G. KLEIM.

FOLDING MACHINE.

APPLICATION FILED SEPT. 5, 1906.

906,722. Patented Dec. 15, 1908.

4 SHEETS—SHEET 1.

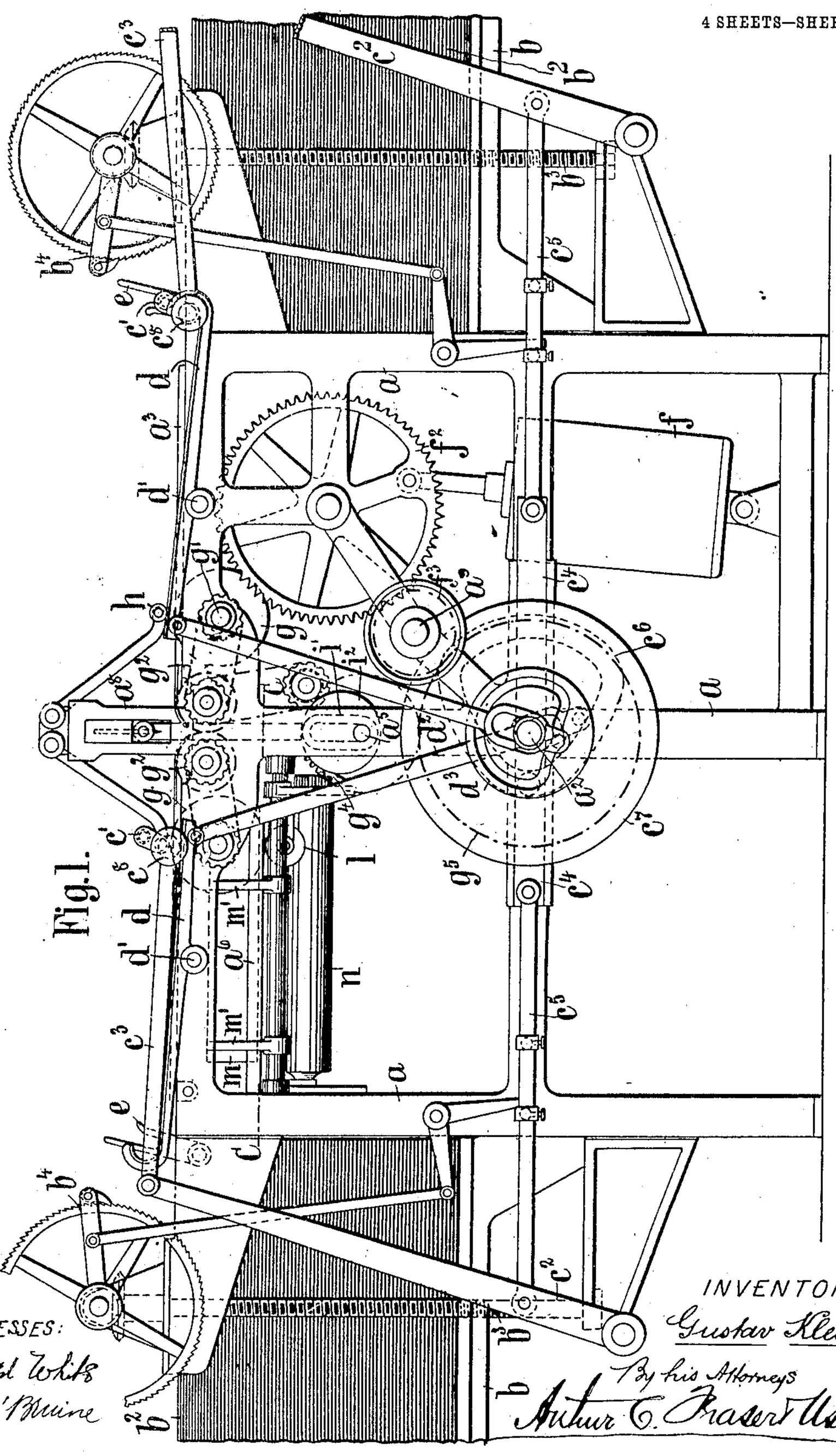

Fig. 1.

