Nov. 28, 1939. R. KLEMM 2,181,241

PAPER SHEET FEEDING MECHANISM

Filed June 29, 1938 7 Sheets-Sheet 1

Fig. 1.

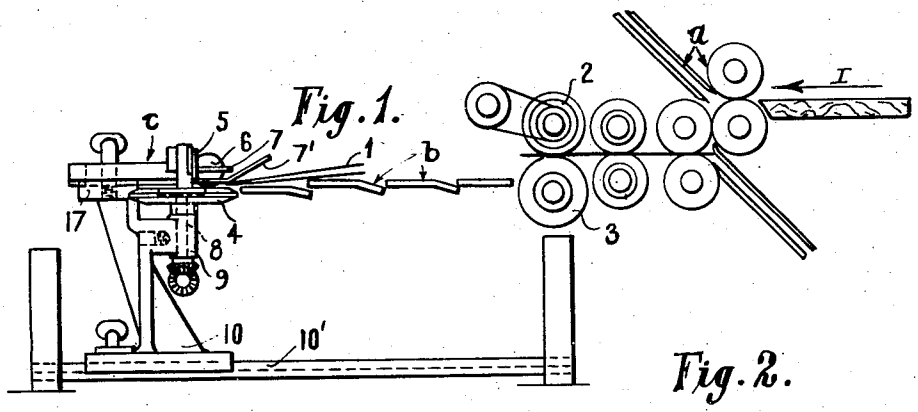
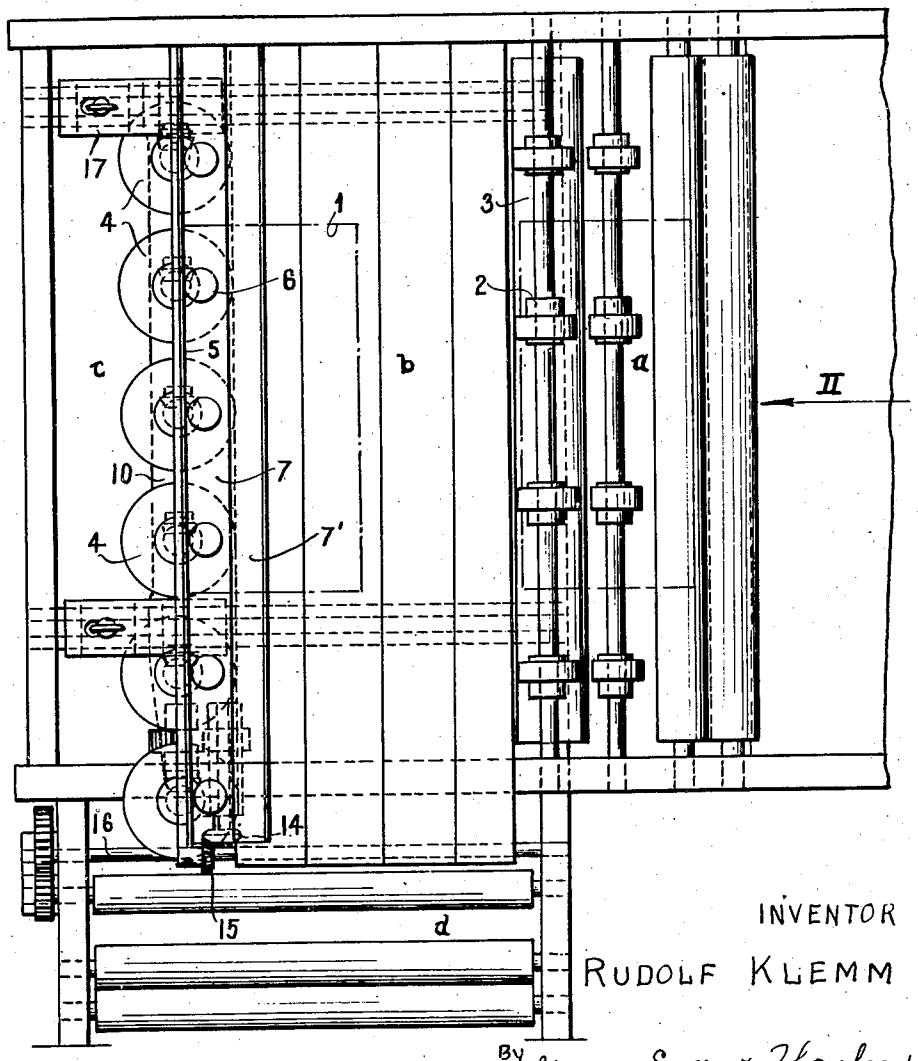


Fig. 2.



