N° 15,709 A.D. 1900

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COMPLETE SPECIFICATION.

Adding and Recording Machine.

I, ADOLPHUS SYLVESTER DENNIS, citizen of the United States, residing at 28, Vienna Street, in the City of Cleveland, County of Cuyahoga, and State of Ohio, United States of America, Manager, do hereby declare that nature of this invention, and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

My invention relates to improvements in adding and recording machines.

In the accompanying drawings Fig. 1 is a side elevation of the complete machine.

Fig. 2 is a plan view of the machine.

Fig. 3 is a longitudinal sectional elevation on line A—A, Figs. 2 and 6.

Fig. 4 is a longitudinal sectional elevation on line B—B, Figs. 2 and 6.

Fig. 5 is a central longitudinal sectional elevation on line C—C, Figs. 2 and 6.

Fig. 6 is a plan view of the machine on section line D—D, Fig. 4.

Fig. 7 is a plan view, looking down from line E—E, Figs. 4 and 5.

Fig. 8 is a rear elevation of the machine, looking to the left from line G—G, Fig. 4.

Fig. 9 is a cross section on line F—F, Fig. 4, looking to the right.

Fig. 10 is a front elevation, partly sectional, of the carriage and the pivoted column determining levers therein.

Fig. 11 is a cross section of the adding wheels proper, the totalizing wheels and associated parts on a line corresponding to H—H, Fig. 12.

Fig. 12 is a cross section of three several adding wheels, showing their bearings as herein after more fully described.

Fig. 13 is a cross section on line I—I, Fig. 11, showing the totalizing wheels on their shaft.

Fig. 14 is a perspective detail of a single totalizing wheel out of the group in Fig. 13.

Fig. 15 Sheet 4, is an elevation of the type-bar for printing the items.

In the views thus shown 2 represents the frame of the machine which carries all the other parts directly or indirectly, whether stationary or operative. The keys are represented by 3 of which there are 10 in this machine, running from 0 to 9, inclusive, and in addition there is a key 4, to correct errors in the column work as hereinafter described. The nine several keys are employed to write the items, whatever their size, but have nothing to do with the totalizing mechanism, which is a separate line, as will be seen further along.

The carriage 5 rests horizontally across the top central portion of the machine, as seen in plan, Fig. 6, and in elevation Fig. 5, and carries a number of parts, as will appear. It runs on ball bearings on the channelled cross rails 6 of the main frame, and is under constant spring tension through the flat spring coil 7, Fig. 7, having one end fastened to its enclosing case 8 and the other to shaft 9. A drum 10 rigid on this shaft, and a corresponding drum 11 on the opposite side of the machine, Fig. 9, are connected by endless metal tape, 12, secured to the

[*Price* 8*d*.]

carriage 5 at one point, so that every time a key-lever is depressed to print a character the carriage is fed forward one step, after the manner of a typewriter.

On the rear end of shaft 9 is a segmental ratchet 13 adapted to be engaged by two escapement pawls 14 and 15 successively, Fig. 8. These pawls are arranged side by side on an upright rocking post 16 which has a head 17 on which pawl 15 is rigid, and pawl 14 is pivoted. Normally, pawl 14 engages ratchet 13, and when a key is depressed post 16 is rotated and pawl 14 carried inward out of engagement while at the same time pawl 15 takes its place before permitting movement of the ratchet 13, and holding shaft 9 still. Meantime pawl 14 has been drawn down by its link connection to engage the next lower tooth as will soon appear.

All the key-levers have like operations, and when any one is depressed it strikes the cross frame 18 beneath, Fig. 5. Said frame is pivoted at both sides on cross shaft 19 on which the keys are independently pivoted. Frame 18 has an arm 20 centrally through which the rear vertical pawl carrying post 16 is rotated by means of rod 21 having an L shaped head 22, and the arm 23 on post 16 having, in this instance, a set screw 24 engaged by head 22 when it is forced inward by arm 20. This causes post 16 to rotate just enough to exchange pawls in engagement with ratchet 13, as above described, and this occurs every time a key lever is depressed.

The further action of pawl 14 is dependent on the movement of the printing hammer 25 supported on arm 26 carried by shaft 27, Figs. 5 and 8. The blow of this hammer to make an imprint is dependent on spring pressed bolt 30 which rests against short arm 31 rigid with shaft 27, said bolt being confined to operate in the casing 32, containing spring 33 bearing against the head of said bolt. Another short arm 34 rigid with shaft 27 engages the short portion of L shaped head 22 in which is a slot 35 adapted to receive the downwardly curved end of said arm 34 when said head is carried rearward through the action of rod 21 and shaft 27 is rotated as the hammer 25 delivers its stroke. Then as the key lever which has caused this action rises the rod 21 is carried back by the action of its spring 36, the short arm 34 is raised out of its slot to position as in Fig. 5, by the pull from spring 7 on shaft 9 and pawl 14 and its link 41, bolt 30 is forced back under this pull and hammer 25 assumes normal retired place.

Now, reviewing the operation of pawl 14, Fig. 8, the said pawl is pivoted in head 17, and is subject to opposite movements. Thus a bolt 40 supported in arms on the post 16, and spring pressed serves to hold the said pawl up even with pawl 15 at its side. It also has a link 41 connecting with arm 42 on shaft 27, so that when said shaft is rotated for the actuation of the hammer it will pull down the pawl 14 far enough to engage in over the next tooth below, as pawl 15 is released by swinging backward to rest instantly on release of the key lever. Then as pawl 14 rises to normal position it allows rotation enough of segment 13 to make a step of feed for the carriage to print in the next column.

Sometimes it is desirable to do spacing without operating a key lever, as when an error in setting the carriage occurs. For this purpose I have the lever 4, apart from the key levers proper and which is rigid with shaft 19, thereon. This particular lever has an arm 44 rigid with itself, or with shaft 19, adapted to engage push rod 45, Fig. 5, and through arm 23 on rotatable post 13 actuate pawls 14 and 15, thus affording an independent way for feeding the carriage 5. In this operation, the moment pawl 14 is disengaged from segment 13 the bolt 30 is free to act and throw the hammer arm 26 forward but the hammer is deterred from making a full stroke by the L shaped head 22, which now serves as a stop by reason of arm 34 striking the top of said head instead of entering slot 35.

On the rear of the carriage 5 are feed rolls 47 and 48 between which the sheet of paper printed upon is placed, a feed spout 49 for the sheet being shown in this machine. The paper is fed upward by these rolls with the ink ribbon 51 between it and the type bar 52. Said bar, Fig. 15, Sheet 4, is adapted to slide

back and forth in a slot in the top cross piece 53 of the main frame, to bring any called for figure into printing position. It bears figures or characters corresponding to those on the key board, so that the depression of any given key brings the corresponding character on this bar before hammer 25 for impression.

A line of separate mechanism connects said bar with the key levers, Figs. 5 and 9. Each key lever 3 has an arm 54 projected beyond its pivot on shaft 19 engaging beneath plate 55, fixed on shaft 56. The said arms are graduated in length according to the denomination or value of the key lever in the series, the lever having the highest numeral or character requiring the furthest throw as this machine is organized. The rotation of shaft 56 through wing 55 moves the mitre gear 57 thereon, Fig. 9, which meshes with segment 58 on upright shaft 60. The said shaft 60 has an arm 61, at its upper end, Fig. 2, connected by link 62 with type-bar 52. This produces exact correspondence and selection between the characters on said bar, which are from 0 to 9 in this instance, and the key levers of the same value, and the selections are unerring when the right lever has been touched. Normally, the cypher is opposite hammer 25, in which case the bar 52 does not move to make an impression. Spring 64 connected with an arm on upright shaft 60 restores said shaft 60 to initial position after each action.

A separate back stop is provided to limit the throw of arm 61 according to the character selected on the type-bar, said stops consisting of small vertically movable bolts 66 each adapted to shoot up in its own hole 67, Fig. 2 and 6, when called. These bolts 66 extend from under the bottom of the machine, Fig. 8 to the top and are operated by the key levers through diagonally arranged levers 68, pivoted between their ends on the under side of the machine and engaged by rods 70 at their front ends. These rods are attached each to its own key-lever and have springs about them to restore the key-levers to working position after each depression. The lower ends of said rods simply bear on levers 68 but might be pivoted thereto and so it occurs when any key-lever is depressed it throws up its corresponding back stop bolt for the arm 61 which controls the type-bar. This makes positive what might otherwise be an uncertain stop for said bar.