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Rene' Bruine

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Gustav Kleim,
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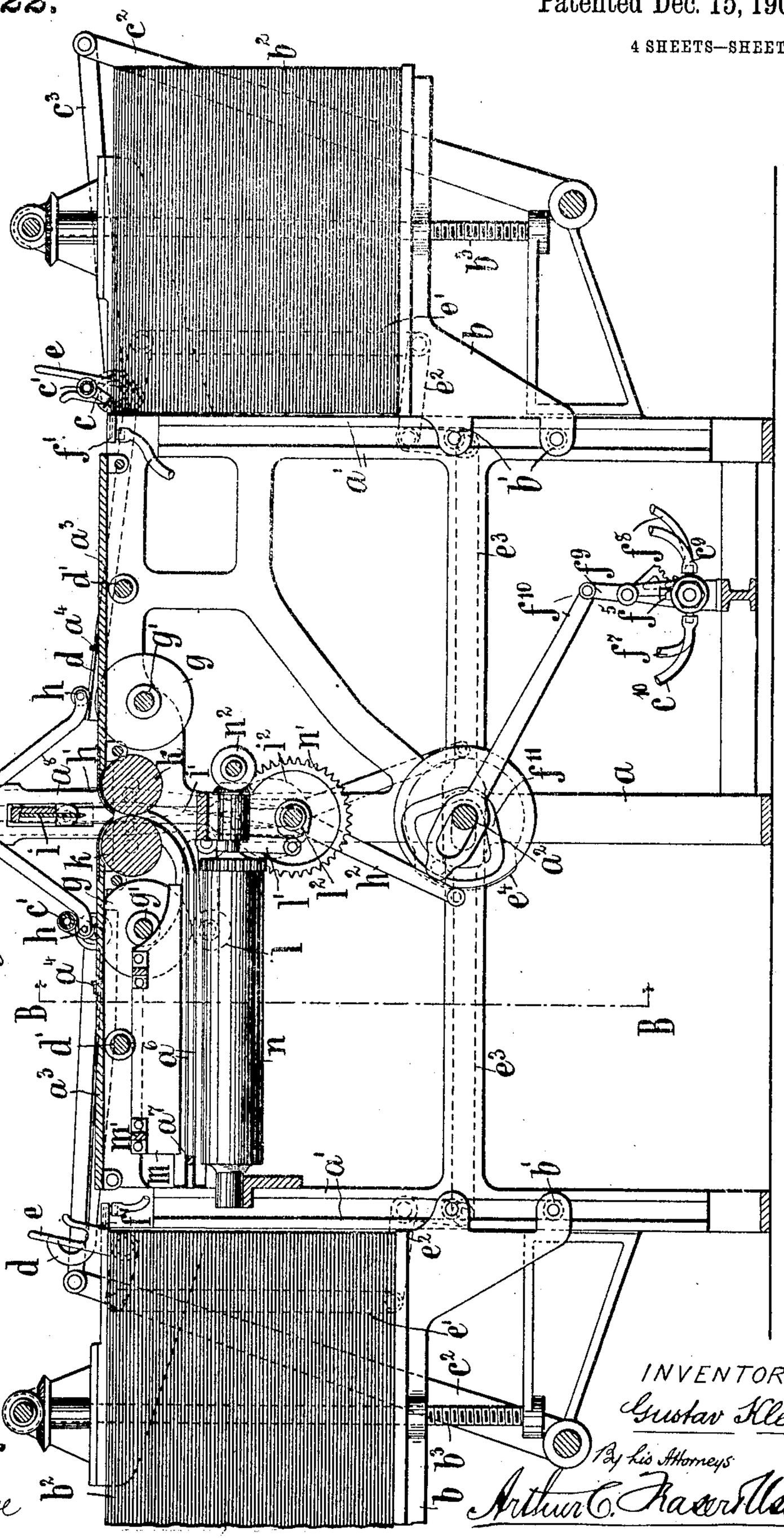
4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