INVENTOR

RUDOLF KLEMM

BY Young, Emery & Thompson.

ATTYS.

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PAPER SHEET FEEDING MECHANISM

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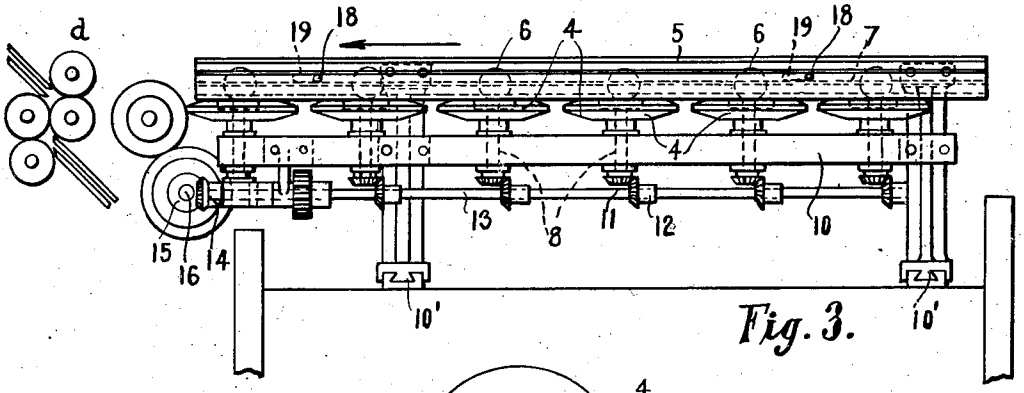


Fig. 3.

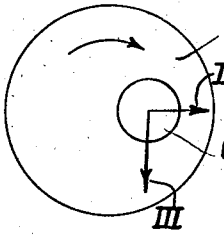


Fig. 6.

Fig. 4.

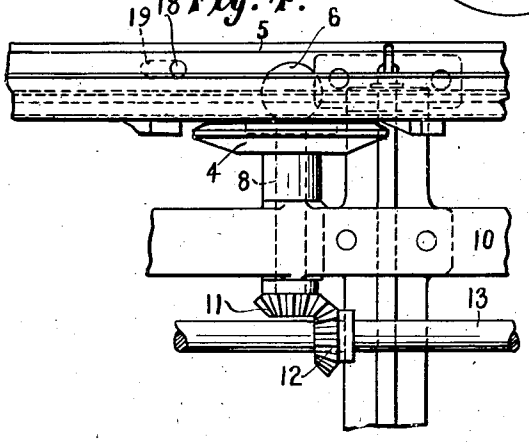
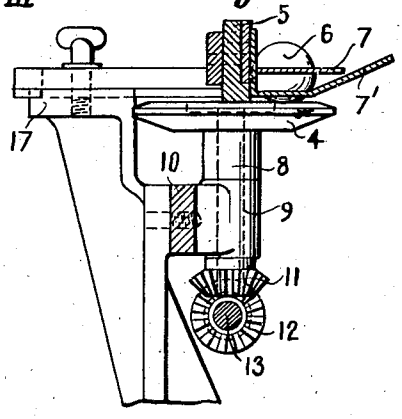


Fig. 5.



INVENTOR

RUDOLF KLEMM

By Young, Emery & Thompson

ATTYS.

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Fig. 7.

