(No Model.) 7 Sheets—Sheet 1.

A. BRADLEY.

PAPER FOLDING MACHINE.

No. 521,083. Patented June 5, 1894.

FIG. 1.

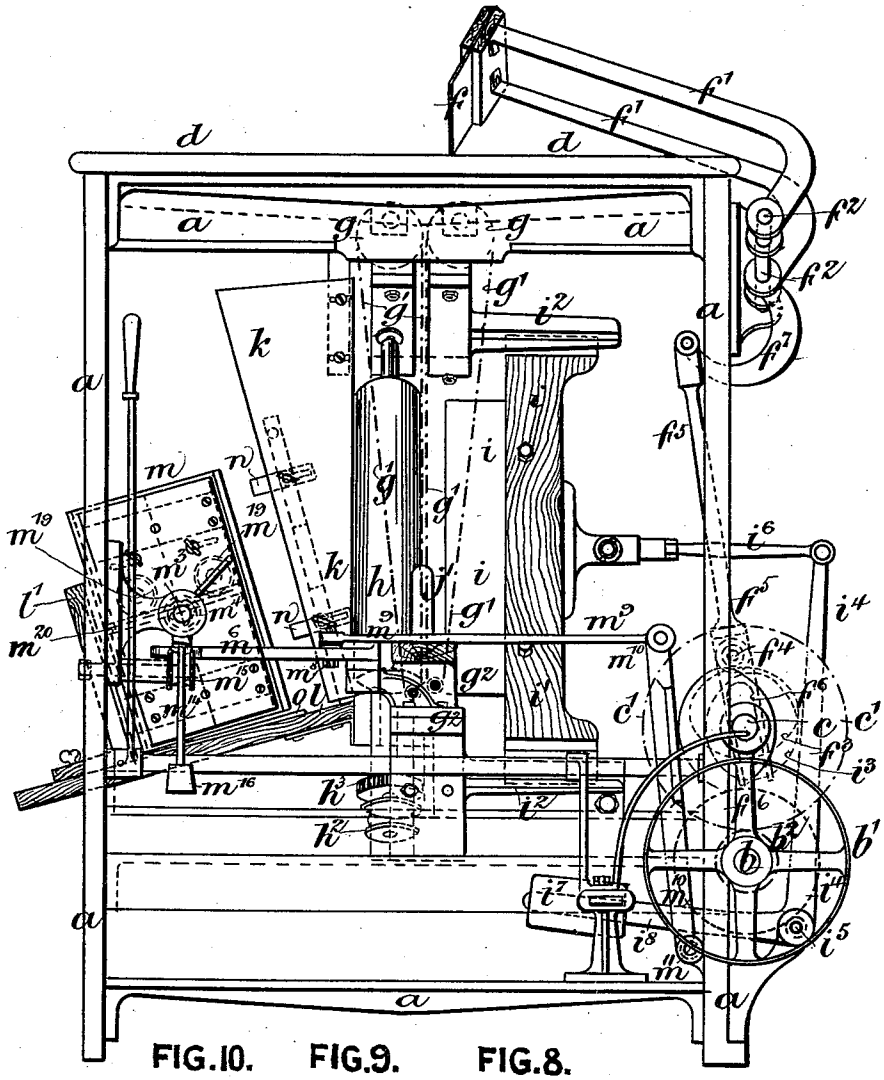


FIG. 10.

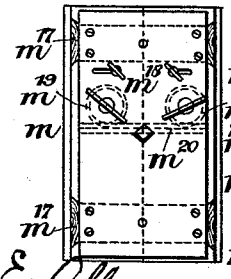


FIG. 9.

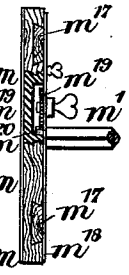


FIG. 8.

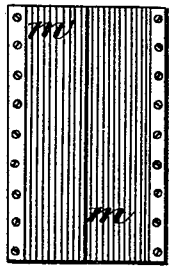
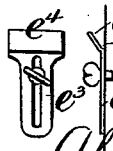


FIG. 6. FIG. 7.



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(No Model.) 7 Sheets—Sheet 2.