The carriage 5 normally is at the left of the machine, and for printing is moved towards the right as many points as there are figures in the item to be printed. Thus if the sum or item be say 365, the carriage is carried over to print the first figure in the hundreds column, the second in tens column and the third in units, and the vertical thumb levers 72, Figs. 5 and 10, particularly serve to fix the starting place for any given item, large or small. These levers are pivoted in a boxing 73 on the front of the carriage and have substantially right angled projections or fingers 74 at their bottom adapted, when said levers are used to engage each its own particular stop 75 on the frame below, thus preventing the moving of the carriage to the right further than the right stop will allow. Thus, if the third lever from the right be engaged by the thumb to move the carriage to starting place in hundreds column it would engage say the third lug or stop 75 from the right and stopping the carriage there make that the starting point for printing that item, tens being the next and units last. If the wrong lever 72 had been operated, say to set the machine in the ten thousand column, the spacing lever 4 can be operated to bring the machine to the right position, and then operations begin through the key levers. The lugs or stops 75 are staggered and the points 74 of the levers are arranged in respect thereto so that each will engage only its own stop and none other, and all the levers are arranged to work with the spring pressed bar 76 or they may have retracting springs of their own or both as preferred to restore them to normal position. Hence, in printing an item the first thing to do is to bring the carriage to the right place according to the column in which the first figure is to be printed. Then printing goes forward through the key-levers and this operation is repeated for each successive item indefinitely.

The hammer arm 26, so-called, Fig. 8, is really a heavy wire bow having its two extremities fixed on the shaft 27 at the sides and bottom of the machine, and the hammer is adjustably secured thereon.

The foregoing mechanism, mainly, has to do with the printing of items, and the total or sum of its items need not be struck off if not wanted, but it has been faithfully added up as each figure has been recorded and now nothing remains to be done but to strike off the total in a single line and at a single stroke by or through the totalizing hammer. In this carrying forward of the work for totalizing the items, I employ a set of adding wheels 77 and a set of total or recording wheels 78, Figs. 5 and 11, and with these the initial operating wheel 80, through which each adding wheel is reached by sliding wheel 80 in beneath it. There are as many adding wheels as key-levers, and a certain recording wheel geared with each adding wheel so that each lever not only works a line of mechanism to print the items, but also to add the items as they are printed, by carrying their sum forward with the adding and total wheels.

The wheels 77 and 78 are supported within the walls of what is termed the head 81, Figs. 2 and 9, while wheel 80 is adapted to slide on shaft 82. In this sliding movement it is controlled by a carrier arm 83 which is fixed at its lower end to a longitudinally sliding shaft or rod 84, Figs. 7 and 9, and this rod is connected by rigid arm 85 with the endless belt 12, attached at its top to the carriage 5. The carrier arm 83 engages in the hub of wheel 80 so as to give a positive movement to the wheel and hold it where adjusted but leaving the wheel free to turn.

Thus, it occurs that wheel 80 is caused to respond to every movement of carriage 5, and by reason of this connection of arm 83 with belt 12 below the drums 10 and 11 the wheel 80 is always moved in the direction opposite to the carriage. Hence, if the carriage be moved by hand to the right, the said wheel travels a like distance to the left, and the parts are so arranged relatively that if the carriage be set to start printing in any given column the said wheel will come to the same column. This also places the said wheel in harmony with the key levers, so that it will carry into the totals the sum called for by said levers. If the figure be, say 5, the wheel 80 will rotate the adding wheel 77 with which it is engaged to carry up five points, and the same with any one of the several adding wheels to which for the time it may be moved through the key levers and carriage.

The shaft 82 carrying wheel 80 is rotated from shaft 56 Fig. 5 by segment 86 thereon engaging segment gear 87 on shaft 82. This gear rotates loosely and carries a pawl 88 which engages ratchet wheel 89 fixed on said shaft. Hence, this ratchet always holds every point moved up through segment 87.

Now, referring again to the adding wheels 77, Fig. 12, it will be noticed that they are each mounted on a hub 90 rigid on shaft 91 and with a race and anti-friction balls about its periphery, to afford an easy action for said wheels. The hubs 90 are all engaged also with the parallel rod 92, and each adding wheel has two cams 93 at its side, with ten points corresponding to ten in addition between the shoulder of each cam, and a lever 94 rides on each set of cams through a roller bearing thereon. A dog 95 on each lever 94 engages with ratchet teeth 96 on the side of the wheel 77 in the wheel next higher, numerically, so that when pivoted lever 94 through its roller jumps or drops off the shoulder of a cam 93 the spring pressed rod 97 pushes dog 95 forward and gives a single point rotation to the next higher adding wheel, thus carrying a number into said wheel. The same operation extends through all said wheels, and in this way, the items are first added up into the adding wheels themselves. A spring pressed pawl 98 engages ratchet 96 at the side of each wheel to prevent backward rotation.

Each adding wheel has also a catch or dog 100, Fig. 11, which is normally engaged with the teeth thereof to keep the wheel from rotating except when required, and the said catch is substantially L shaped, pivoted at its angle and bearing its short arm arranged to be engaged and depressed by roller 101 on the

top of wheel carrier 83, so that when said wheel is slid on its shaft into engagement of any one of the wheels 77 the roller 101 at the same time unlocks the catch 100. This liberates that particular adding wheel for rotation, and the catch drops back as soon as the carrier is moved on. When it is desired to disengage all the catches 100 at the same time so as to enable all the adding wheels to be alike turned to starting point after a given task is completed, I provide a rotatable cam shaft 104, Figs. 5 and 11, adapted to bear on the short arms of catches 100 and throw them all out at once. The said shaft is turned by means of crank levers 105, Fig. 1, gear 106 on shaft 107 and gear 108 on shaft 104. A pawl 110 on the inside of gear 108, Fig. 3, engages it with shaft 104, and thus it is rotated, but said pawl can be disengaged by depressible bolt 112. This enables a total to be struck off at any time without wiping out the additions then in the adding wheels, and frequently it is desirable that this should be done. Then the gear 108 will run idle and the other chain of gears going to the paper roll for printing the total and marked 113, 114, 115, 116 and 117, successively, will operate alone, as hereinafter seen.

Referring now to Fig. 4, segment 118 on shaft 104 meshes with gear 120 on adding wheel shaft 91. Gear 118 has teeth only half way round which is all it requires to bring the adding wheels back to zero, as a half rotation of them suffices in any case, having two stopping points each at their cam shoulders. This also gives time for the total or aggregate to be struck off through the rotation of crank 105 before the adding wheels are set back. In this rotation of the wheels 77 to zero they travel in their usual direction and are each engaged by its own pawl 121 at its side and fixed on one of the rods 92, Fig. 12.

The totalizing hammer 23 is fixed on a vibrating frame 122 which has a lateral sliding movement sufficient to carry the hammer over opposite the total wheels to strike off any given total, more or less. But it never moves further over than to take off the total then made. This prevents printing a series of naughts beyond the figures of the total as would occur if the entire nine total wheels were always covered. I limit this action of the hammer to the wheels used by means of a splined rod 124, Figs. 5, 11 and 13, adapted to run in a transverse slot across the edge of all the wheels 78, and which is open across all of them alike when said wheels are brought back to starting point. When this occurs their cyphers are all alike exposed at the front. Of course, all the wheels not used to print a total remain that way. Hence, the spline rod 124 can run into all the unused ones, but this is its limit, and this I utilize to determine the movement of the hammer 123 laterally.

In Fig. 1, I show an inclined shaft 125 having an arm 126 at the bottom engaged with a projection on the sliding rod 127 carrying hammer frame 122. At its top is an arm 128 connected with one end of the long spring pressed spline rod 124. A short arm 130 on shaft 125 Figs. 3 and 6, runs in engagement by roller with cam 131 on shaft 107 inside gear 106, and by thus rotating shaft 125 I get the necessary sweep to both arms 126 and 128, and they move together the same distance.

The hammer 123 is caused to strike by shouldered cam 133 on short shaft 134 carrying gear 113; arm 135 lying against said cam, shaft 136 carrying said arm, and another arm 137 rigid with said shaft, Fig. 4, and bearing at its extremity against a bail 138 along the bottom of hammer shaft 127. A heavy spring 140 presses against arm 137, and the moment arm 135 drops off the shoulder of cam 133 this spring gives an effective blow to hammer 123. Normally, the said several parts are in about the relation shown in Fig. 3, ready to be moved to action. A depressible stop 142 fixes the stopping point of crank lever 105 through which these actuations are made.

In Fig. 4 it will be seen that there are four pins 145 in pairs above and below the shaft 91 on which rests yielding spring arm 146 supported on the frame.

The totalizing or total recording wheels 78 are loosely supported on a common shaft, and have ten characters each on their periphery equally spaced, apart and

corresponding teeth at their sides in mesh with the opposite adding wheel. The two sets of wheels are so arranged that every unit added into one is carried forward into the other set, and the units, tens, hundreds, and *etc.*, are taken care of in the total wheels through rotations from the adding wheels.

Means for actuating the feed rolls 47 and 48 to set the paper at the proper elevation for each new line of figures to be printed consists of a ratchet wheel 147 (Figs. 6 and 9) on the feed roll shaft 148 which is engaged and rotated by an arm 149 on shaft 150 supported on the carriage 5, and this shaft 150 has a slotted arm at its end within boxing 73 which is rocked by a pin on bar 76 whenever a lever 72 is actuated.