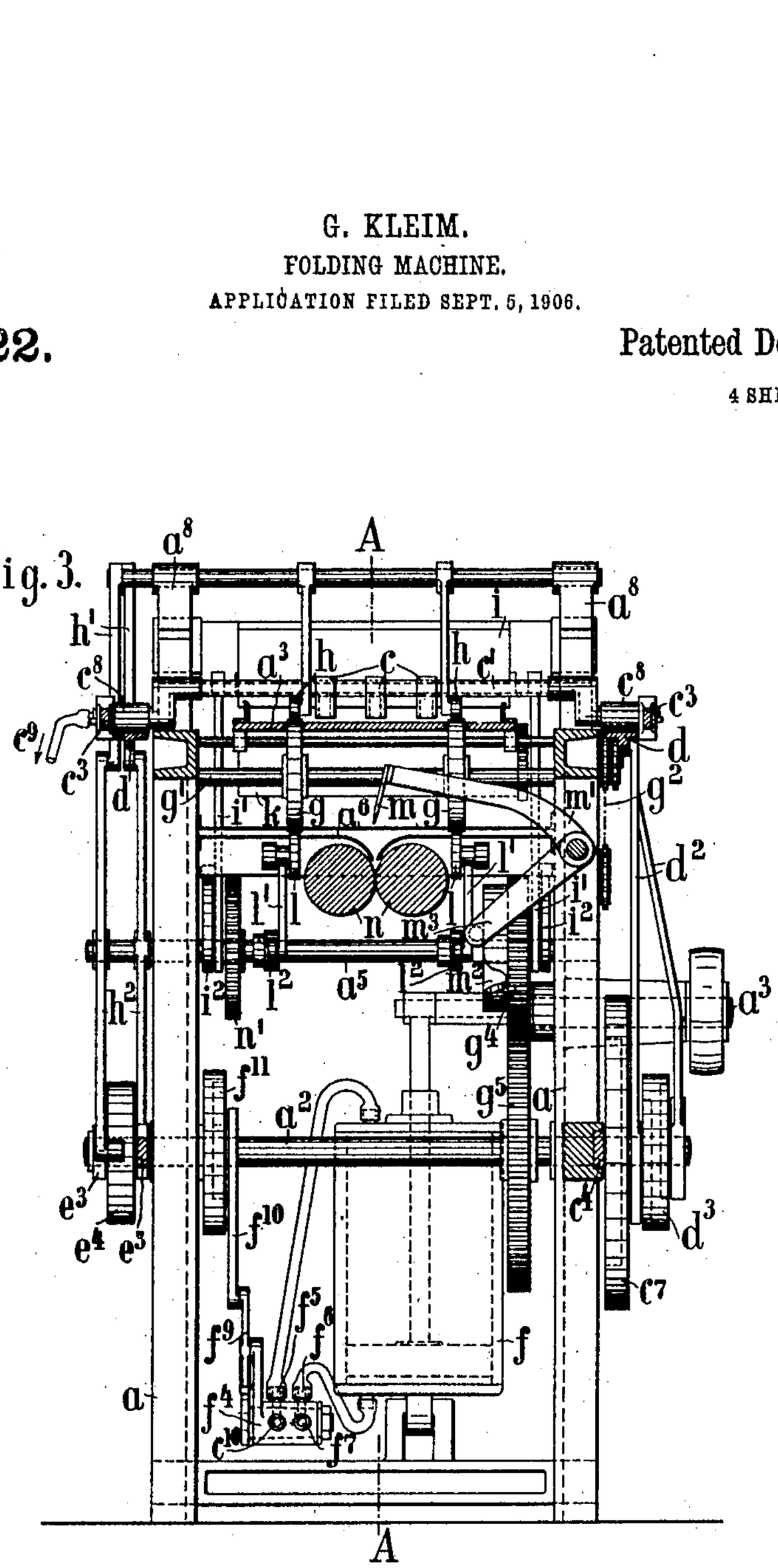


Fig. 8.

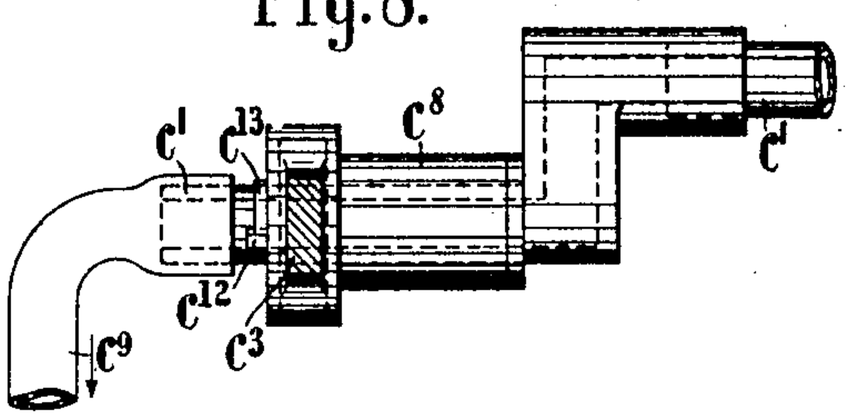
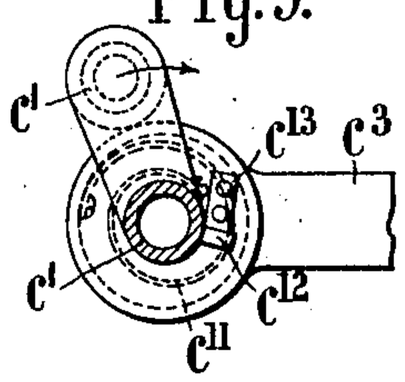


Fig. 9.



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4 SHEETS—SHEET 4.

Fig. 4.