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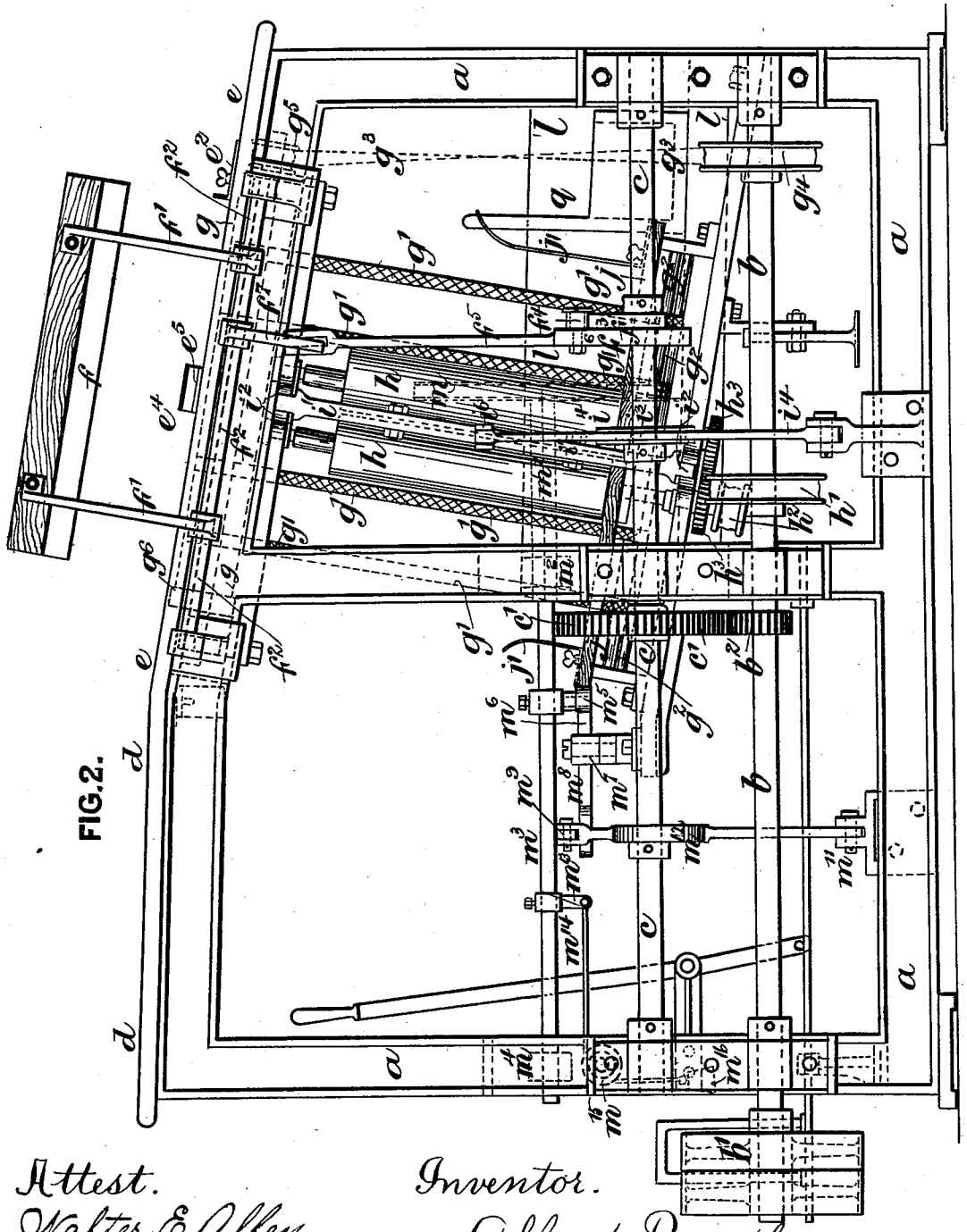

FIG. 2.

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FIG. 3.

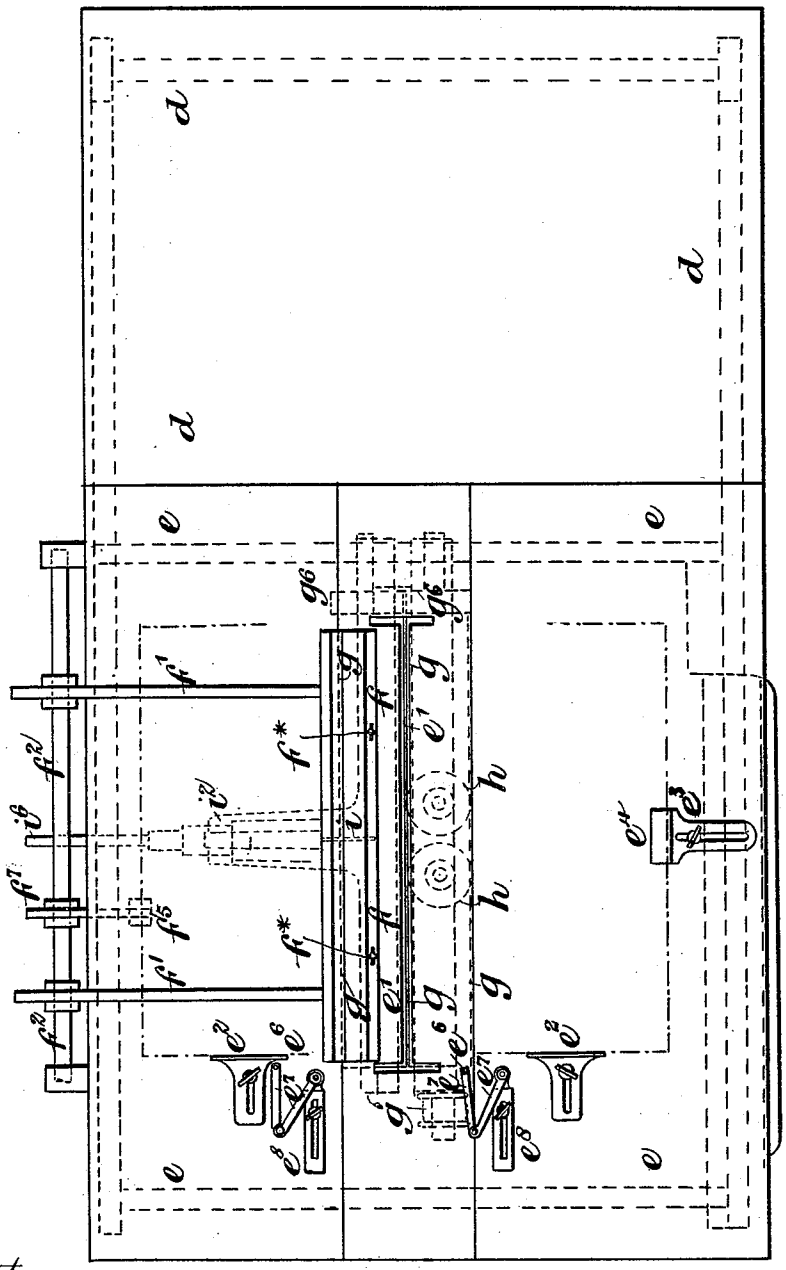

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FIG. 4.

