upon, when occasion requires, to list or print the items and to print or record subtotals and totals, and in general to make a permanent record of whatever operation they may be called upon to perform. With this object in mind I have devised an attachment to a tabulator which will operate in synchronism or exact accord therewith to record each item, subtotal or grand total as the case may be, and to adapt the tabulator to listing I provide means for varying and controlling its speed whereby it must be run at a reduced speed when listing or may be run at its normal high speed when merely tabulating.

The accomplishment of this result has involved chiefly the devising of new mechanical devices, and combinations, and in these the invention resides. The general nature of the improvement may therefore be gathered from the consideration that in the tabulator proper there are a number of indicating wheels which are set to indicate the numbers corresponding to the perforations in the cards. My new attachment is capable of printing each number so indicated, or the totals of a group of such numbers, or the grand totals of several groups. It is provided with means for resetting the indicating wheels to zero after any or any number of operations, so that after resetting no totals may be preserved, or on the other hand, if not reset, a subtotal may be printed and preserved, so that the next printed total will be a grand total and so on.

As above stated, there is used a controlling device by which the speed of the tabulator is reduced when the attachment is used for listing, but if only totals are to be printed, then the machine may be set for the higher or normal tabulator speed, and the individual numbers are not printed, the totals being recorded by pressing a button, which causes the proper mechanism for the purpose to operate.

The improvement is illustrated in detail in the accompanying drawings:

Figure 1 is a side view in elevation of a conventional form of tabulator with my improved attachment associated therewith.

Fig. 2 is an enlarged view in elevation of the printing attachment showing a part of the tabulator. The cover of the attachment is removed to exhibit the general internal arrangement.

Fig. 3 is a sectional view of the attachment taken on the line 3—3 of Fig. 4.

Fig. 4 is a sectional view of the same on the line 4—4 of Fig. 3.

Fig. 5 is a section on line 5—5 of Fig. 3.

Fig. 6 is a section of the same on line 6—6 of Fig. 3.

Fig. 7 is a top plan view of the attachment with the paper roll and cover removed.

Fig. 8 is an enlarged detail of the means

for setting the printing type carriers and effecting the printing.

Fig. 8ª is a detail of a zero control device, shown in Fig. 8.

Fig. 9 is a view in side elevation on an enlarged scale of the printing type carriers.

Fig. 10 is a detail of a portion of the type carrier.

Fig. 11 is a detail of a type on the line 11 of Fig. 10.

Fig. 12 is a side view of the upper portion of the mechanism in the tabulator taken on line 12—12 of Fig. 14.

Fig. 13 is a detail view partly in section of a part of the tabulator mechanism.

Fig. 14 is a top plan view of the intermediate portion of the tabulator and its printing attachment.

Fig. 15 is a sectional view of the same parts on the line 15—15 of Fig. 14.

Fig. 16 is a detail of the ribbon feeding mechanism for printing from the type.

Fig. 17 is a vertical section through one of the counters of the tabulator.

Fig. 18 is a top plan view of the indicating wheels of the tabulator and the contacts which control the printing mechanism.

Fig. 19 is a detailed plan view of the tabulator type wheels and setting mechanism therefor.

Fig. 20 is a section on the line 20—20 of Fig. 19.

Fig. 21 is a plan view of cams and contacts in the printing attachment, the contacts being those controlling during the printing and resetting portion of the cycle.

Fig. 22 is a side view of the same parts.

Figs. 23, 24, 25 and 26 are detail views of certain cams and contacts employed in the tabulator printer attachment.

Fig. 27 is a plan view of a cam box and contacts controlling the operation of the tabulator.

Fig. 28 is a sectional view on the line 28—28 of Fig. 27.

Figs. 29, 30, 31, 32 and 33 are detail views of cams and contacts used in the tabulator.

Fig. 34 is an end view of the tabulator clutch mechanism.

Fig. 35 is a side view of the same, and

Fig. 36 is a diagram of the circuit connections and an illustration of the relations of the several parts of the apparatus.

Similar reference numerals in all of the above figures are employed to designate corresponding parts thereof.