When the total is to be printed the feed rolls are actuated to rotate first in one direction to carry the paper down slightly, so that the total will be printed in close relation to the last figure printed, and second, in the opposite direction to feed the paper upward after the total has been printed to bring the same in plain view at the top of the machine. This reverse motion is attained through gears 113 to 117 (Figs. 1 and 3), gear 117 having a long, flat sided shaft which extends into feed roll shaft 148 to rotate roll 47 and slidingly engaged therewith to allow for the side movement of the carriage. Gears 115 and 116 are in constant mesh with gear 117 and gear 113 is always in mesh with gear 106 on shaft 107. Fastened at each side of gear 113 are segment gears 151 and 152 which communicate rotation to gears 116 and 114, respectively, and segment 152 being in advance position and engaging gear 114 first to cause the downward feed of roll 47 through the intermediate gear 115 meshing with gear 117, and segment 151 following to next engage gear 116 to reverse the movement of the roll 47 and feed the paper upward.

Referring back to the adding wheels 77 and their operating wheel 80 it will be seen in Figs. 4 and 11 that at one side of the wheel 80 and pivoted on its hub is a stop supporting member 160 having a spring pressed stop 161 mounted thereon to engage with the adding wheel 77 in mesh with wheel 80 and this stop engagement is effected after the required rotation has been given through the line of mechanism leading back to each key lever 3 and is important in that it provides a positive stop for each adding wheel to prevent the same from being carried too far by momentum or otherwise and thus insures the correct carrying forward on the totalizing wheel of the item selected. This stop mechanism is governed by a depending arm 162 on each key lever engaging a separate sliding rod 163 for each key, the rods being mounted in a frame 164 and having their opposite ends bearing against a pivoted plate 165. The top or free end of this plate has a sliding engagement within the bifurcated arm of member 160, and whenever a key lever 3 is actuated this plate 165 and stop 161 is also thrown into action by its respective rod 163 but the levers arms 162 are set back slightly from the ends of rods 163 so that the stop action is not brought into play until the adding and totalizing wheels are first actuated, the second movement being timed for each of the keys and their corresponding adding and totalizing wheels.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed I declare that what I claim is:—

1. A typographical adding and recording machine in which there are employed both a series of adding wheels and a series of recording wheels connected therewith, and a series of key levers having different values expressed thereon and different lengths of operating arms rigid therewith, a single operating wheel for engagement with any one of the adding wheels, and a rocking member intermediate of said key lever arms and said operating wheel to give said operating wheel a variable rotation according to the value of the lever depressed, as herein described, with reference to the drawings.

2. In connection with the subject matter of Claim 1, the slidable and rotatable

initial operating wheel and the rocking arm for rotating said wheel, as herein described with reference to the drawings.

3. In connection with the subject matter of Claim 1, the single initial operating wheel and the series of adding wheels arranged side by side, a set of key levers and arms connected therewith of varying length according to the value of the lever, and all bearing on a rocking device which actuates the said initial operating wheel, and total recording wheels geared with the said adding wheels, as herein described, with reference to the drawings.

4. In connection with the subject matter of Claim 1, a series of adding wheels and a series of recording wheels geared together, and means for actuating said wheels consisting of a single slidable and rotatable operating wheel connected up with the key levers by mechanism adapted to impart varying rotations to said operating wheel according to the value of the number to be recorded, as herein described, with reference to the drawings.

5. In connection with the subject matter of Claim 1, the wheel 80 and the carriage and the arm to slide the wheel, and the rocking arm for rotating said wheel, as herein described, with reference to the drawings.

6. In connection with the subject matter of Claim 1, the lock for the adding wheels to prevent rotation beyond the point where the wheels should stop when a key lever is depressed, as herein described, with reference to the drawings.

7. In connection with the initial operating wheel and the carriage and its arm for sliding the said wheel, the series of adding wheels in a fixed frame, as herein described, with reference to the drawings.

8. In connection with the type-bar, the bolts and the key levers for operating them to limit the movements of said bar, as herein described, with reference to the drawings.

9. In connection with the totalizing hammer, the frame carrying said hammer and laterally movable to the width of the column to be added, as herein described, with reference to the drawings.

10. In connection with the subject matter of Claim 1, the type-bar provided with a series of characters corresponding to the key levers and adapted to be moved a distance with each depression of a key lever proportionate to the rotation of an adding wheel, so that the same sum is both added in and printed at the same time, as herein described, with reference to the drawings.

11. The recording wheel and the laterally slidable total recording hammer, and the devices to set the hammer to the width of the column added, consisting of a laterally slidable frame carrying said hammer and width determining mechanism engaging the last rotated recording wheel, as herein described, with reference to the drawings.

12. The recording and printing mechanism, the series of key levers connected therewith to print the items and total, and the paper feed rollers and means connected therewith to feed the paper in opposite directions successively before and after the total is printed, as herein described with reference to the drawings.

13. In connection with the adding and recording wheels and printing mechanism, the series of key levers operatively connected therewith to print the items, means to print the total and return the adding and printing wheels to starting position, and separate means to strike off the total and feed the paper without actuating said wheels to permit of further additions to the items already recorded, as herein described, with reference to the drawings.

14. The adding, recording and total printing mechanism and separate item printing mechanism, a series of key levers to actuate both said item and totalizing mechanism, a paper carrier and feed, and means to print the total, return the adding mechanism to starting position and feed the paper in a single operation, as herein described, with reference to the drawings.

15. In connection with the item printing hammer, a spring to throw the hammer into action, means to normally detain said spring from action, and the key levers and mechanism to liberate said spring and allow it to act on the

hammer and throw it forward, as herein described, with reference to the drawings.

16. In connection with the slidably mounted initial operating wheel, the carriage and the ribbon for moving the carriage, and an arm on said ribbon engaging said wheel, levers on the front of the carriage to fix the starting position of the carriage and a series of adding wheels corresponding to said levers and arranged to be separately engaged by the initial operating wheel, as herein described, with reference to the drawings.

Dated this 4th day of September 1900.

ALLISON BROS.,
Agents for the Applicant.

Redhill: Printed for Her Majesty's Stationery Office, by Malcomson & Co., Ltd.—1900.

A.D. 1900. Sep. 4. N° 15,709.

DENNIS' Complete Specification.

SHEET 1

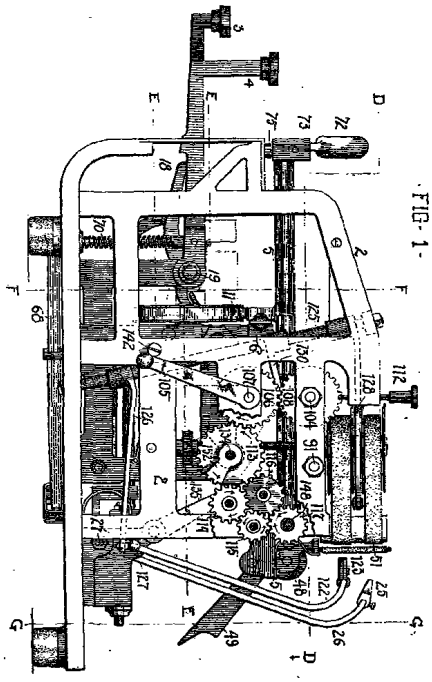

FIG. 1.

(10 SHEETS)

SHEET 2

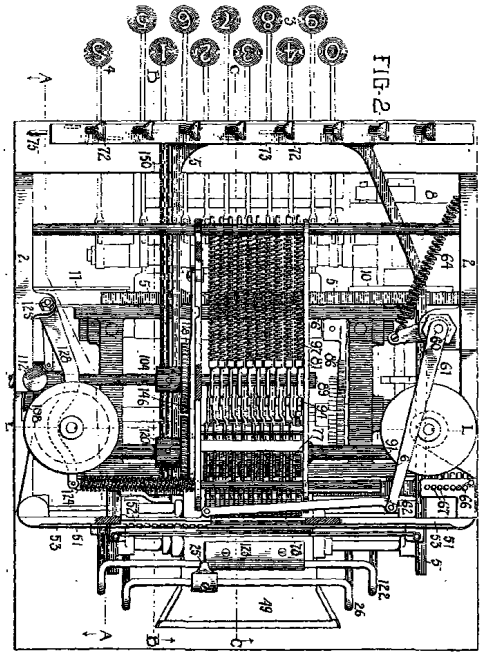

FIG. 2.