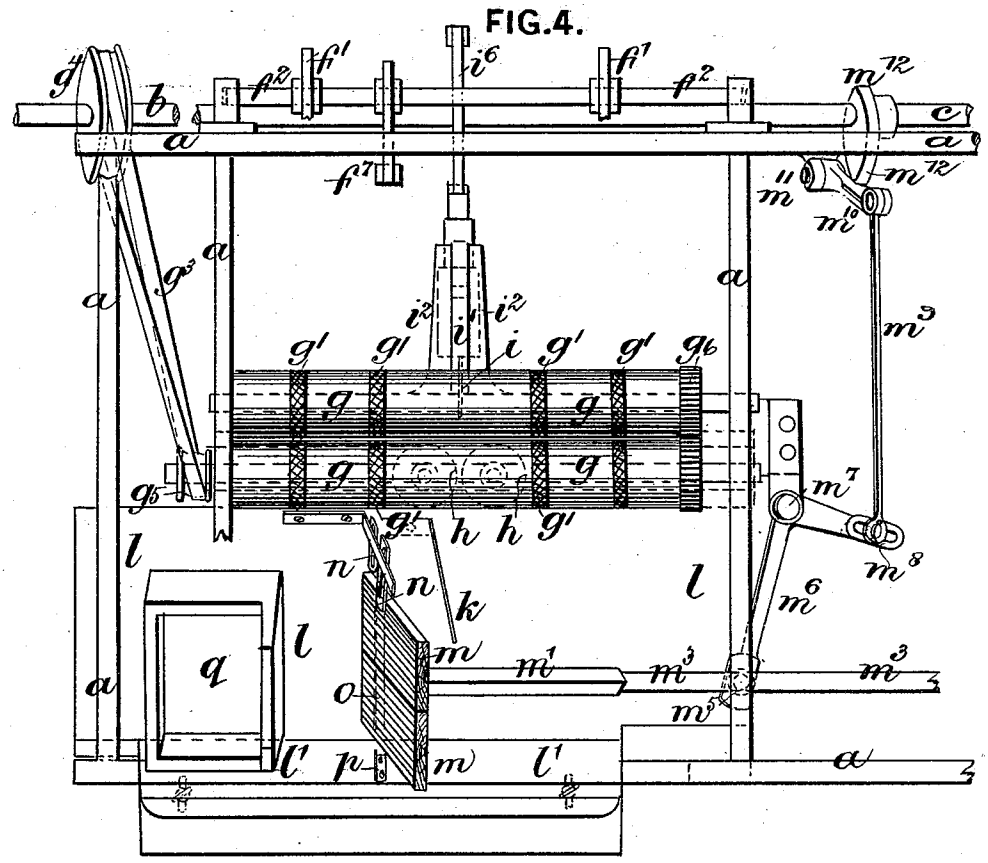

FIG. 5.

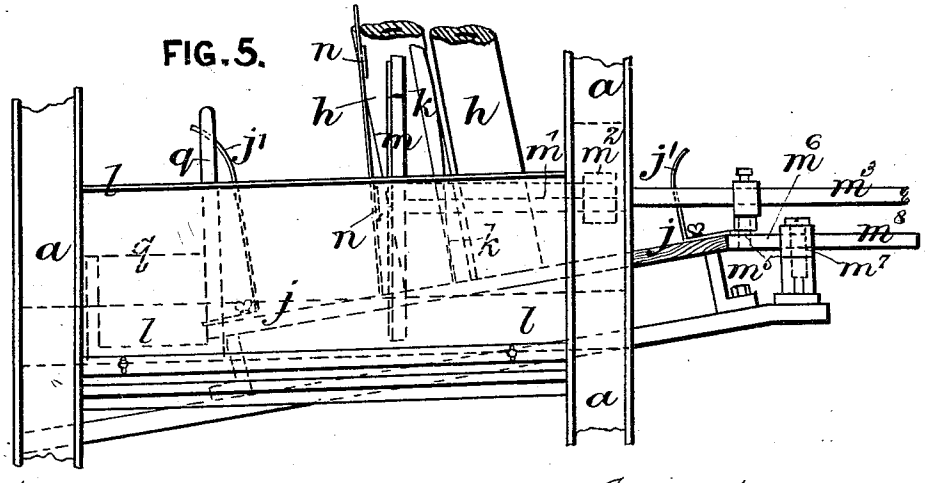

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FIG. II.