The tabulator proper is will known in the art and requires but little further description than will be given incidentally herein. In Fig. 1 the card-controlling portion 1, the driving motor 2, the counter shaft 3, and the counters 4, 5 and 6 are shown in their normal relations. As is well known, as the perforated cards are passed through the machine, one or more of the counters are operated to show the figures or the totals of the figures represented by the perforations in said cards.

My improved printing attachment for such a tabulator is designated by the numeral 7, and between this attachment and the tabulator is a casing 8, a part of the interior mechanism in which I shall now describe by reference to Figs. 12, 14 and 15.

In these figures the shaft 9 extends from the tabulator motor 2 and carries a gear 10 which imparts rotation to a cam 11 upon the cam surface of which travels a lever 12, with a roller at its end and actuated by a spiral spring 13. The lever 12 oscillates a loose hub 21 on shaft 14 with which hub it is integral or to which it is fixed, and it has attached to it a plate 15 having a notch 16. When the machine stops after any cycle of operation this notch by reason of the fact that the lever acts on the higher point of the cam, is immediately under a projection on a pivoted handle or lever 17, the end of which projects out through a slot in casing 8. When it is not desired to list, this handle is depressed, locking the lever 12 against movement, so that it does not follow the cam 11, and at the same time lever 17 itself is locked down by a bell crank catch 18 actuated by a spring 19 and may not be again raised until a push button 20 is forced down to release the bell crank catch.

In the printing casing proper 7 the shaft 14 extends as shown in Fig. 4 and carries in addition to the hub 21 a second loose hub 22 and both ends 21 and 22 have teeth or notches therein. Intermediate these hubs is a sliding notched sleeve 23 keyed to the shaft and adapted to be moved from engagement with one hub 22 to the other 21, or conversely, by means of a lever 24 oscillated by a cam groove in a disk 25, on shaft 90.

Pinned to the shaft 14 is also a double lever 26 (see Figs. 3, 4 and 8) which partakes of the oscillatory movement of said shaft, and is thus raised or lowered according to whether the keyed sleeve 23 engages with hub 21 to which the lever 12 is secured, or whether it engages with the hub 22, integral with which is a lever or arm 27 which bears upon and is oscillated by a cam 28 on the shaft 90.

The normal position of the sleeve 23 is in engagement with the hub 21, and this must be the case when the machine is used for listing. By means to be hereinafter described, the lever 24 throws the sleeve 23 into engagement with hub 22 when a total is to be printed from which it follows that in listing the shaft 14 is oscillated by the lever 12, but in total printing by lever 27.

Referring now to Fig. 8, the ends of the oscillatory lever 26 are connected by links 29 with a cross head 30 movable over vertical rods 31, and imparts vertical movement

thereto. Extending from the cross head 30 are arms carrying a bail 32 which extends through a plurality of slotted bars 33 equal in number to the type wheels of the tabulator and each carrying a series of ten sliding type bars 34. Normally the bars 33 are drawn upward by spiral springs 35 connected to them through links and lever 36 and therefore are in contact with the bail 32 and follow the upward movement of the latter imparted by lever 26 until arrested by pawls 37 operated by the magnets 38, and engaging in one of a series of notches 39 in the side edge of the bars 33. The spacing of the notches 39 corresponds with the spacing of the movable type 34 and the movement of the bars under the influence of the levers 26 is synchronous with the movement of the perforated cards through the machine, so that when a perforation is encountered by a brush in the tabulator, the corresponding magnet 38 is energized, as will be hereinafter set forth, and the bar is stopped at a point in its upward travel which brings the type corresponding to such perforation into the printing position and holds it there until after the printing.

The cross head 30 has rearwardly-extending projections 40 with rollers which work in slots in plates or levers 41, pivoted at 42 and as the cross head rises these levers, by reason of the conformation of the slots, are forced back, thereby swinging a bail 43 to the left into engagement with pivoted spring actuated levers 44, forcing the same back and allowing a series of pivoted spring actuated printing levers 45 to swing away from the type bars carried by the plates or bars 33. At the limit of upward movement of the cross head 30, however, this bail 43 is turned down and slips off from the ends of levers 44 and these being suddenly released are thrown by their springs forward, thus driving the printing levers forward with sufficient force and momentum to strike either a type or the blank point on a type carrier. A type thus struck, strikes the paper 46 on a roller 47 and prints thereon the proper figure.