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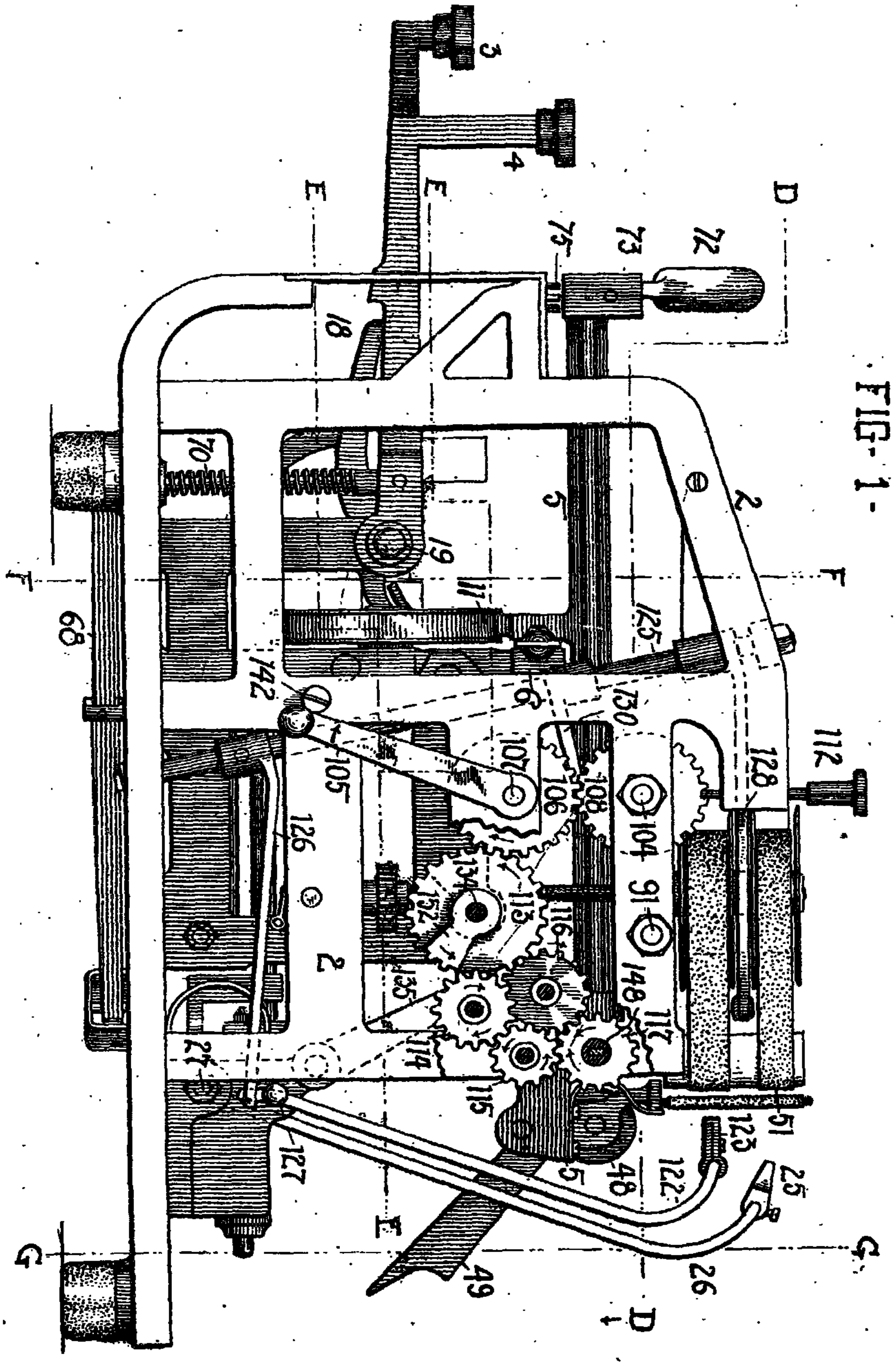
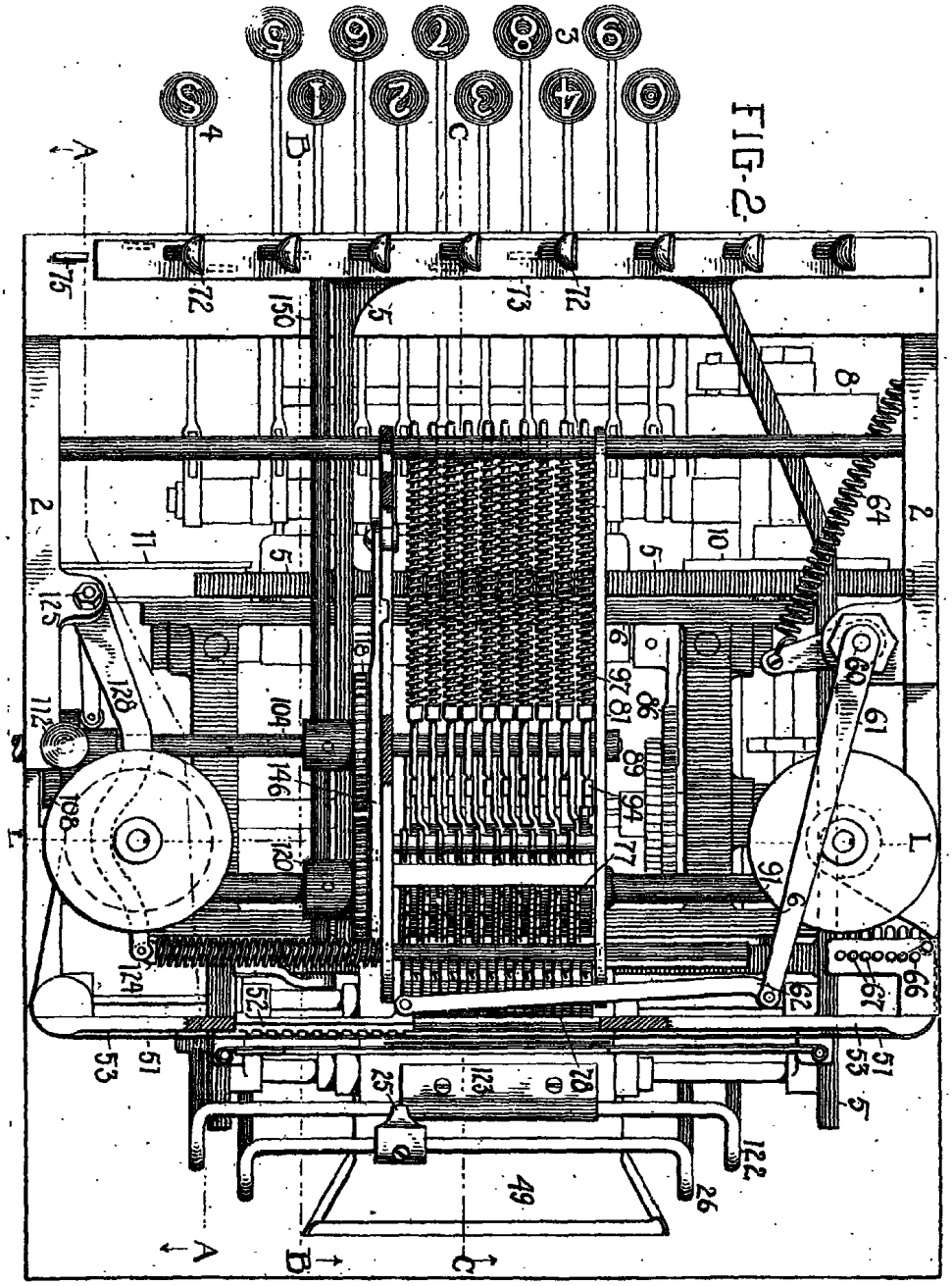


FIG-1-

FIG-2.



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DENNIS' Complete Specification.

SHEET 3

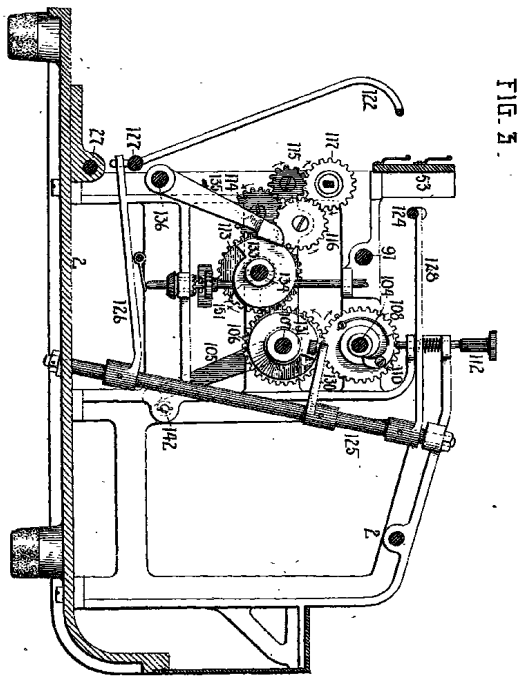

FIG. 3.

30 SHEETS

SHEET 4.

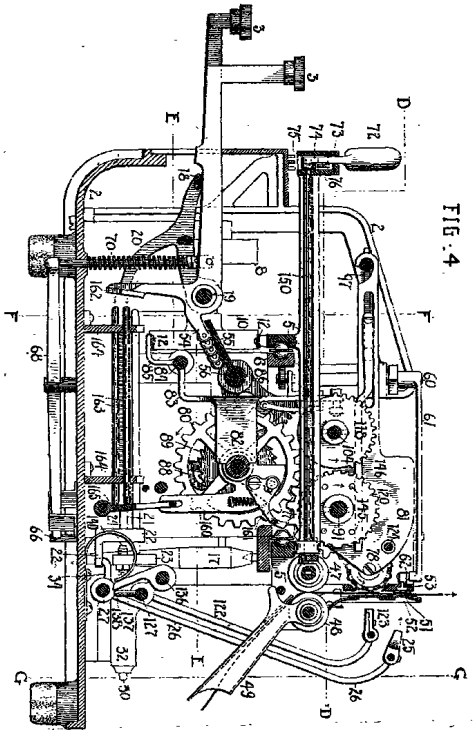

FIG. 4.