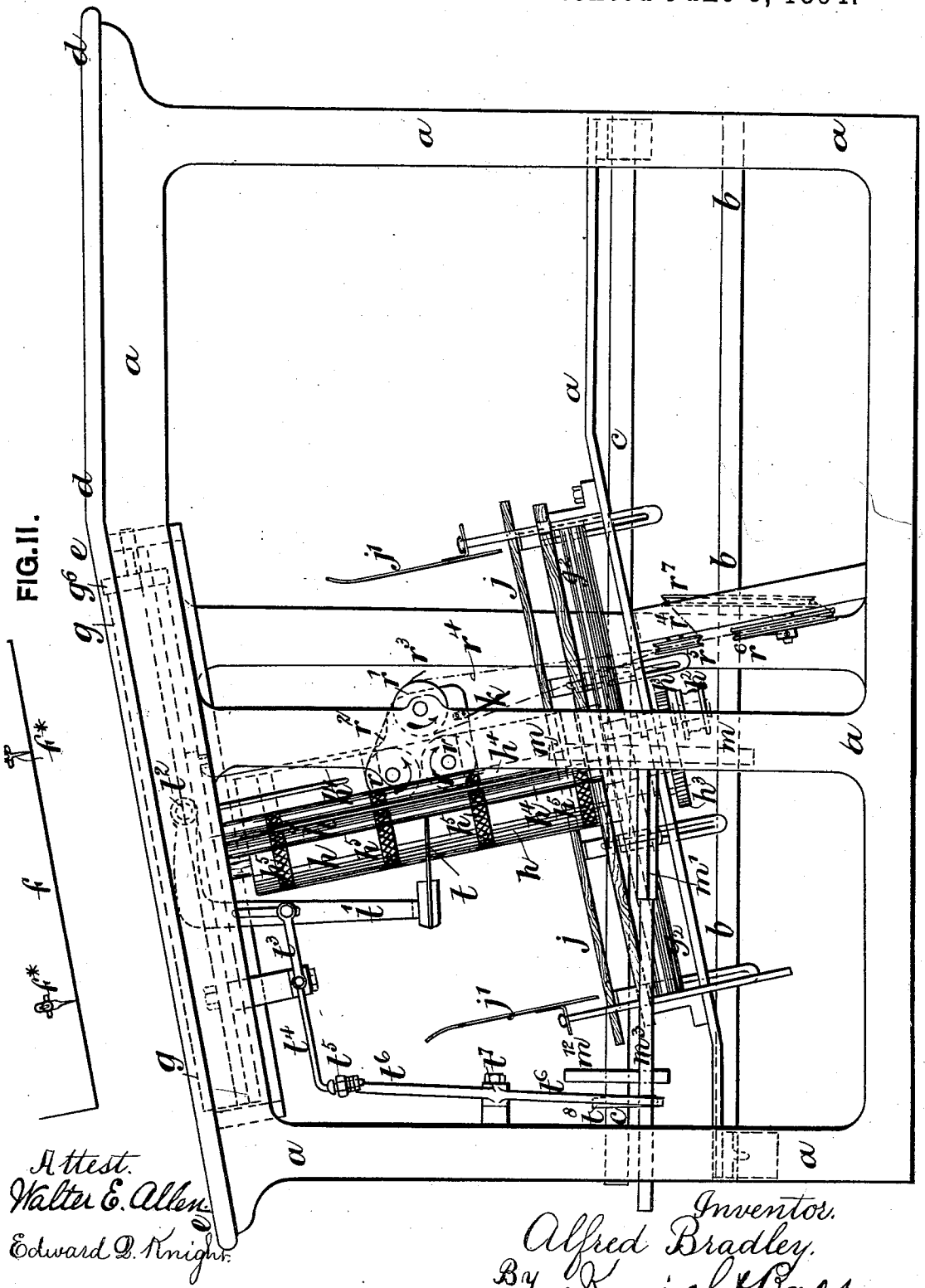

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FIG. 12.

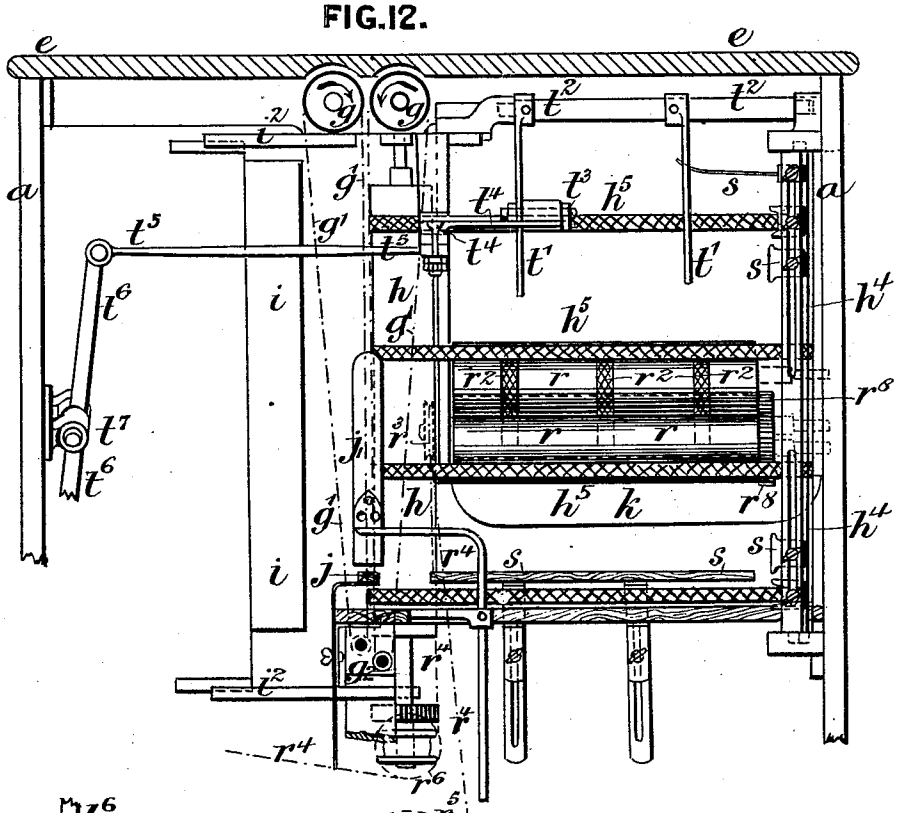

FIG. 13.