By the means above described it will be seen that every perforation in a proper card will cause to be set at the printing position and printed on a sheet of paper a figure corresponding to that perforation, in addition to tabulating the same figures in the usual and ordinary way. It is necessary, however, when listing or printing in this manner to provide for a slower operation of the machine than for tabulating only; for printing totals and subtotals; for resetting all parts to zero at certain desired times and for performing certain other operations and I shall now describe the means which I have devised for accomplishing these operations.

On the tabulating portion of the machine, see Fig. 1, is a lever or handle 48 which, by its actuation of any well known form of mechanism, imparts to the machine a slower or a faster speed. For example, when shifted to the left this handle throws in a belt operating a small pulley 49 which drives the machine at a relatively high speed and when shifted to the right throws in a belt operating a large pulley 50, which drives the machine at a slower speed. In the present case the slower speed is used when the machine is listing, and the higher speed when tabulating only.

The handle 48 carries an arm 51 which controls in its movement the contacts 52 and on low speed these contacts are brought together. By reference to Fig. 12, it will be seen that when the lever or handle 17 is raised a central contact strip 53 comes into engagement with an upper contact 54, but when the handle is lowered this central contact engages a lower contact 55.

Passing now to the diagram, Fig. 36. It may be assumed that the tabulator is provided with a manual starting key 57 and the usual emergency stop key 56, but no further description of the character or function of these keys is needed, as they are always used in machines of this class. Assuming, however, that these keys are closed, then if the handle 17 be depressed the circuit through the tabulator start key 57 is closed by the engagement of contact 53 with contact 55. The listing or printing circuit, however, is broken at two points; viz., between 53 and 54 and between contacts 52, and this circuit may not be completed for listing until the handle 17 is unlocked and raised, and until the lever 48 is thrown to the left to operate the machine at its slower speed. The machine may therefore tabulate at both speeds, but it can list only at slow speed.

To print totals and subtotals the following mechanism is employed: Assuming that the machine has been listing and has printed a column of figures, and it is desired to print the total of the printed figures. This may be done manually by depressing the reset key 58, see Figs. 1 and 36, which operation closes the circuit of a source 59, through the reset motor 60. The shaft of this motor carries a worm 61, Fig. 3, that imparts rotation to a gear wheel 67 loose on shaft 90. The key 58 also energizes an electro-magnet 62 which releases a clutch 63 on the shaft 90 by the movement of its armature 64, rigid with an arm 65 that raises a pin 66 out of a circumferential groove in the clutch and permits the said clutch which is keyed to shaft 90 to engage under spring action with the gear wheel 67.

The said arm 65 carries also a pin 68, see Figs. 4 and 12, and on its upward movement causes said pin 68 to engage with a

pawl 69 engaging with a cam 70 on a shaft 71. The pawl 69 is carried by an arm or plate 72 which is fixed to a gear wheel 73 loose on shaft 71, and in gear with the shaft 90 through a gear wheel 75, but as the pawl is thus disengaged from the cam 70 the latter is not revolved by the first revolution of the cam and gear 73. The magnet 62, however, as shown diagrammatically in Fig. 36, is short circuited by a properly timed cam 74 so that the pin 68 drops out of the path of the pawl 69 during the first revolution of gear 73, which is thereby permitted to reengage with the cam 70 and to rotate the same during and by the second rotation of the gear wheel 73. By the above described arrangement the gear 75, makes one revolution while the cam 70 makes two. The purpose of this may be thus explained.

During the first half revolution of the gear wheel 75 the lever 27 operates to raise the type carrier and print a total, but during this period the gear wheel 73 is stationary. During the second half of the revolution of wheel 75, however, while resetting the type carriers, the gear wheel 73 rotates and imparts its rotation to the shaft 90 which operates in the usual way to reset all the tabulator counters to zero.