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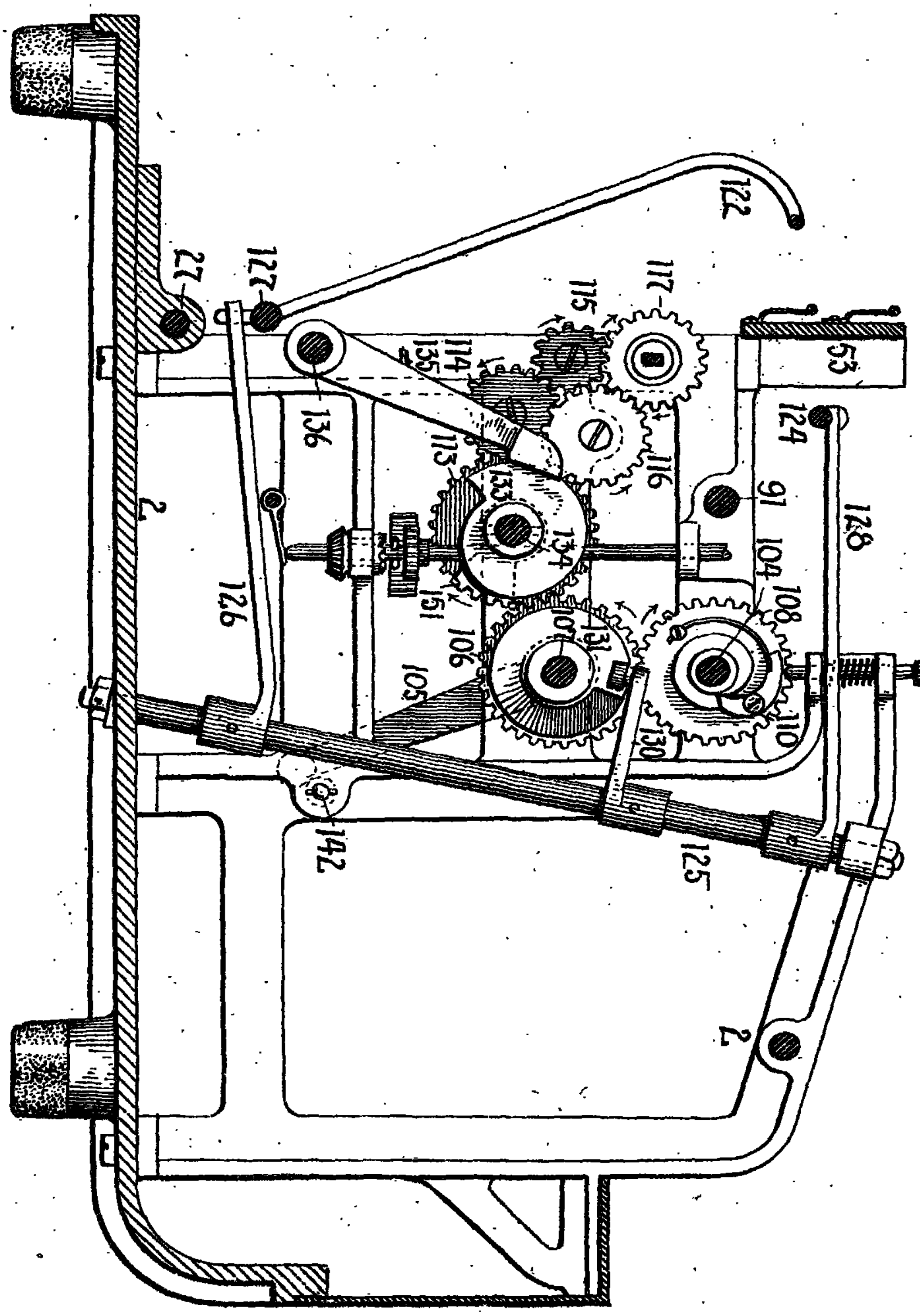
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FIG. 3.

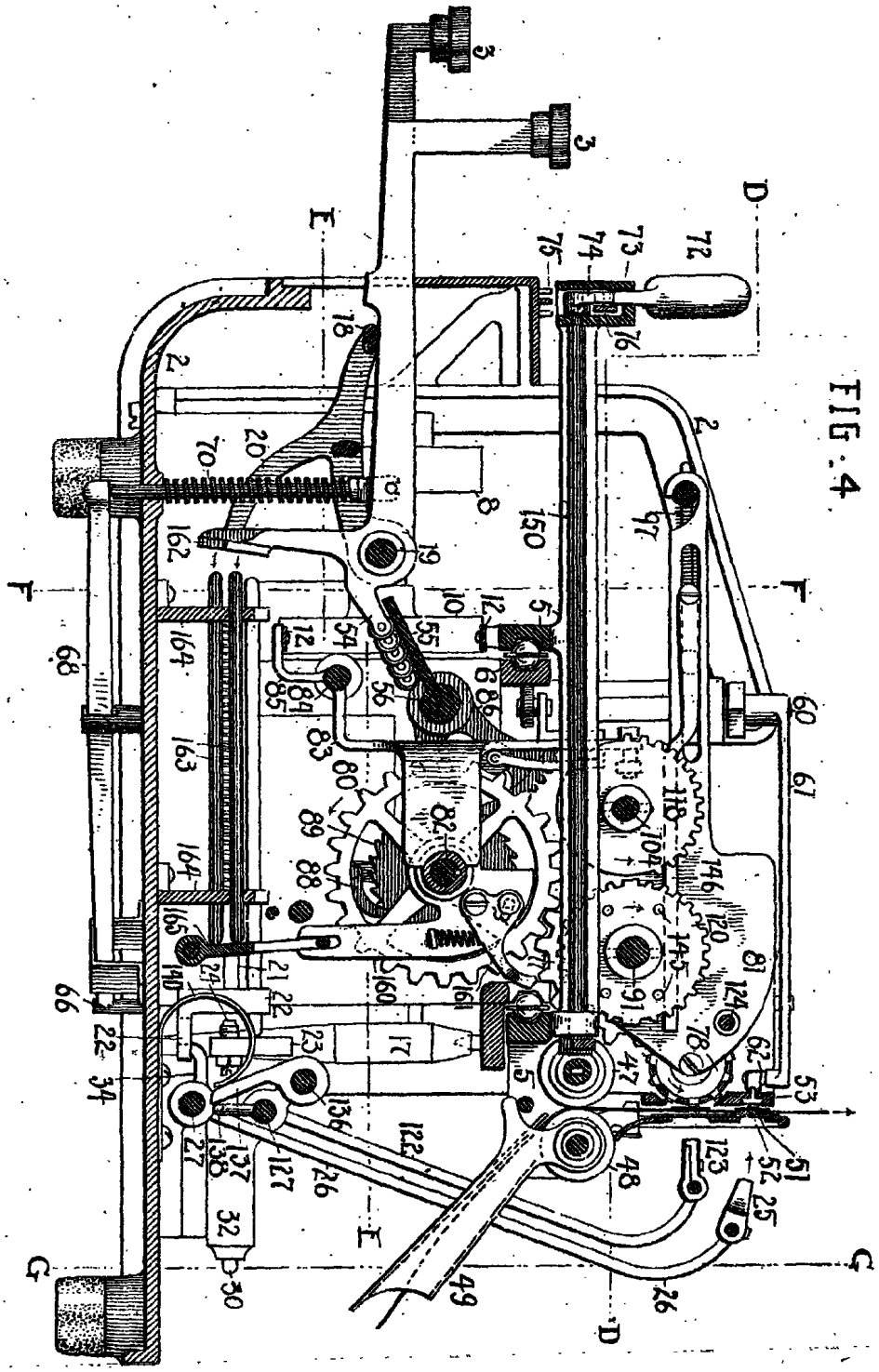

FIG. 4.

Malby & Sons' Photo-Litho.

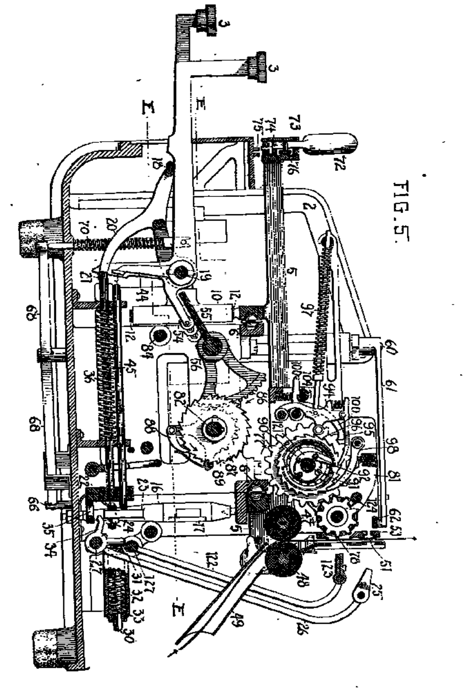

FIG. 5.