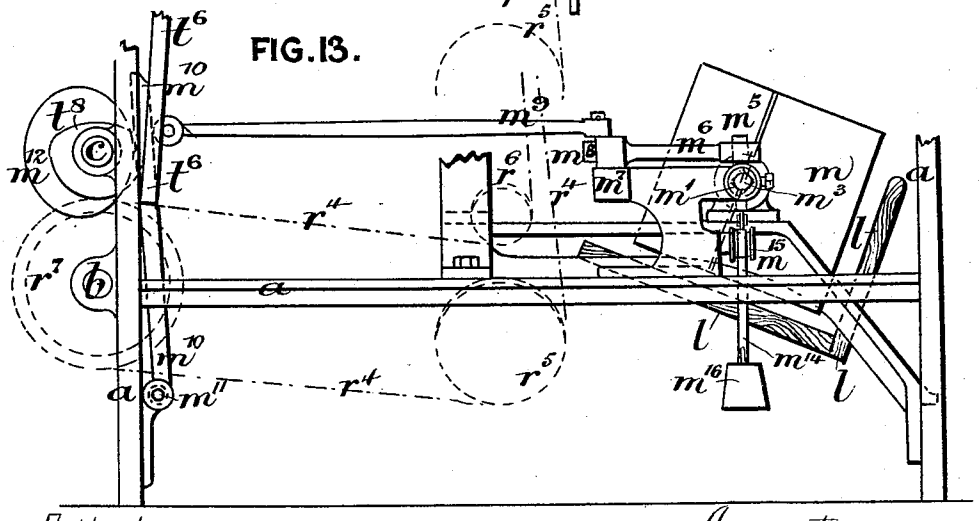

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FIG. 15.

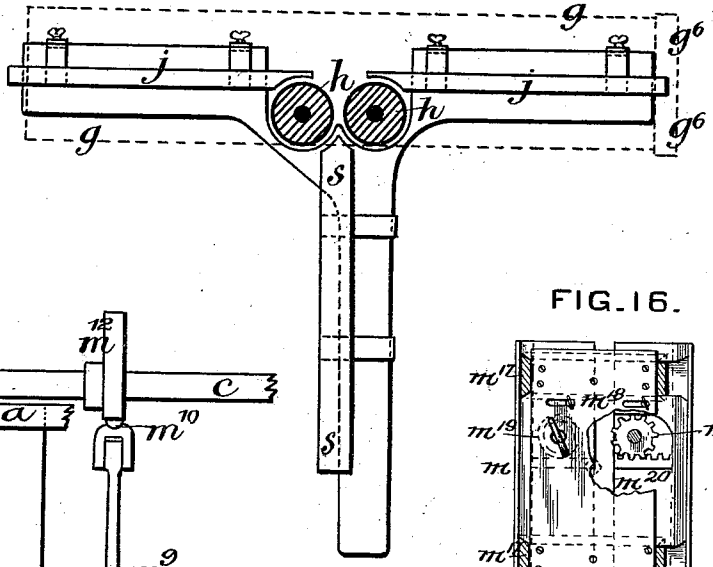

FIG. 16.

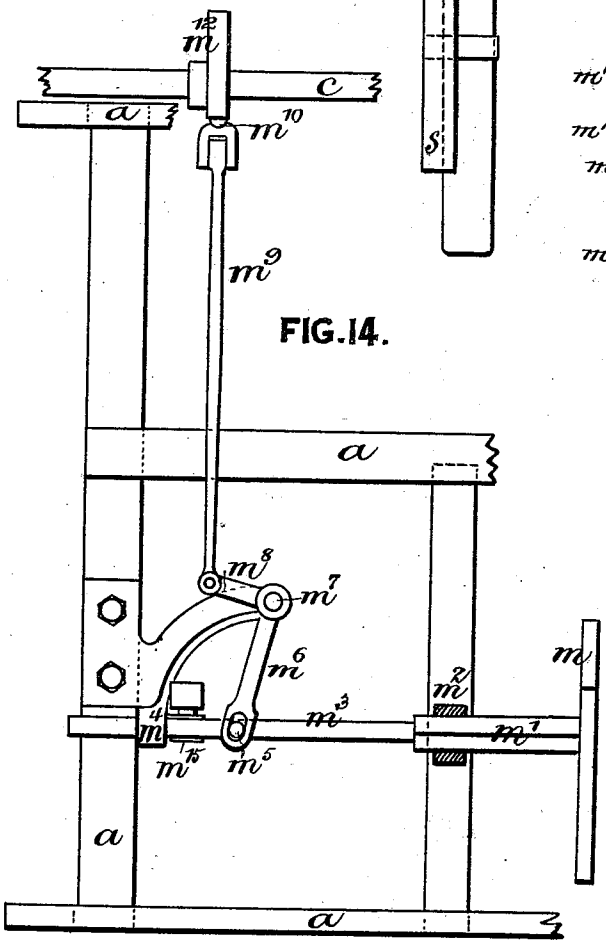

FIG. 14.