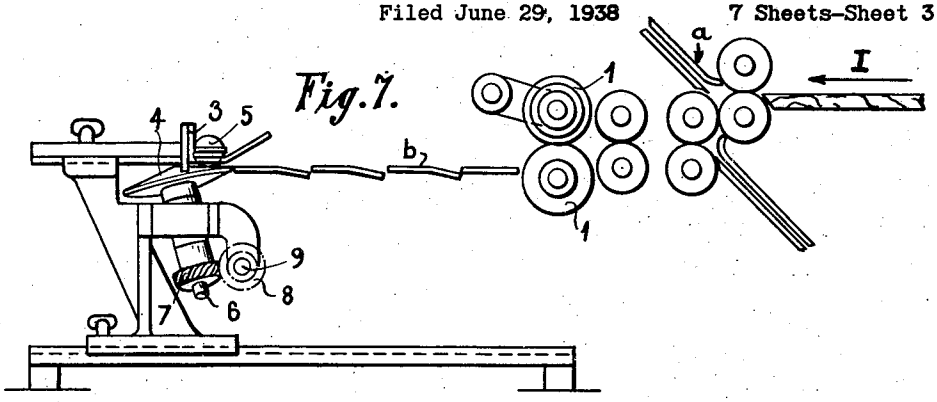
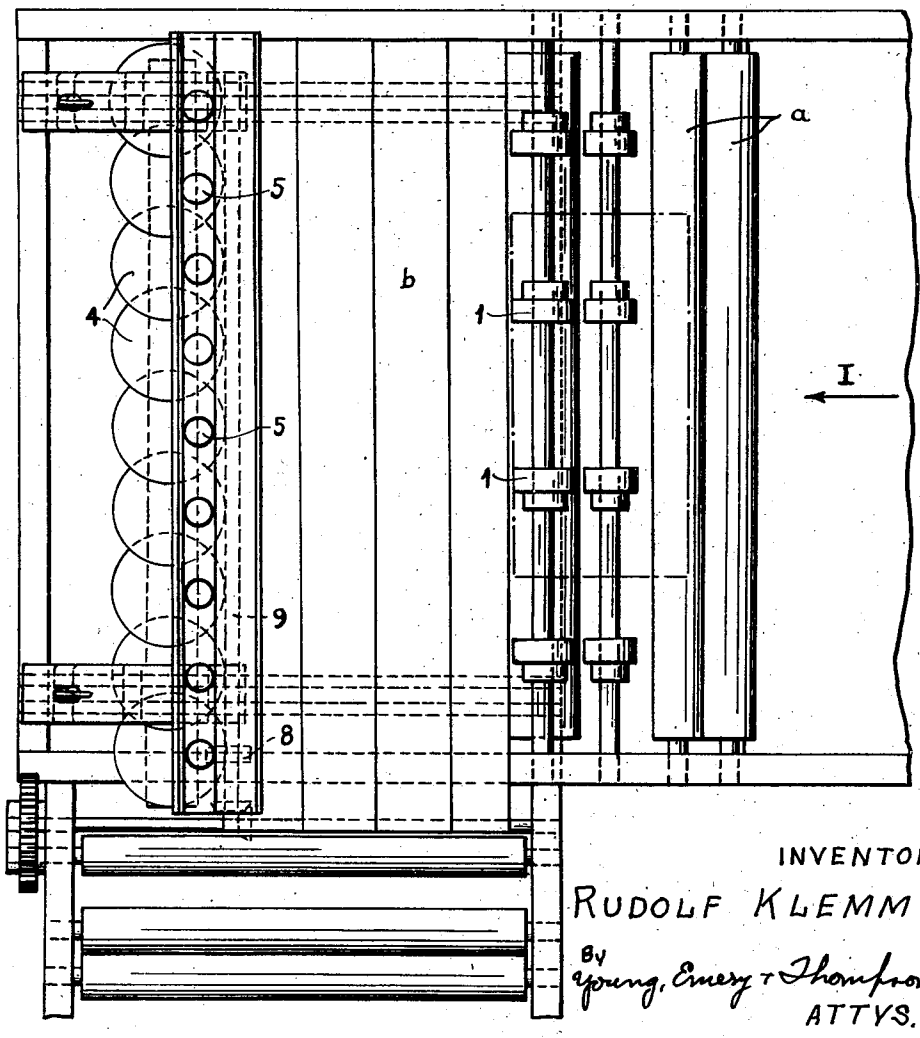


Fig. 8.