Fixed to the gear wheel 75 is a cam 76 best shown in dotted lines in Fig. 12, and upon this cam bears an arm or lever 77 pivoted at 78, see Fig. 15. The lever 77 is connected by a turn buckle 79 with an arm 80 fixed to a shaft 81, which extends back to the tabulator, where over each set of indicating wheels 82, Figs. 17 and 18 it carries a bail 83 fast to it, and associated, as will be set forth, with contacts corresponding to each indicating wheel.

In gear with the indicating wheels and moving in exact unison therewith are cam disks 84 with ten steps of varying height corresponding to the numbers on the wheels; that is to say, the highest step corresponding to 9 and the lowest to zero. By each rotation of the cam 76 the shaft 81 is rocked and the tail 83 is depressed, and this results in the following operation.

A set of contacts 85, 86 are associated and mounted with suitable insulation on a support 87 turning loosely on shaft 81, and by a spiral spring 88 the lower contact 85 is held against a shoulder on an insulating post 89 on bail 83, while the upper contact 86 is held out of contact with 85 by the top of this post which projects up through the lower contact. When the bail 83 is lowered an insulating stop on each contact 85 comes in contact with that step on the disk 84 under it, which on the stoppage of the machine is presented to that position, so that the bail still descending draws the post 89 away from the upper contact and allows this to come into engagement with the contact under it.

It will be borne in mind that when the conditions now being described are established by the depression of the key 58, the last figure or figures in the column in the listing machine have been printed and the type carriers restored to their initial or normal positions. But, while such type bars or carriers, after the operation of key 58, are not raised again by the movement of lever 26, they are raised in the same way by the lever 27 and move in synchronism with the bail 83 and its associated parts. Hence, when this bail is depressed and the circuit controlling contacts 85 and 86 brought into operation, these contacts will close at points in the cycle of operation dependent upon the height of the steps on disks 84 which they encounter, or in other words, the value of the digits which these steps represent.

The contacts 85, 86 control the circuits of the magnets 38 of the listing machine, and hence these magnets will arrest the type carriers at points in which the type thereon corresponding to the steps are brought into the printing position. It will be seen that in this machine there is one set of type for each column of figures which are used for both listing and total printing. These type are arranged in vertical rows with the 9 at the top of the carrier. This is so that the type will correspond with the numbers when listing, as the 9 is the first number which on a perforated card comes under the tabulator contact brush when the cards are fed through the machine. In taking a total the step cam disks 84 have the highest points to represent 9 so that when the contact device is locked down on these disks, the first point of contact would of course, be the highest point, representing 9.

In this machine there are certain details and refinements of construction and operation, which, now that the general nature and purpose of the device have been set forth, may be described to assist in a more complete understanding of the invention. I therefore take them up without special regard to order, but following certain operations of the machine, for which purpose reference is made chiefly to Fig. 36.

When the machine, which in this case is the well and widely known Hollerith tabulator, is started in operation perforated cards are passed successively between a conducting plate 92 and a series of brushes 93, which are plugged into circuits including the tabulating or counter relays 94, and the listing or printing magnets 38. Whenever a brush, therefore, comes over a perforation both of these magnets are, or as above described, may be operated to perform their allotted functions, but the proper operation

of the machine as a whole requires various circuits to be made or broken at certain points in each cycle of operations, and for this purpose two sets of cams are employed, one in box 95 on the tabulator, shown in detail in Figs. 27 and 28, the other in the listing machine, shown in Figs. 4, 5, 21 and 22. The construction of these cam contact devices is illustrated in detail but only to assist the mechanic in producing them as their specific construction is largely an immaterial matter. The main point of interest is their functions and these may be thus described.

Cam contact 96, Figs. 29 and 27, is that which controls the stopping of the tabulator at a definite point in any cycle of operation, in order that when so stopped the total printing mechanism may be properly operated. Although this cam breaks the circuit once during each cycle, it is understood that if a card is still passing or other conditions are maintained in which the machine should not be stopped it is not effective.

Cam contact 97 also breaks its circuit once in each cycle, and controls the breaking of the circuit through the brushes 93 to the adding magnets of the tabulator counter, and also through the listing magnets of the printing mechanism.

Cam contact 98 in like manner controls the making of the same circuits and operates in conjunction with cam 97.