FIG. 17.

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UNITED STATES PATENT OFFICE.

ALFRED BRADLEY, OF LONDON, ENGLAND, ASSIGNOR TO LEONARD UPCOTT GILL, OF SAME PLACE.

PAPER-FOLDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 521,083, dated June 5, 1894.

Application filed May 23, 1893. Serial No. 475,257. (No model.) Patented in England July 25, 1892, No. 13,521.

To all whom it may concern:

Be it known that I, ALFRED BRADLEY, a subject of the Queen of Great Britain, residing at 172 Elms Road, London, S. W., England, have invented certain new and useful Improvements in Folding-Machines, of which the following is a specification.

British Patent No. 13,521, dated July 25, 1892, was granted for this invention.

The invention has reference to folding machines such as are used for folding newspapers, pamphlets or other sheets of papers of eight or sixteen pages and where the sheets are fed to adjustable stops or gages or for over or under pointing.

The chief object of this invention is to avoid curling the edges of the sheet while being fed (thereby obtaining accelerated speed) and also to obtain the sheets evenly piled or knocked-up delivered direct from the folding rollers without the use of carrying tapes or the necessity of twisting or turning the sheets.

In machines where the pile of paper to be folded is placed on a horizontal table or bank and is thence lifted or drawn sheet by sheet on to a horizontal folding board, as is commonly in use, the act of drawing the sheet through the air and along the horizontal surface of the folding board, causes the front and forward edges of the sheet to curl upward and to accumulate air between the under surface of the sheet and the folding board, thus bringing the sheet to a rest unsteadily and causing many sheets to miss being folded at the proper time or to be folded untruly and with uneven edges. For the purpose of avoiding this loss of speed and accuracy I provide a sloping table or bank for holding the pile of paper to be folded. From this table or bank the sheets are drawn on to the folding board, which has a further declination. The front edge of the sheet, being thus at a continuously declining angle to the resistance when being drawn through the air, is kept down in transit, cuts the air from between its under surface and the surface of the folding board and rests firmly before an inclined folding knife descends.

For the purpose of folding sheets of eight pages requiring two folds, I place an inclined folding knife and rollers, which form and direct the first fold, with their length at the same angle or declination as and parallel with the front edge of the folding board, whereby the operator in drawing the sheet to the gages does not pass either hand beneath the inclined folding knife edge, and the inclined folding knife and rollers which form and direct the second fold are placed at right angles to the inclined folding knife and rollers which form the first fold. When the folded sheet passes through the second fold rollers of a machine for folding eight pages, it is in the desired position for delivery, *i. e.*, nearly upright with its back folded edge forward. To secure direct delivery without carrying, twisting or turning the sheet, I provide an inclined adjustable facing bar or guide at the point of delivery from the rollers in order to steady the sheet until it reaches by its own momemtum the opposite face of a right angled sloping gathering trough placed at right angles to the delivery rollers for receiving the folded sheets. The slope of this trough falling away from the rollers prevents the sheet from rebounding. At the moment the folded edge of the sheet reaches the face of the gathering trough, an adjustable pusher forces the sheet past shallow stops, which prevent the sheet returning in the way of the delivery of the next sheet, and is so added to the pile of work in the gathering trough.

For the purpose of folding sheets of sixteen pages requiring three folds, I follow the foregoing plan to the end of the second fold, where I place the inclined folding knife and rollers which form and direct the third or last fold at right angles to the second and place the gathering or knocking-up trough in suitable position to receive the sheets.

The inclined folding knives, rollers and pusher are actuated by rods and cams connected with a driving bar moved by any ordinary power.

My invention consists in features of novel construction hereinafter described and claimed. And in order that my said invention may be more clearly understood and readily carried into effect, I will proceed, aided by the accompanying drawings, more fully to describe the same.

In the drawings, Figure 1 is an end view, Fig. 2 is a back view and Fig. 3 is a plan or top view of a two-fold folding machine constructed according to my invention. Fig. 4 is a plan of parts drawn in a plane parallel with that of the folding table, but with the sheet carrying table and folding table removed. Fig. 5 is a front view of parts. Fig. 6 is a plan and Fig. 7 is an edge view separately of a guide stop or gage adjustably fixed on the folding table. Fig. 8 is a front view, Fig. 9 is a sectional edge view and Fig. 10 is a back view of the packer presser separately. Fig. 11 is a front view of parts of a three fold folding machine. Fig. 12 is an end view of parts drawn in a plane parallel to that passing through the rollers *h h*. Fig. 13 is an elevation of some of the lower parts at the left end of the machine drawn in a vertical plane. Fig. 14 is a plan of parts giving motion to the packing presser, and Fig. 15 is a sectional plan showing the rollers *h h*, support *j* and lower support *s*. Fig. 16 is a back view and Fig. 17 is a transverse section of the packer presser in its expanded position.

In all the figures like parts are indicated by similar letters of reference.

I will first describe the two-fold folding machine, which is represented at Figs. 1 to 10.

a is the framing, *b* the driving shaft, and *c* the cam shaft. The driving shaft *b* receives motion from a strap or band not shown passing around the pulley or driver *b'* and communicates motion to the cam shaft *c* by pinion b^2 taking into a toothed wheel *c'* on the cam shaft *c*.

d is the table or bank for holding the pile of paper to be folded and *e* is the folding board.