INVENTOR

RUDOLF KLEMM

By Young, Emery & Thompson

ATTYS.

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PAPER SHEET FEEDING MECHANISM

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Fig. 9.

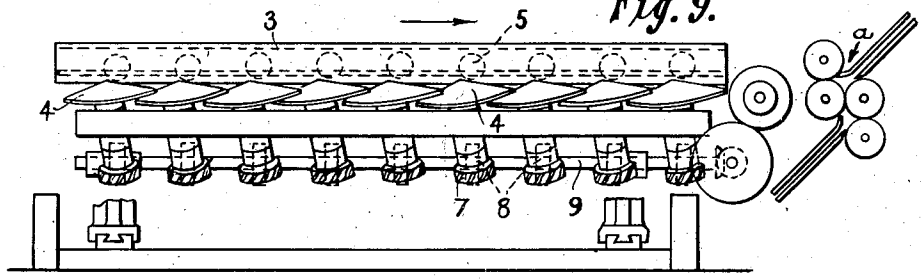


Fig. 10.

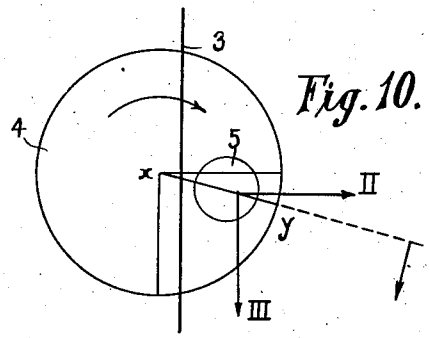
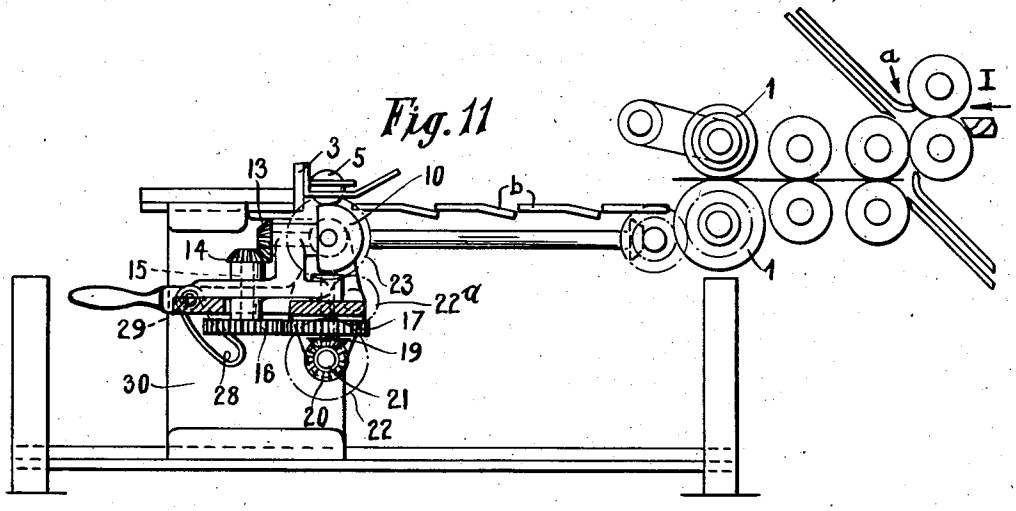