Cam contact 99 controls the tabulator circuit in conjunction with a lever 100 which closes that circuit when a card is in the tabulator, but breaks it when such card has passed out and none other takes its place. The cam controls the contacts and operates to stop the machine at a predetermined point, known in practice as point D on the tabulator index.

Cam contact 101. This cam makes one revolution during the passage of a card feeding through the tabulator, and is timed so that its lower contact 102 breaks circuit just after the machine has passed the normal stopping point indicated by D on the index. This contact is in the circuit of the reset key 58 and on separating breaks that circuit so that the counter disks can not be reset, nor a total printed while the tabulator is running, nor until the machine has come to a full stop at D when contact 102 is again made. In addition to these interlocking contacts those designated by the numeral 103 are required, which are held open by the clutch stop control magnet 104, as shown in Figs. 34 and 35, so long as this magnet is energized. This is necessary to open the reset key circuit in two places in series, as contact 102 closes once each cycle. The upper contacts 105 are closed at the end of each tabulator cycle just when it reaches the normal stopping point D and this will automatically start the reset and printing mechanism, provided the switch 106 be closed, this switch being manually operated. Contacts 103, it will be observed, also work in conjunction with the upper contact 105, being in circuit therewith, as shown in Fig. 36.

There are three switches 139, 107 and 108, shown in Figs. 1 and 36, which control the three counters 4, 5 and 6 respectively. If these switches are opened the circuits to the corresponding ten printing magnets 38 of each set which control the stopping of the type bars or carriers, are broken, and the type carriers will all travel to present a blank point in the printing position so that no figures will be printed.

In Figs. 34 and 35 the details of the clutch control magnet 104 which controls the starting and stopping of the tabulator are shown. The circuit of this magnet is controlled primarily by the tabulator start key 57, and when energized it attracts its armature 109, thereby disengaging a pin 110 mounted on lever 111 rigid therewith, from the sliding clutch member 112 impelled by spring 113 and this member when so released is forced into engagement with the tabulator shaft thereby starting the tabulator. The armature 109 remains in attracted position as long as the tabulator is running and until the cam contacts 96 break the circuit, when the magnet 104 releases the said armature which is then forced away from the magnet cores by means of a spring plunger 114. As the pin 110 engages in a slot in the clutch member 112 a properly tapered portion of this slot throws out the clutch when engaged by the pin 110. Contacts 103 are broken while magnet 104 is energized, this being effected by an arm 115, carried by the level 111.

In Fig. 16 is shown the inking ribbon feed, the construction of which may be any known in the art, and which is not described herein in detail as it forms no part of the present invention. This ribbon feed is operated by a pin 116, extending from the cross-head 30, see Fig. 3, and engaging in a slot in a pivoted bar or plate 117. As the cross-head rises and falls this engagement imparts a sufficient sidewise movement to the bar 117 to feed the ribbon one step.

In Fig. 3 a push button 118 is shown which when hand-operated releases a clutch member 119 in the printing mechanism whenever it may be desired to operate the machine by hand.

In Figs 3, 8 and 8ª a zero control device 120 is shown. There is one of these levers for each type carrier and each is pivoted at 121. Each lever has an arm 122 projecting over the next lever to the left of the group of nine levers. If the lower ends of lever 120 drop into a recess or slot 123 in the bars

33 these bars will rise to a point where a blank space is presented to the printing position, but should the levers 120 be held out so that the ends do not pass into the recesses 123 but are stopped by a projection 124, then the type carriers will be raised to a point where they present zero type at the printing position. From the construction shown and described it is manifest that all type carriers to the left of those thus raised to print zero will present blank spaces at the printing position, so that no zeros will be printed at the left of a total.

In Figs. 4 and 5 a series of cams are shown as carried by the shaft 90 in the printing mechanism and these are rotated and operated whenever this shaft is connected up and rotated by the motor 60. The contacts which coöperate with these cams are shown in Fig. 21 and in detail in Figs. 23 to 26. In Fig. 23 the cam and contact combination 125 controls the breaking of the circuit to all of the printing magnets 38, interrupting these circuits when such magnets have been used to print a total only.