According to my invention I fix the table *d* at a gentle or slight incline and the folding board *e* at a greater incline. By these means the front edge of the sheet, being supported in the pile at a declining angle, and when being drawn through the air on to the folding board, being at a further declining angle to the resistance of the air, is kept down in transit, cuts the air from between its under surface and the surface of the folding board *e* and comes to rest firmly before the inclined folding knife *f* descends.

The inclined folding knife *f* is carried by arms *f'* mounted on an axis f^2 and it is operated by means of a cam f^3 acting upon a truck f^4 carried by a link f^5 connected to a curved lever f^7 fixed to the axis f^2. The lower part f^6 of the link f^5 is forked and fits or straddles the cam shaft *c* by which it is guided, the weight of the inclined folding knife *f* and parts connected therewith acting to keep the truck f^4 against its cam f^3. The inclined folding knife *f* presses the center of the sheet to be folded down through an opening *e'* in the folding table and into the grip of a pair of inclined rollers *g g*, which, by the aid of tapes *g' g'* passing partly around them and partly around smaller inclined rollers g^2 g^2, guide the singly folded sheet down into position between the inclined rollers *h h* and the second inclined folding knife *i* and on to an inclined support *j* between adjustable regulating guides *j' j'*, when the inclined folding knife *i* is caused to move forward and press the singly folded sheet into the grip of the rollers *h h*, at the same time releasing it from the grip of the tapes *g' g'*. The rollers *g g* receive rotary motion by means of a belt g^3 passing partly around a pulley g^4 on the driving shaft *b* and partly around a pulley g^5 on one of the rollers *g g*, and motion is communicated from the one roller *g* to the other by means of toothed gearing g^6 g^6. The rollers *h h* receive rotary motion by means of a belt not shown passing partly around the pulley *h'* on the driving shaft *b* and partly around a pulley h^3 on the end of one of the rollers *h*, motion being transmitted from one roller *h* to the other by toothed gearing h^3.

The second inclined folding knife *i* is carried by a frame *i'* mounted in guides i^2 i^2, and it receives to and fro motion by means of a cam i^3 on the cam shaft *c* acting against the edge of a lever i^4 mounted at its lower end on an axis i^5 and connected at its upper end by link i^6 with the inclined folding knife *i;* a weight i^7 on a crank arm i^8 of the lever i^4 acts to keep such lever up to its cam.

When the sheet of paper has been pressed by the inclined folding knife *i* into the grip of the rollers *h h*, the latter in their rotation carry the doubly folded sheet past an inclined adjustable facing bar or guide *k* situated at the point of delivery from the rollers *h h*, which guide steadies the sheet until it reaches by its own momentum the opposite face of a right angled sloping gathering trough *l* placed at right angles to the delivery rollers *h* for receiving the folded sheets. The slope of this trough *l*, by falling away from the rollers *h*, prevents the folded sheet from rebounding. At the moment the folded edge of the sheet reaches the face *l'* of the gathering trough, an adjustable pusher *m* forces the sheet past shallow stops *n*, *n*, *o* and *p*, which prevent the sheet from returning in the way of the delivery of the next sheet, and so adds it to the pile of work in the gathering trough. The stops *n n* are provided with means for vertical, lateral and radial adjustment independently of each other to suit the inclination of the folded sheet.

The pusher *m* is attached to the end of a rod, one part *m'* of which is formed of square section and is guided in a correspondingly shaped bearing m^2, while the other part m^3 is of circular section and is guided in a bearing m^4. This pusher *m* receives to and fro motion in the following manner. On the part m^3 of its rod is fixed a collar carrying a pin m^5 which passes through the slotted end of the arm m^6 of a crank lever mounted on an axis m^7 and whose other arm m^8 is connected by link m^9 with the upper end of a lever m^{10} whose lower end is mounted on an axis m^{11}

and whose edge is acted upon by a cam m^{12}. The part m^3 of the pusher rod has also attached thereto an arm m^{13} to which one end of a cord m^{14} is fixed, which cord, after passing over a guide pulley m^{15}, has attached to its other end a weight m^{16} which acts to give motion to the pusher in the contrary direction to that given by the cam m^{12}.

q is a weighted movable stop placed in the sloping trough l which serves as the end of the trough, against which the folded sheets are packed but which will give way and travel along the trough as the stock of folded sheets accumulates.

e^2 e^2 are adjustable stops or gages near the lower edge of the folding table e and e^3 is another adjustable stop or gage near the front edge of the said table, against which each sheet is brought so as to secure the correct inclined folding thereof by the folding knife f. The stop or gage e^3, shown separately at Figs. 6 and 7, is made with an inclined overhanging front edge e^4, underneath which the edge of the sheet to be folded is placed, and such part e^4 terminates at its connection with the body of said gage with a vertical face e^5, against which the sheet is brought, and such face e^5, in addition to acting as a gage, prevents the sheet from being jammed in the wedge formed space between the part e^3 and the folding table e.

e^6 e^6 are adjustable points carried by jointed arms e^7 e^7 pinjointed to carriers e^8 e^8 adjustably fixed to the folding table e. These points may be set to any printed mark, rule or other printed part of the sheet within the radius of said arms so as to secure the correct folding of the sheet to register (*i. e.* the printed matter) and they are specially suited for binders' use. These points are what are known as "overpoints," and are commonly used as the gage by which the best class of book work is folded, as by their means a sheet can be folded true as regards the printed matter upon it, whereas, the side and bottom gages, that is the "stop" gages, only serve to fold a paper truly as regards itself, that is to say, supposing the printing upon a sheet was not square with the sheet itself, by the overpointing, the sheet would be so folded, that the printed pages would be exactly true to each other so that when trimmed in the ordinary way the inaccuracy of the print to the paper would not be evident, whereas, if the sheet had been folded by stop gages (that is by the edges of the paper itself) it would follow that each page of print would not come fairly on each page of paper as in the former instance. The machines are fitted with both kinds of stops to adapt them for use in either first or second class work.