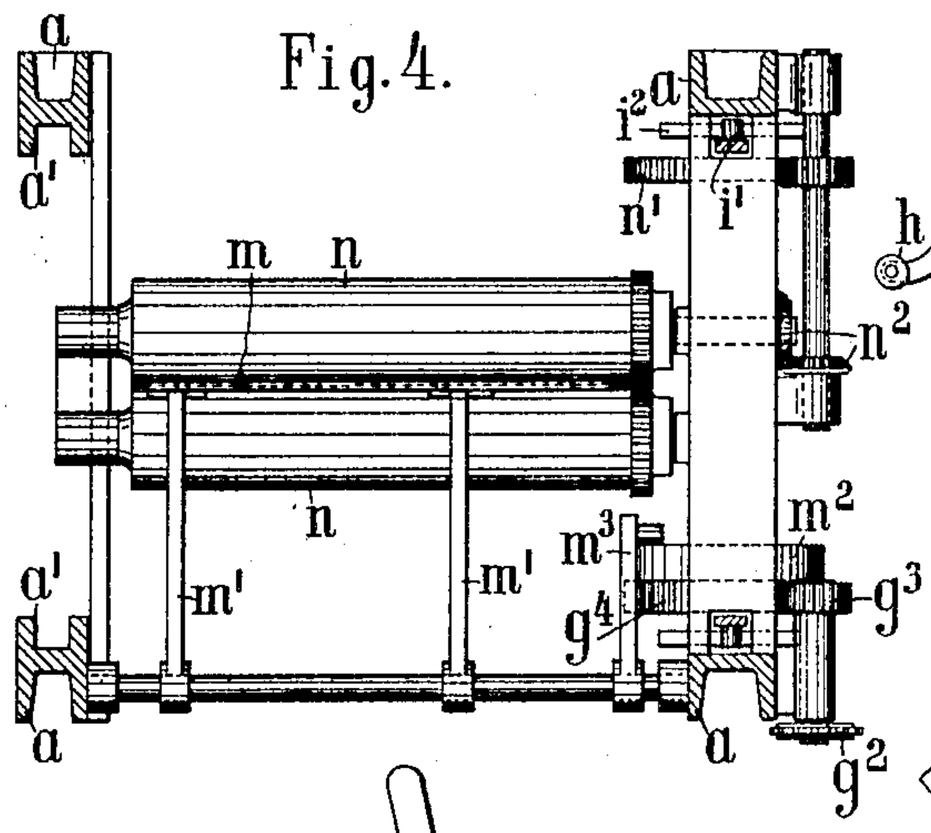


Fig. 5.

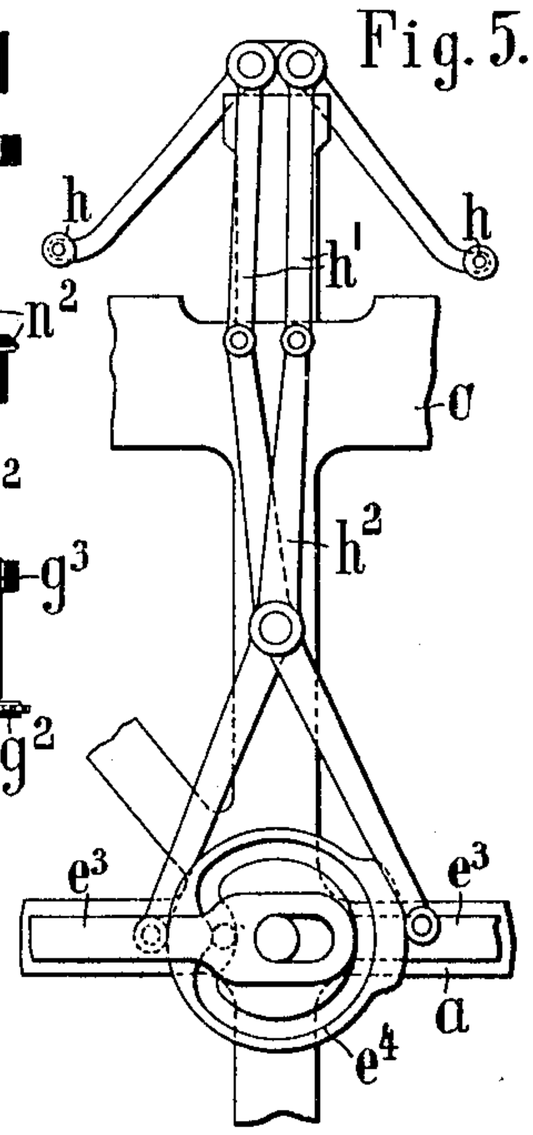


Fig. 6.