In Fig. 24 the combination 126 controls the making of the circuit to the printing magnets 38.

In Fig. 25 the combination 127 makes contact shortly after the reset motor 60 starts and short circuits the clutch control magnet 62 and controls the stopping of the printing mechanism, by breaking the circuit at the end of the cycle.

In Fig. 26 the cam and contact combination involves two contacts 128 and 129. As soon as the reset or total printing cycle starts, the lower contacts 129 are separated, thereby breaking the tabulator circuit, and it is therefore impossible to tabulate until the cycle is complete. All of these cams, it will be observed, make only one revolution in taking a total. The top contacts 128 controlled by the same cam, close for an instant at the end of each cycle, which automatically starts the tabulator after the printing and resetting operations have been completed, providing switch 130, which is hand-operated, has been closed.

The tabulator will not automatically start even if switch 130 be closed, when there are no cards in the machine as this circuit is controlled by a relay 131, Fig. 36, which is in circuit with the contact controlling lever 100, which does not operate to close the relay circuit unless a card is in the machine.

In Figs. 21 and 22 there is shown a cam mechanism which is used for boosting the shaft 90 forward to complete the cycle, and thus overcome the additional load thrown on that shaft at the end of each cycle. This mechanism comprises a lever 132 pivoted at 133 and having a right-angled arm 134 to which is connected a stout spiral spring 135. The lever 132 carries a roller 136, which travels over the high part of a cam 137 on the shaft 90, and by this means the spring is held under tension. Near the end of the cycle the roller drops into a depression over the inclined surface 138 and the force of the spring is exerted against this inclined surface with a tendency to push the cam and shaft in the direction of its normal movement.

The tabulator, as will be seen from Figs. 1 and 13, is provided with hand-operated milled sleeves 140 on the shaft 91, for throwing in the clutch members 141 that operate to throw into operative condition the means for resetting of the tabulator counters. The sleeves 140 are of any ordinary construction and contain indentations into which pins in the clutch members 141 pass when the sleeves are forced forward, and when they are thus set or forced in the corresponding counter will reset to zero. On the milled sleeves 140 are grooves 142 into which project the ends of pivoted levers 143, see Figs. 1 and 2, so that as the sleeve is moved in or out of engagement this lever operates the contacts 144 as shown in Fig. 17. One of the type carriers 33, which in Fig. 9 is marked 145, has but two type, an asterisk, and the letter S, and this carrier is controlled in its upward movement by the same means as the other type carriers.

When contacts 144 therefore are broken the carrier 145 is permitted to rise until the asterisk is brought to the printing position and is printed together with the total. This indicates that when the total was taken, the tabulator counters were reset to zero.

On the other hand, if the clutch member 141 is out, the lever 143 is in a position to close contacts 144 and if a total be taken with these contents closed and the clutch out, the counters are not reset, and the type carrier 145 is stopped to present the S to the printing position, which will indicate that the total is a subtotal and that the counters were not reset.

In addition to the contacts 144 for controlling the printing of the asterisk and the S there are two contacts 146 and 147 shown in Fig. 36 though but one appears in Fig. 17 as the other is on the other side of the counter. When a total is taken by the depression of the bail 83 an insulated screw 148 brings contacts 146 first together and a similar screw brings contacts 147 later together. If contacts 144 happen to be closed by the clutch member 141 being out, then the type carriers are stopped at the position to print S, but if contacts 144 are opened and switch member 141 in, when contacts 146 close, the S is passed and when later, contacts 147 are closed the carrier is stopped to print an asterisk.

There are other mechanical parts and de-

tails used in the apparatus above described which require no specific description that will tend to convey a more complete understanding of the main invention, or which are present in other machines of this general class and are well known. In the above description attention has been paid to the more or less specific construction of the purely mechanical elements and reliance has been had on the diagram, Fig. 36, for the electrical devices as the functions of these and not their specific construction are of the essence of the invention, and constructors of such machines require no more than a mere statement of their nature and purpose to enable them to properly build the machine as a whole to be operated.