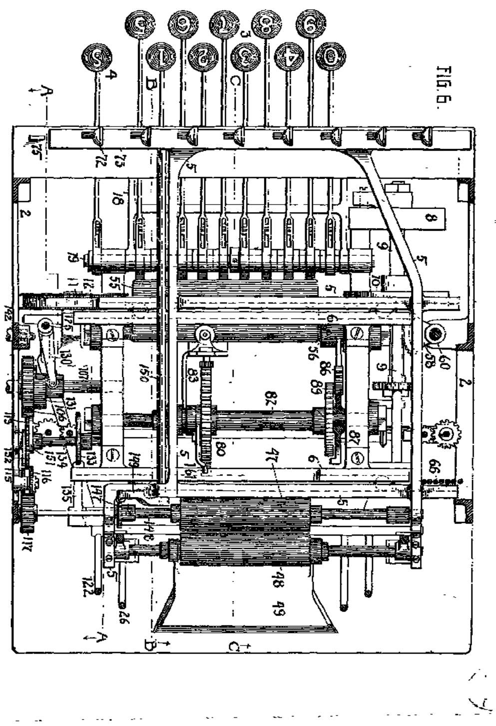

FIG. 6.

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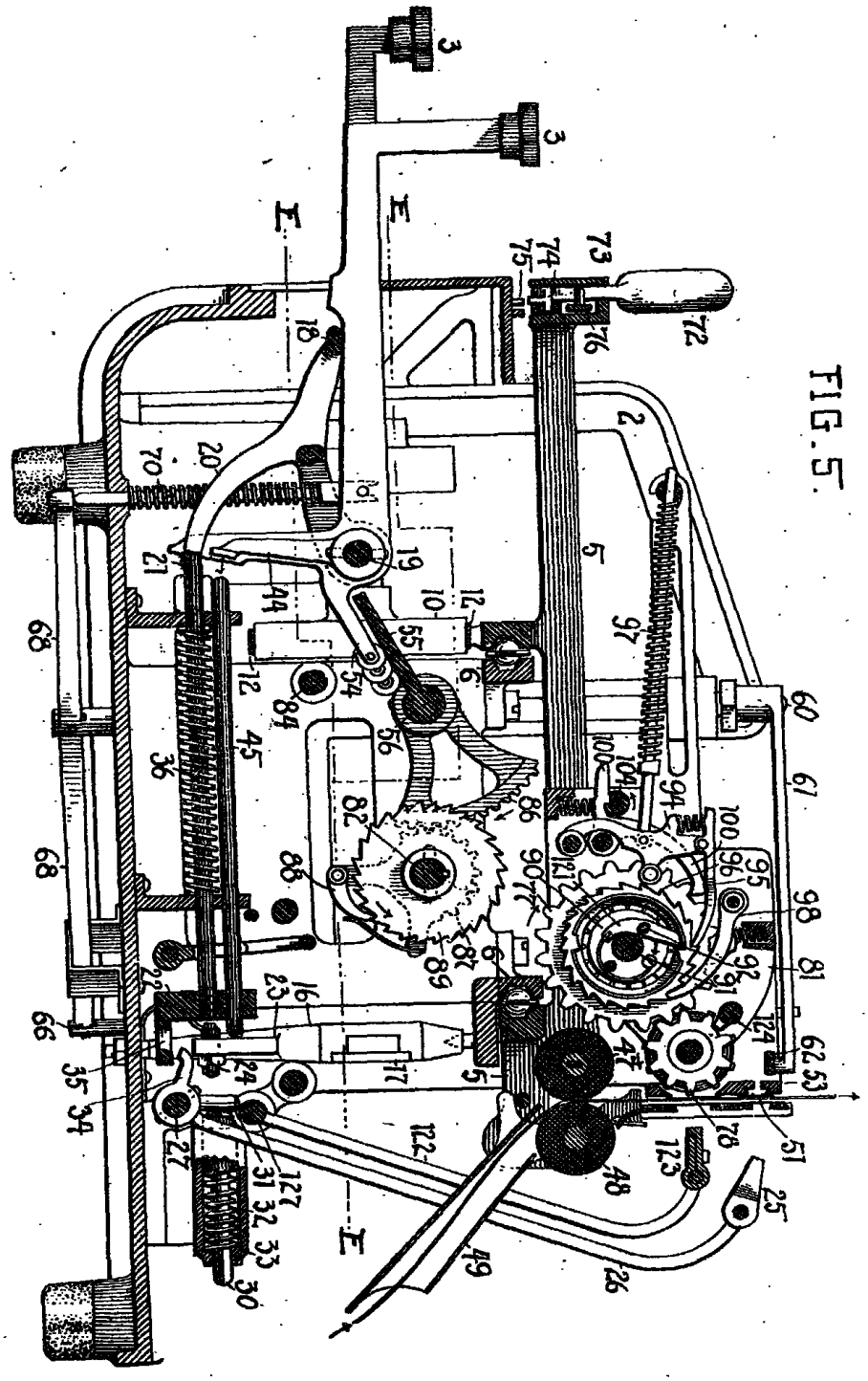
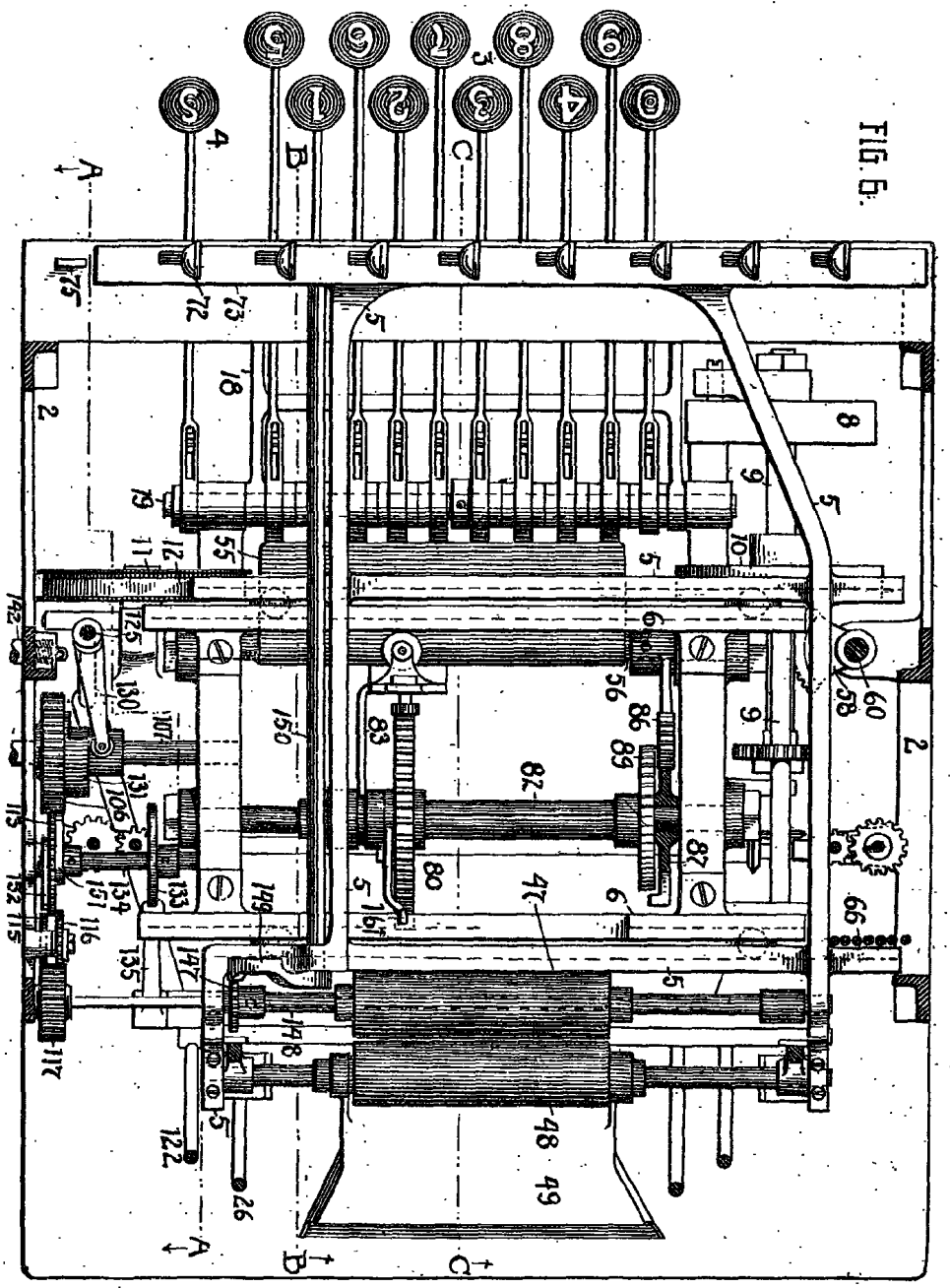


FIG. 5.