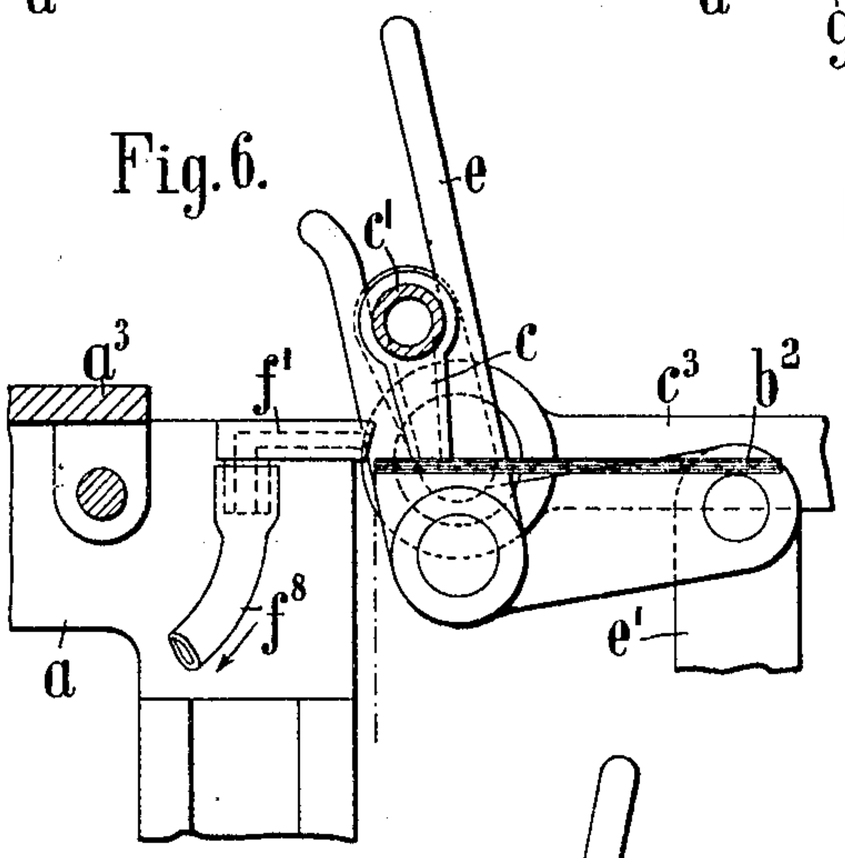


Fig. 10.

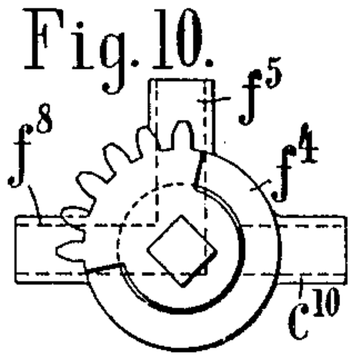


Fig. 7.

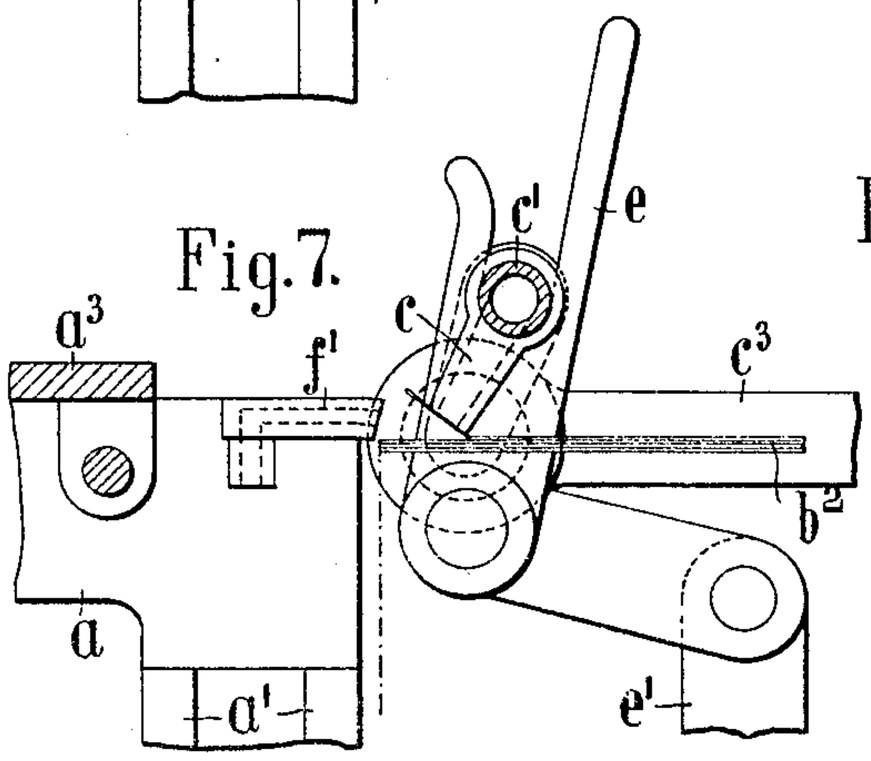
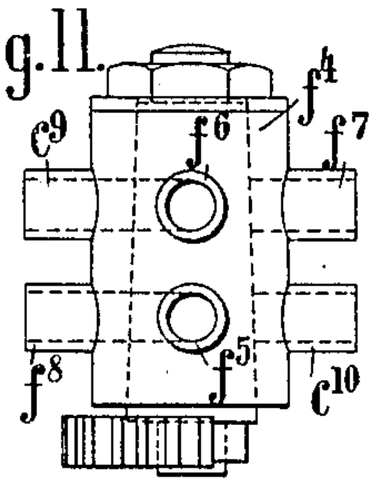


Fig. 11.