I may here state that overpointing is commonly used for book work and stop gages for newspaper work.

f^* f^* are adjustable points carried by the inclined folding knife f which may be set to two dots printed in the margin on the inner side of the sheet for the purpose of folding to register (*i. e.* to the edges of the printed matter) and they are specially suited to printers' use. These dots take the place of the ordinary perforations by needle points on the "form" and can be easily printed, thus avoiding the piercing of the sheet and the laceration of the rollers and blankets consequent on the use of perforating points.

I will now describe the three-fold folding machine parts of which are shown at Figs. 11 to 15. The said machine is constructed on similar lines to those of the two-fold folding machine so far as the first and second folds are concerned, but made to the necessary proportions, and instead of the sheet passing direct from the rollers h h past the facing bar or guide k to the sloping collecting trough l, I in this case interpose between the rollers h and collecting trough l, means for effecting a third fold. For this purpose I employ guide rollers h^4 parallel with the rollers h and I pass conducting tapes h^5 around the rollers h h^4 to conduct the doubly folded sheet opposite a pair of folding rollers r r and between and against adjustable stops s s. When the sheet has arrived against such stops the third folding knife t presses it between the folding rollers r r, which complete the third fold. In connection with these rollers r r is a third or conducting roller r', around which and around the upper roller r conducting tapes r^2 are passed. The conducting roller r' is driven as follows. It has on its axis a pulley r^3, around which passes a gut r^4, which latter also passes around guide pulleys r^5 r^6 and around a driving pulley r^7 fixed on the driving shaft b. Said roller r' communicates motion to the lower roller r by toothed gearing r^8 and to the upper roller r by means of the tapes r^2, which latter, by bearing partly around the lower roller r, act to bend the folded edge of the sheet downward and thereby to direct it past the facing bar or guide k into the sloping gathering trough l, where it is acted upon by a pusher m and added to the collection in the gathering trough l in a similar manner to that described with respect to the two-fold folding machine except that the pusher m in the three-fold machine acts to push the folded sheets in the contrary direction to that of the two-fold machine. The third folding knife t is carried by arms t' fixed to an axis t^2; to one of such arms is pinjointed one end of a link t^3 whose other end is loosely jointed to one arm of a crank t^4, the other arm of which is loosely connected to one end of a connecting rod t^5 whose other end is loosely connected to the upper end of a lever t^6. This lever t^6 is mounted on an axis of motion t^7 attached to the frame of the machine and the lower end of such lever is acted upon by a cam t^5 to give the required motions to the folding knife t, which latter, by its weight, keeps the lever t^6 up to the cam t^8.

The pusher m used in connection with the

two-fold machine is made in two parts capable of sliding on dovetail guides m^{17} fixed to the back m^{18}, which latter is provided with two pinions m^{19} acting in combination with racks m^{20} on the sliding parts, thereby enabling the pusher to be adjusted in width as may be required. The pusher m used with the three-fold machine is similarly made and adjustable in width but on one side only.

I have not thought it necessary to give further drawings or description of the three-fold folding machine as the construction and operation of such machine will be clearly understood from the drawings and description of the two-fold machine combined with the drawings and description of the complementary parts of the three-fold machine.

By the above described arrangements of folding machines, the paper, from its first fold to its deposit in the collecting trough, is kept in substantially vertical planes, except at the moment of passing between the third pair of folding rollers, and it is delivered direct from the last folding rollers of either a two-fold or three-fold machine into the collecting trough knocked-up to an even edge.

Having fully described my invention, what I desire to claim and secure by Letters Patent is—

1. A folding machine comprising a suitable frame having a slightly inclined table, and a folding board still further inclined and having an opening in line with the table a driving shaft, a cam-shaft located at one side of the frame and connected with the driving-shaft, the inclined rocking axis mounted in bearings at one side of the folding board, provided with arms carrying an inclined folding knife, the curved lever fixed to the axis, the link having a forked lower end straddling the cam-shaft and provided with a truck, the cam fixed to the cam-shaft, and providing a bearing for the truck, the inclined upper gripping rollers mounted in bearings beneath the folding board and receiving the folded sheet pressed between them by the folding knife, the lower inclined rollers, the tapes working over the upper and lower rollers for guiding the folded sheet, the inclined support for the folded sheet, the upwardly extending inclined rollers, the upwardly extending inclined knife for pressing the folded sheet between the upwardly extending inclined rollers, the facing guide bar, and the right angled sloping gathering trough, and the pusher; substantially as described.

2. The combination, with the upwardly extending inclined delivery rollers; of the facing guide bar, the right angled sloping gathering trough placed at right angles to the delivery rollers, and the pusher, the pusher-rod having an inner part formed of angular section and an outer part of circular section, the bearings for the two parts of the rod, the collar fixed to the outer part carrying a pin, the crank-lever having an arm formed with a slot through which the pin passes, the vertical lever, a link connecting the levers, a cam-shaft having a cam bearing on the vertical lever and means for returning the pusher; substantially as described.

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