Fig. 11



INVENTOR

RUDOLF KLEMM

By Young, Emery & Thompson

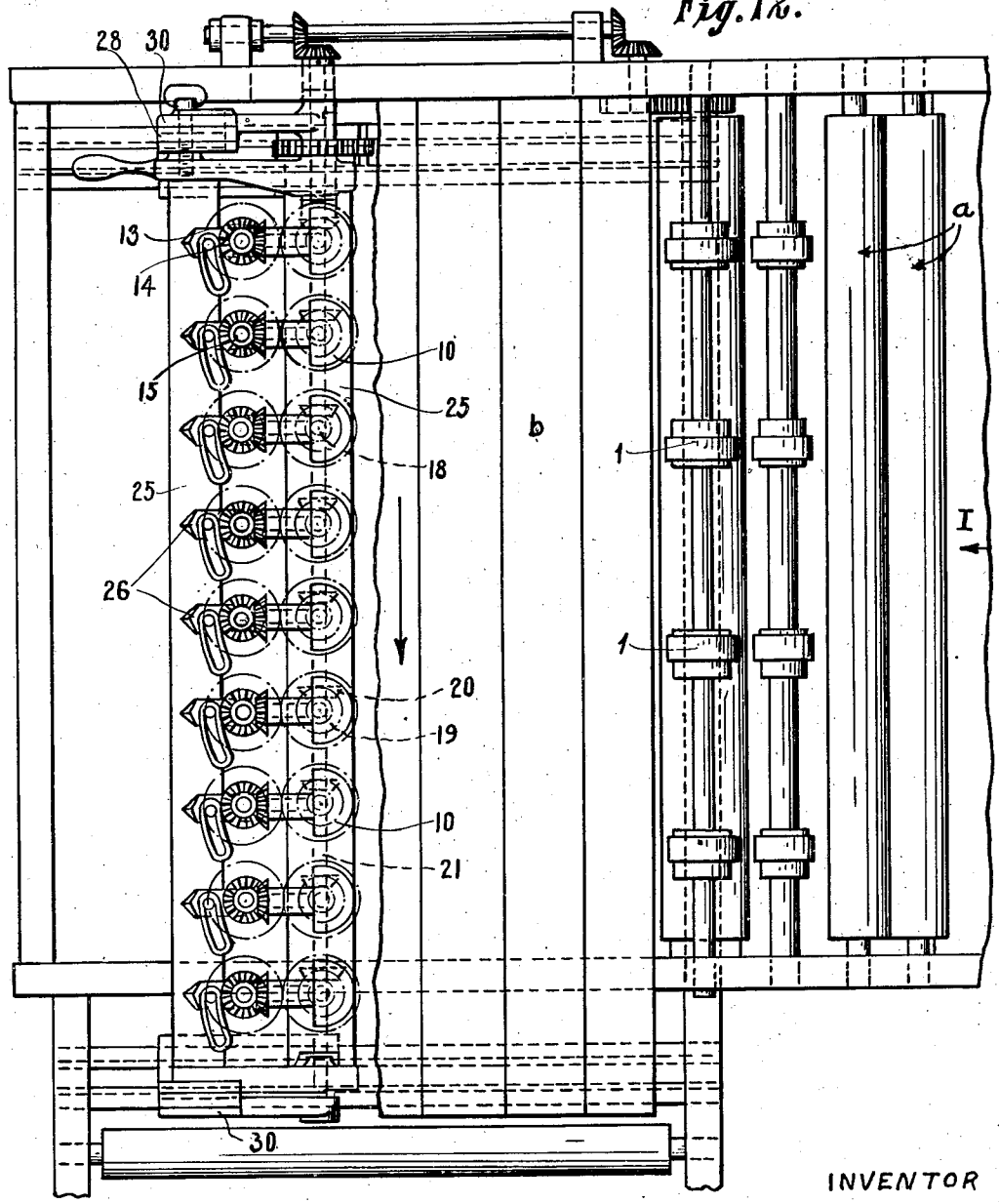
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PAPER SHEET FEEDING MECHANISM

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Fig. 12.



INVENTOR

RUDOLF KLEMM

By Young, Emery & Thompson

ATTYS.

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Fig. 14.