WITNESSES:

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UNITED STATES PATENT OFFICE.

GUSTAV KLEIM, OF LEIPZIG-LINDENAU, GERMANY.

FOLDING-MACHINE.

No. 906,722. Specification of Letters Patent. Patented Dec. 15, 1908.

Application filed September 5, 1906. Serial No. 333,367.

To all whom it may concern:

Be it known that I, GUSTAV KLEIM, a subject of the King of Prussia, residing at Leipzig-Lindenau, Germany, have invented certain new and useful Improvements in Folding-Machines, of which the following is a specification.

In previous folding machines a single stack of paper is employed from which the sheets are carried to folding rollers one after the other by means of a suitable carrying mechanism.

According to the present invention sheets are fed alternately from two separate stacks to the same folding mechanism. In the complete embodiment of the invention illustrated, the stacks of paper are arranged at opposite sides of the folding apparatus and pneumatic suction rods operating according to a well known principle are used for conveying the sheets from the stacks. These, however, do not constitute the entire means for advancing the sheets, but they bring the sheets only to transporting rollers which are arranged near and parallel to the folding rollers; whereupon certain pressure rollers arranged above the transporting rollers are lowered on to the latter so as to press the sheet against them and cause it to be further advanced until it lies over the folding rollers at the middle of the machine. During this action of the transporting rollers the suction rod which has carried the sheet to the transporting rollers returns to its starting position in order to pick up a new sheet, and the suction rod at the opposite side of the machine moves forward simultaneously in order to carry its sheet to the transporting rollers lying between its stack and the folding rollers, whereupon the pressure rollers at this side of the machine are lowered to grip the sheet upon the transporting rollers. Thereupon from this side of the machine a sheet is shoved over the folding rollers while the sheet previously brought between these folding rollers from the other side has been folded and further advanced.

The folded sheet is conveyed to the under side of the transporting rollers and by means of lower pressure rollers is pressed upon the under side of the transporting rollers so as to be carried forward sidewise thereby until it lies over a second pair of folding rollers which are arranged at right angles to the first pair. Thus with a single folding mechanism (or succession of folding mechanisms for effecting successive folds) the output of the machine is doubled (that is compared with machines using a single feeding mechanism) since the folding mechanism may be operated at twice the speed of the mechanism for picking up and feeding the separate sheets thereto.

A folding machine embodying the invention is shown in the accompanying drawings.

Figure 1 shows the machine in side elevation; Fig. 2 is a vertical longitudinal section of the same on line A—A of Fig. 3; Fig. 3 is a transverse section on the line B—B of Fig. 2; Fig. 4 is a horizontal section on the line C—C of Fig. 1; Figs. 5 to 11 are separate details partly on an enlarged scale.

Referring to the embodiment of the invention illustrated, there are provided on opposite sides of the main frame *a* platforms or tables *b* arranged to slide up and down, being guided by attached rollers *b'* working in guides *a'*. The tables carry stacks b^2 of the sheets to be folded. The lifting of the top sheet of each stack is effected in any known or suitable way such, for example, as by means of suction rods *c'* extending transversely of the machine and provided with mouth pieces *c*. The rods *c'* are connected with swinging arms c^2 by means of links c^3 and are thereby alternately carried from the stack to the central part of the machine and back to their starting positions so that when one suction rod is in position to lift a sheet from its stack the other rod stands near the middle of the machine. Thus the two suction rods simultaneously move to the right or to the left. The simultaneous operation of the two pairs of swinging arms c^2 is effected by a sliding rod c^4 which is in engagement with a curved groove c^6 in a cam c' on the shaft a^2 and which is reciprocated by such cam, its movement being transmitted to the swinging arms c^2 by means of links c^5 (see Figs. 1 and 3). Each suction rod *c'* is offset or cranked at its ends and the bent ends are carried in rollers c^8 by means of which they are supported upon the upper faces of rocking rails *d* arranged at opposite sides of the machine and along which the suction rods are moved back and forth.