[This Drawing is a reproduction of the Original on a reduced scale]

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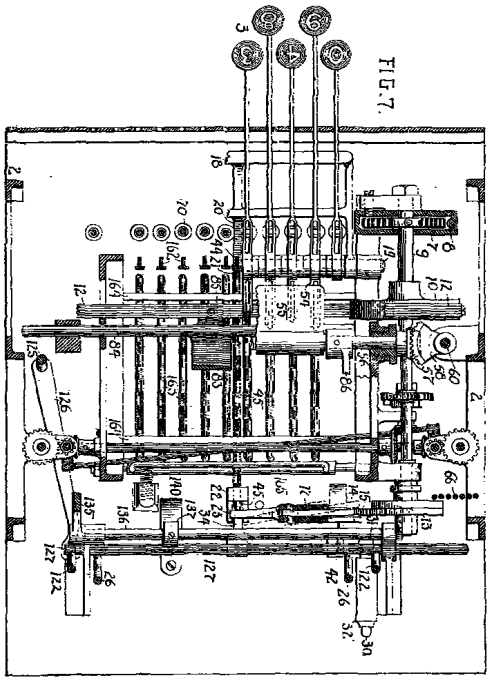
(10 SHEETS)

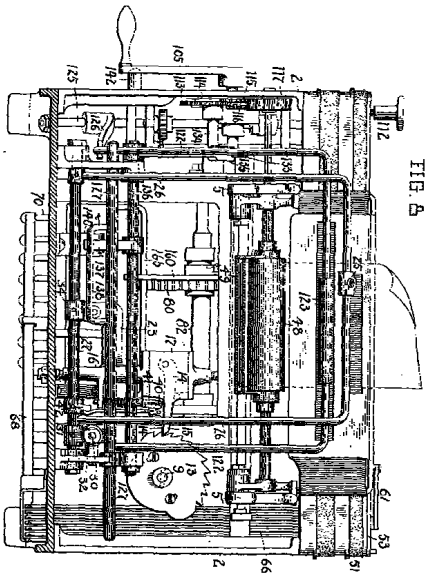
SHEET 7

FIG. 7.



SHEET 8

FIG. 8.



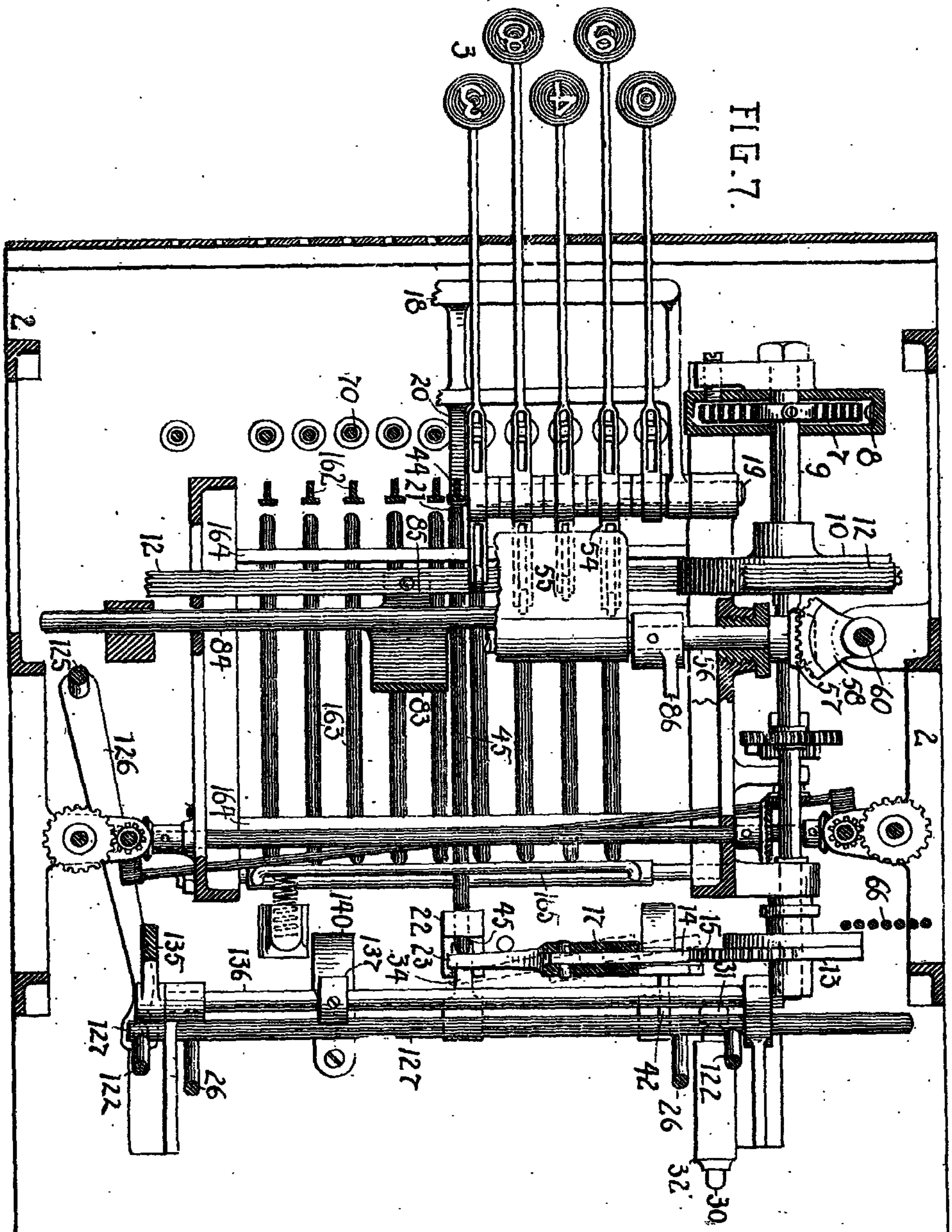


FIG. 7.

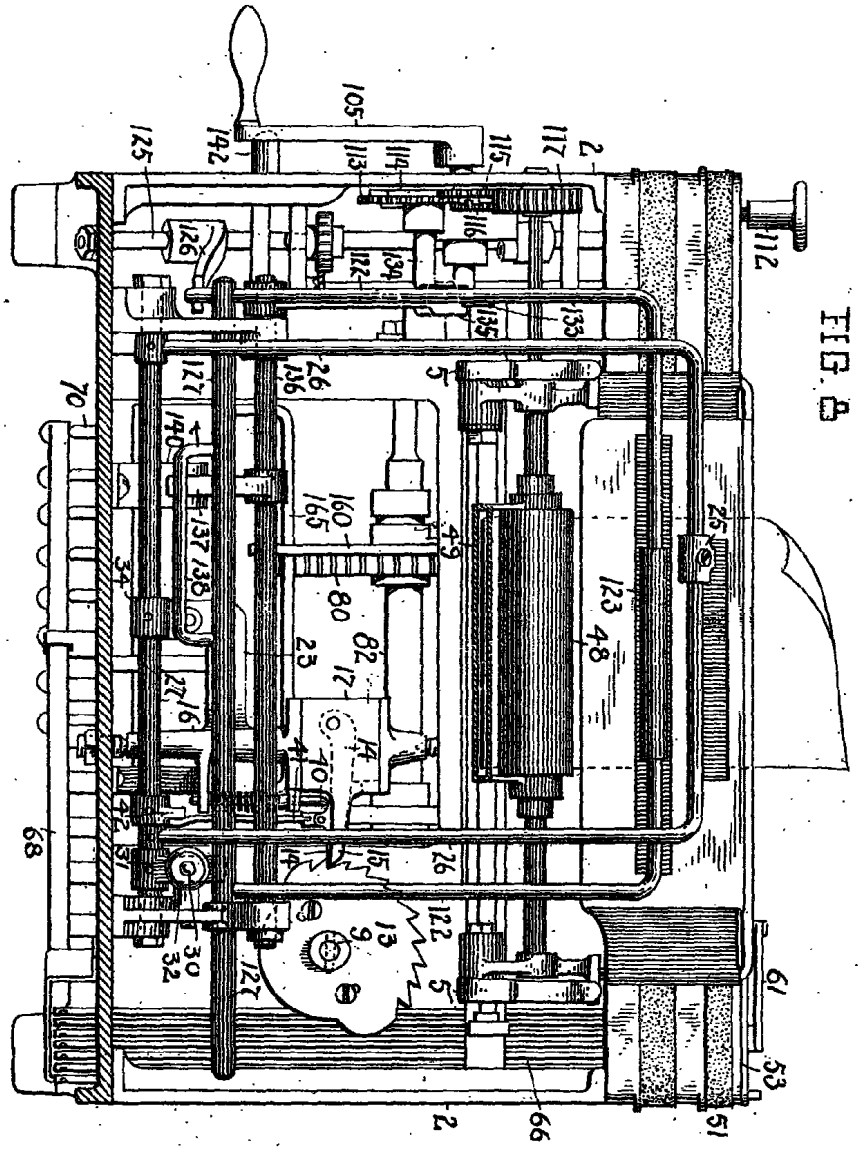


FIG 8

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SHEET 9.