The tabulating art has reached a well known stage of development where with the information herein contained any skilled worker in this are will be able to add to such a machine the novel features of this invention—a listing and printing attachment—so coördinated with the tabulating mechanism that it may be utilized at the will of the operator to list the figures set up on the counters by the perforated cards, to take subtotals and totals and to reset the tabulator counters. No machine so far as I am aware, has heretofore been produced that will effect these operations in the manner herein set forth.

What I claim as my invention is:—

1. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting it with or disconnecting it from the tabulator mechanism and means for causing the tabulator to run at reduced speed under the control of the means which connect the listing attachment with said tabulator.

2. The combination with a power driven tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means for applying the driving power to the tabulator at varying rates, operatively controlled by said intermediate mechanism whereby the machine will be run at a reduced speed when the printing and listing attachment is connected with the tabulator mechanism.

3. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means controlled by the listing attachment to prevent the tabulator from operating while said attachment is in operation for the printing or listing.

4. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with or disconnecting it from the tabulator mechanism, and means for resetting the tabulator counter wheels to zero operated by and during the operation of the total printing means in said listing attachment.

5. The combination with a tabulating machine of a printing or listing attachment, intermediate mechanism for connecting the same with the tabulator mechanism or disconnecting it therefrom, and mechanism in said attachment controlled by the tabulator counter wheels, and adapted to operate independently of the listing means for printing the totals indicated by the adjusted position of the tabulator counter wheels.

6. The combination with a tabulating machine of a printing or listing attachment, means for connecting it when desired with the tabulator mechanism whereby it lists the figures perforated in the tabulating cards, means in said attachment coöperating with the tabulator mechanism for printing the totals displayed by the counters, means controlled by the total printing mechanism for resetting the tabulator counters to zero, and means for indicating when such resetting mechanism has been brought into operation and when not.

7. The combination with a tabulating machine of a printing or listing attachment and means for bringing the same into operative relation with the tabulator mechanism, and circuit controlling means in both the tabulator and the listing mechanism for automatically and coöperatively controlling the operations of both mechanisms.

8. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same with the tabulator mechanism, movable type carriers in the said attachment operated in unison with the tabulator mechanism, and electro-magnets operated by the tabulator contact brushes for stopping at the printing position the type in such carriers that represent the perforations in the tabulator cards through which such brushes make contact.

9. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same with the tabulator mechanism, means for controlling the speed of the tabulator and interconnecting circuits between the tabulator and its attachment and circuit controllers therefor which prevent the tabulator from being operated at is normal or high speed when the listing attachment is connected therewith.

10. The combination with a tabulating machine of a printing or listing attachment and means for operatively connecting the same when so desired with the tabulator mechanism, means for controlling the speed of the tabulator, interconnecting circuits between the tabulator and its attachment and circuit controllers, both manual and auto-

matic, therefor which prevent the tabulator from being operated at its normal or high speed while the listing attachment is connected therewith.

11. The combination with a tabulating machine having sets of counter wheels, of a printing or listing attachment having corresponding sets of printing devices, means for operatively connecting said attachment with the tabulator mechanism, and means for connecting up the resetting mechanisms for the tabulator counters with the total printing mechanism of the attachment.

12. The combination with a tabulating machine and a printing or listing attachment adapted to be brought into operative relation therewith, of motors in both the tabulator and in the attachment, means for connecting the tabulator and listing mechanisms and means for bringing the motor in the attachment into operation for printing totals and for resetting the tabulator counters to zero.

13. The combination with a tabulating machine of an attachment therefor comprising means for listing the figures perforated in the tabulating cards at each cycle of operation of the tabulator while adding on the tabulator counters, and means for printing the total displayed at any time by such counters, contacts operated by said printing means and operating upon cams on the tabulator counter wheels to control the operation of the total printing mechanism.

14. The combination with a tabulating machine of a printing or listing attachment comprising mechanism for listing figures corresponding to those added at or by each cycle of the operation of the tabulator, and independent means for printing the totals displayed at any time by the tabulator counter wheels, means normally connecting the listing mechanism with the tabulator mechanism and total printing controlling means adapted on its operation to disconnect said mechanisms.

In testimony whereof I hereunto affix my signature.

CLAIR DENNISON LAKE.