The tilting rails *d* are pivoted upon pins *d'* on the frame *a* and effect a lowering of the suction rod on the stack of sheets and a raising of the rod with the attached sheet to carry it to the table a^3 and over the gage a^4 on said table (and preferably adjustably ar-

ranged thereon, and a second lowering upon the table. The desired movements of the rails d are effected from the shaft a^2 by means of slotted links d^2 embracing the shaft and engaged by the groove of a cam d^3.

The suction mouth pieces c are so arranged that their lower corner which is toward the corresponding swinging arms c^2 lies almost exactly in line with the center of the rollers c^8, so that the mouth pieces c may be turned about their rear corners (Fig. 2, right-hand side, and Fig. 7), and thus against the pressure of a spring c^{11} (Figs. 8 and 9) which at one end is fastened to the link c^3 and at the other end to the suction rod c', and which is strained in such a direction as to turn the cranked end of the suction rod c' until its projection c^{12} strikes against the stop c^{13}. In this position the suction mouth pieces stand as in Fig. 6 and in this position they are lowered upon the top sheet of paper.

The tilting of the mouth pieces is effected by means of a crank lever e, the upper end of which is slotted so as to form a fork which embraces the suction rod c'. The other arm of the crank lever e is connected by means of a link e' to a second crank lever e^2 which is operated by means of a rod e^3 which is reciprocated by means of a cam e^4 on the shaft a^2. While the mouth piece thus receives a backward swinging movement and bends up the forward edge of the uppermost sheet (Fig. 2, right-hand side, Fig. 7) jets of air are blown through blowing nozzles f' against the upper sheet of the stack in order to effect the release of the uppermost sheet from those lying immediately thereunder.

The sucking of the air out of the suction rod as well as the introduction of compressed air into the blowing nozzles f' is effected by means of a pump f which may be as shown a double acting piston pump set in operation by means of a gear wheel f^2. The wheel f^2 may be rotated by means of a pinion f^3 on the main shaft a^3.

Since the suction and the pressure for the suction mouth pieces and the blowing nozzles of each related pair must be effected at the same time, the operation of the pump is used to obtain this effect. The vacuum at one side of the piston is connected with the suction rod, and the pressure at the opposite side of the piston is connected with the blowing nozzles. Since the suction mouth pieces and blowing nozzles at one side of the machine work alternately with the corresponding members at the opposite side, it is necessary that the pump shall be alternately connected to the mechanisms at opposite sides. This intermittent connection is effected by means of a valve f^4, Figs. 3, 10 and 11, the stem of which is oscillated and the valve is of the rotary plug type provided with two sets of ports, the ports of each set arranged angularly of each other, a casing being provided with six ports. The two upper ports f^5, f^6 are connected respectively with the upper and the lower ends of the pump cylinder (Fig. 3). The port c^9 is connected by means of a pipe with the suction member at the right of the machine, and the port f^8 is connected through another pipe with the right-hand blowing nozzle f', while at the other side of the frame the port f^7 is connected with the left-hand blowing nozzle f' and the port c^{10} with the left-hand suction pipe c'.

The operation of the valve is effected by means of a lever f^1, Fig. 2, which has a toothed engagement with a sector on the valve spindle, and which at its opposite end is engaged with a rod f^{10}, the latter being operated by a cam f^{11} on the shaft a^2 so that for each half revolution of the shaft the valve spindle is turned through a quarter of a revolution. The pump is thus alternately connected with the right-hand pair or with the left-hand pair of devices.

The sheets as they are lifted are alternately carried by the mouth pieces c toward the middle of the machine and to a point where they lie over transporting rollers g suitably mounted upon the frame a. While the suction mouth pieces hold a sheet over these rollers g, pressure rollers h are lowered on to the transporting rollers so as to hold the sheet between the rollers g and h and so that the sheet will be advanced by the rotating rollers g to the middle of the machine, until it strikes a gage a^4. The transporting rollers g are arranged on shafts g' which are suitably rotated by means of a chain drive g^2, which latter is driven by means of pinions g^3, g^4 (see Fig. 4), the latter being driven by a gear g^5 on the shaft a^2. The gear g^5 is driven by a pinion f^3 (Fig. 1) on the main shaft a^9. The alternate upward and downward movement of the pressure rollers h may be effected by the mechanism shown in Fig. 5. Levers h^2 connected with levers h' are oscillated by a cam e^4 which carries on its periphery a curve for effecting the desired movements.