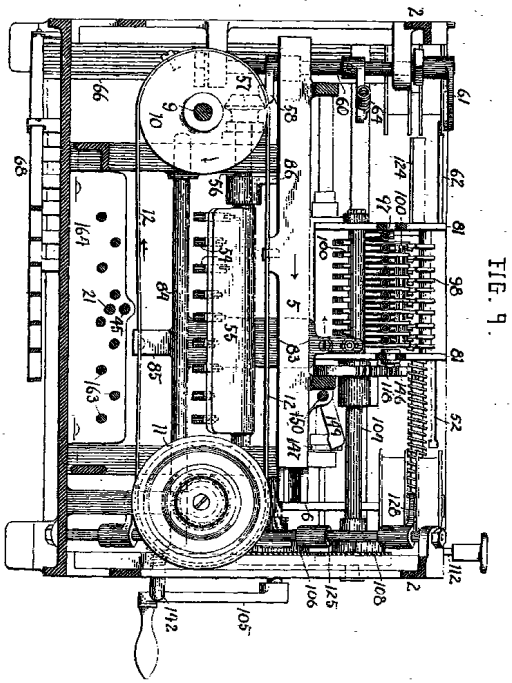

FIG. 9.

(10 Sheets.)
SHEET 10.

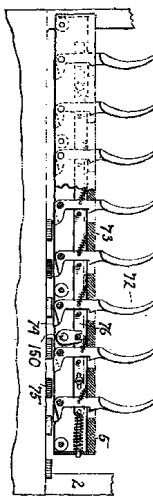

FIG. 10.

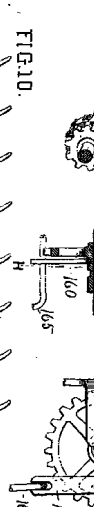

FIG. 14.

FIG. 12.

FIG. 11.

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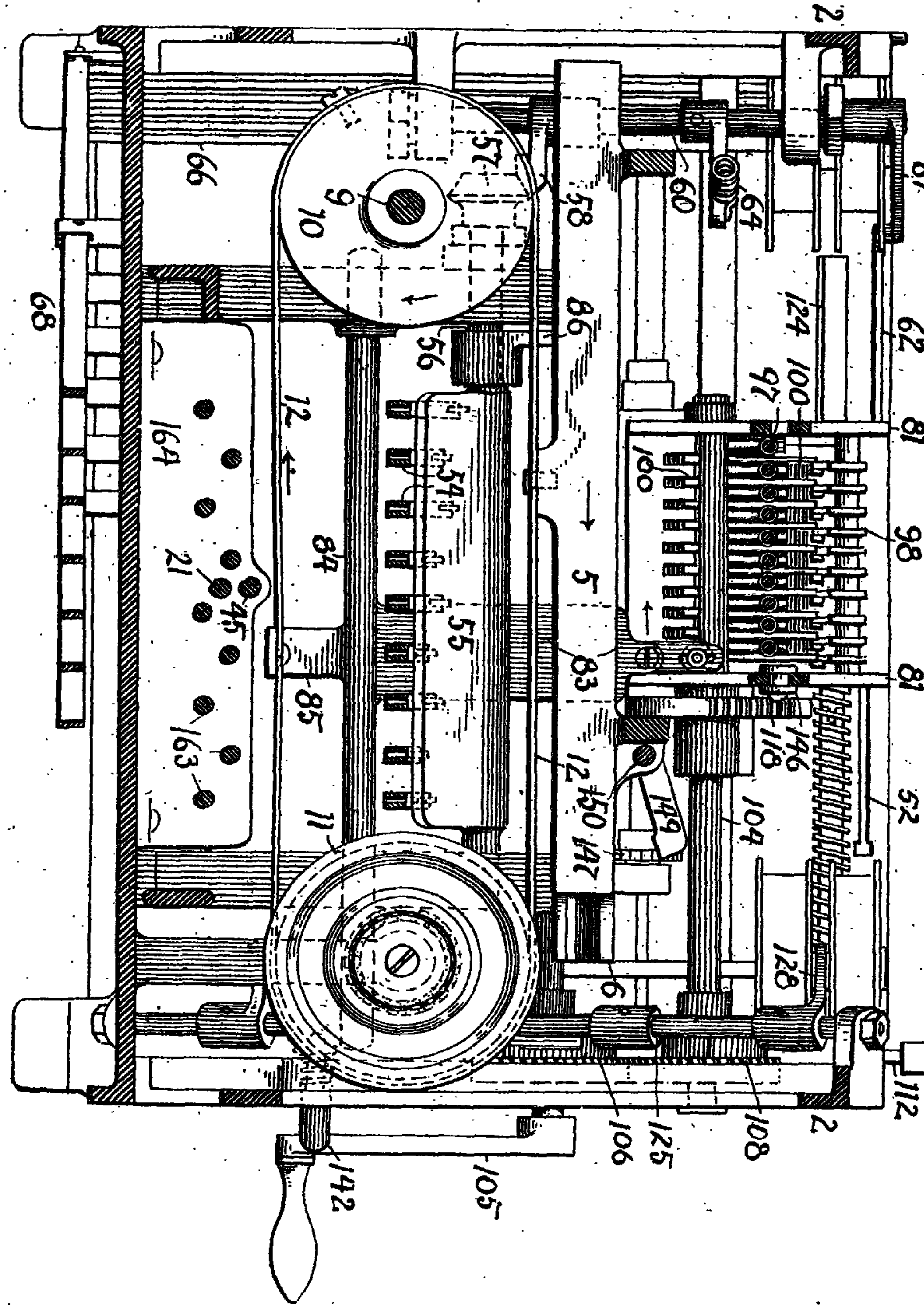
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FIG. 9.

FIG. 13.

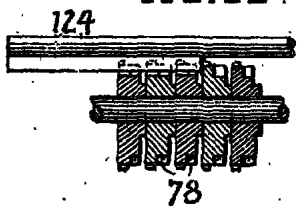


FIG. 12.

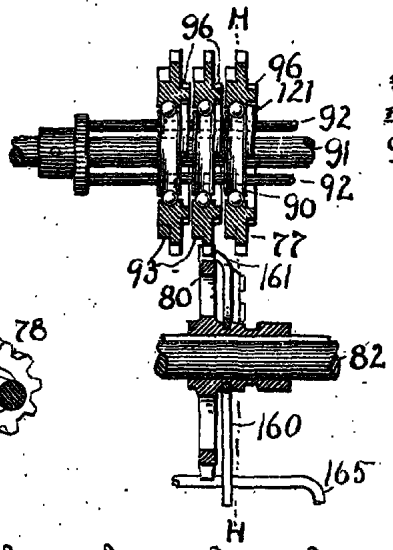


FIG. 11.

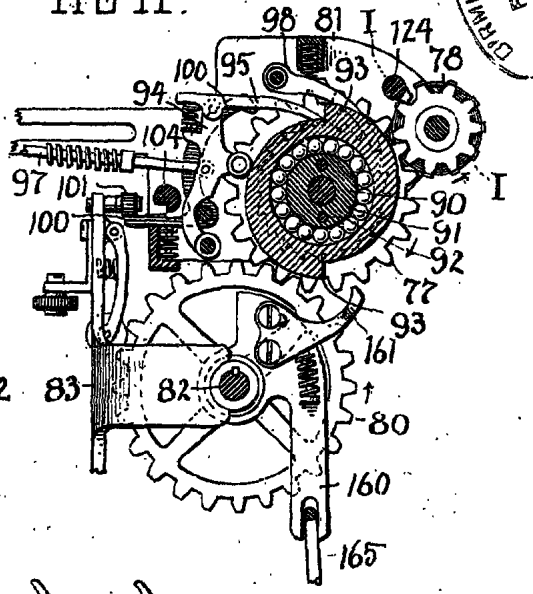


FIG. 14.

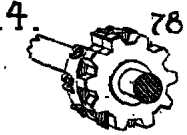
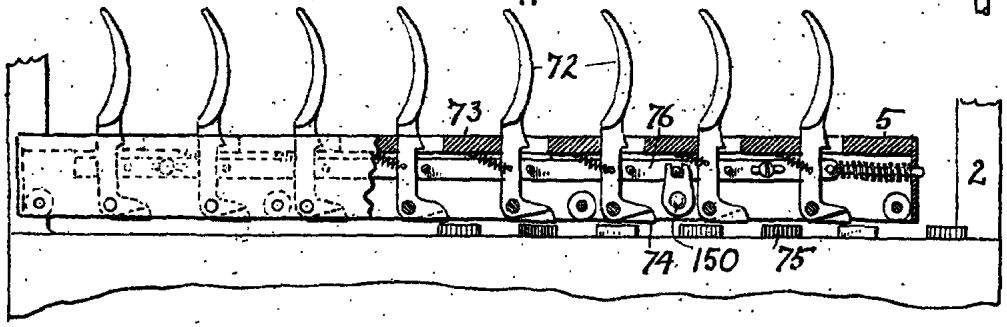


FIG. 10.



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