The sheet placed at the middle of the machine and against the gage a^4 is forced between the two folding rollers k by means of a folding knife i mounted in guides a^8 on the frame a of the machine and moved upward and downward by means of cams i^2 and the connecting rods i'. The folding rollers k fold the sheet together and shove it with its folded edge forward into the guides a^6 which likewise may be provided with a gage a^7. The guides a^6 are curved in such direction that the folded sheet is carried sidewise under the rollers g. The rollers pass through the upper one of the guides, so that the folded sheet can be pressed against the under side of the rollers g by means of the lower pressure rolls l, whereupon the rollers g further advance the

sheet until it strikes against the end of the guide, or against a gage a^7. In this position the sheet lies over a second pair of folding rollers n, which are arranged at a right angle to the first pair of folding rollers k, and under a folding knife m belonging to these second rollers. This knife is carried on arms m' and is raised and lowered by means of the lever m^3 which is operated by the cam m^2 on the face of the pinion g^4. The folding knife m presses the sheet, which has already been folded once, between the rollers n, which grasp the sheet and conduct it to any suitable table (not shown). The second fold is at right angles to the first. The lower pressure rollers l are pressed against the transporting rollers g by means of angle levers l' operated by cams l^2 on the shaft a^5. The second folding rollers n are also driven from the shaft a^5 through a pinion n' and conical pinions n^2; while the folding rollers k receive their movement from the previously described chain gearing g^2. The sheets may be conducted from the second pair of folding rollers to a third folding mechanism similar to the second, or in fact through any number of folding mechanisms acting successively. In order to maintain the stack of sheets always at the same height necessary for the suction rod, the tables b supporting the stacks b^2 are slowly raised by means of a ratchet b^4 operating a spindle b^3.

The operation of the machine is as follows:—From the two stacks of sheets b^2 the suction rods c alternately lift a sheet and carry it over the transporting rollers g, whereupon the pressure rollers h are lowered upon the corresponding rollers g, so that the sheet is gripped between the rollers h and g, and is therefore shoved over the middle of the machine to the gage a^4. During the forward movement of one sheet by its suction rod, the other suction rod moves backward in order to effect the movement of the next sheet from the other stack. The sheet which is laid upon the middle of the machine is pressed between the folding rollers k by the falling of the folding knife i, and is led out of the folding rollers into the guides a^6. But before it is released from the rollers k, the sheet with its folded edge is pressed by the pressure rollers l from below against the rollers g at the left side of the machine, and is further advanced until its edge strikes the gage a^7. The second folding knife m arranged in a plane at right angles to that of the first folding knife i, presses the sheet along a line at right angles to the first fold into the space between the rollers n, out of which the now cross-folded sheet can be conducted and stacked. Any additional number of folds may be provided, as previously explained, before the sheets are stacked. While the suction rod which has carried the first sheet over the first pair of folding rollers returns to its starting position in order to pick up a new sheet and carry it forward, the other suction rod moves forward and brings from its side a new sheet over the first pair of folding rollers, while the sheet first folded has been further advanced in the meantime to the second pair of folding rollers. From the second pair of folding rollers the sheet may be conducted to additional folding rollers as desired.

Though I have described with great particularity of detail a certain specific embodiment of the invention, yet it is not to be understood therefrom that the invention is limited to the specific embodiment disclosed. Various modifications thereof in detail, and in the arrangement and combination of the parts, may be made by those skilled in the art, without departure from the invention.

What I claim is:—

1. A machine for folding single sheets one after another from stacks of sheets, said machine including in combination a folding mechanism, a transporting mechanism at each of two opposite sides of said folding mechanism, said transporting mechanisms operating alternately to each other and adapted to transport a sheet to said folding mechanism, and a suction rod at each side adapted to pick up a sheet from a stack and carry it to the corresponding transporting mechanism, said suction rods operating alternately to each other, whereby sheets are fed alternately from opposite sides and folded one after another by the said folding mechanism.

2. A folding machine including in combination a central pair of folding rollers k, transporting rollers g at each side of said folding rollers, pressure rollers h above said transporting rollers, two suction rods arranged to carry sheets alternately to the transporting rollers at opposite sides of the folding rollers, said transporting rollers arranged to further conduct the sheets to a position over the folding rollers, and a rising and falling knife for forcing the sheet between the folding rollers.

3. A folding machine including in combination a folding mechanism including folding rollers, transporting rollers at opposite sides of said folding mechanism and adapted to transport sheets to a position over said folding rollers, means for conducting folded sheets from between said rollers to the under side of the transporting rollers at one side of said folding mechanism, and means for pressing such folded sheets against the under side of the transporting rollers under which they are conducted.

4. A folding machine including in combination a central pair of folding rollers k, transporting rollers g at each side of said folding rollers, pressure rollers h above said trans-

porting rollers, two suction rods arranged to carry sheets alternately to the transporting rollers at opposite sides of the folding rollers, said transporting rollers arranged to further conduct the sheets to a position over the folding rollers, and a rising and falling knife for forcing the sheet between the folding rollers.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

GUSTAV KLEIM.

Witnesses:
JULIUS GIESECKE,
WALTHER DALICHAN.