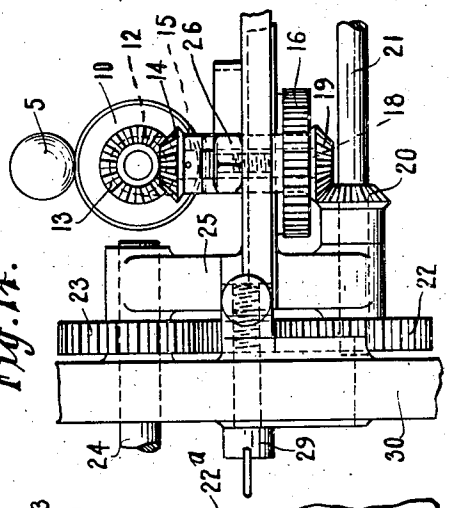


Fig. 13

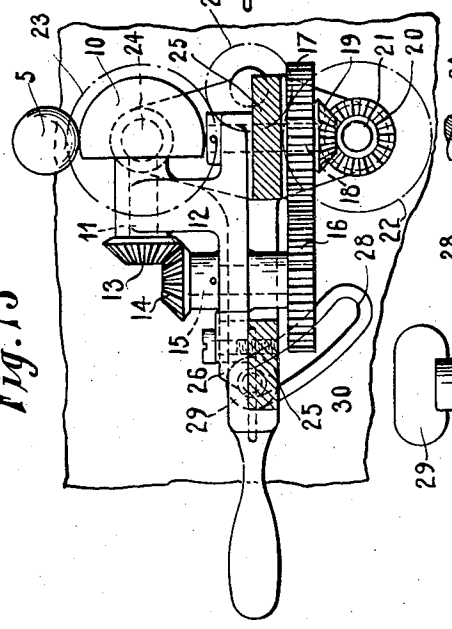
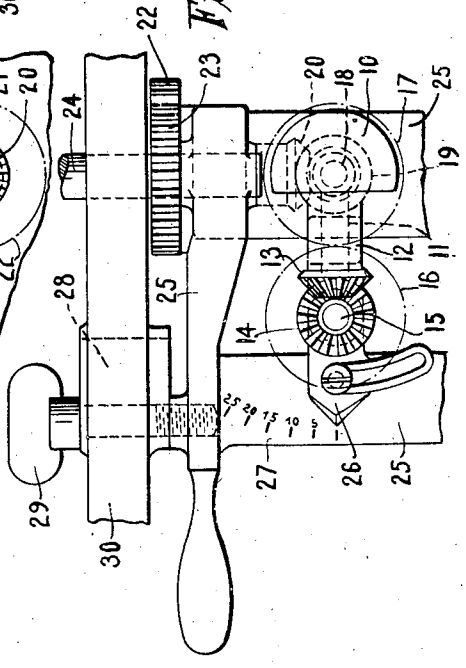


Fig. 15.



INVENTOR

RUDOLF KLEMM

By Young, Emery & Thompson

ATTYS.

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PAPER SHEET FEEDING MECHANISM

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Fig. 16.

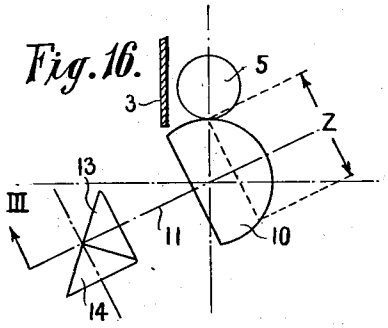


Fig. 17.

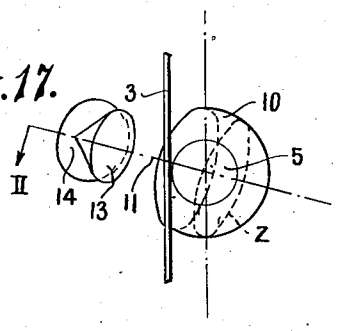


Fig. 18.

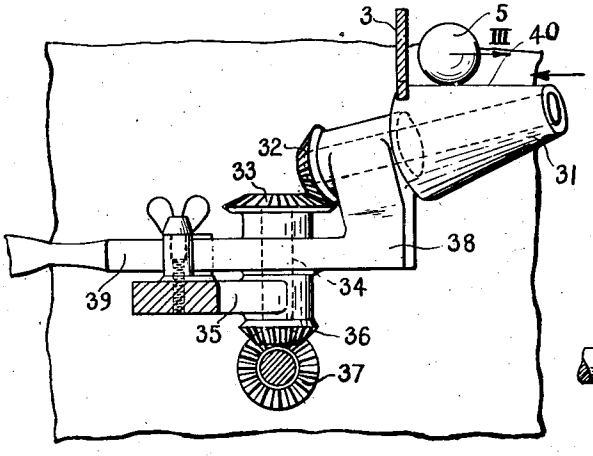


Fig. 19.

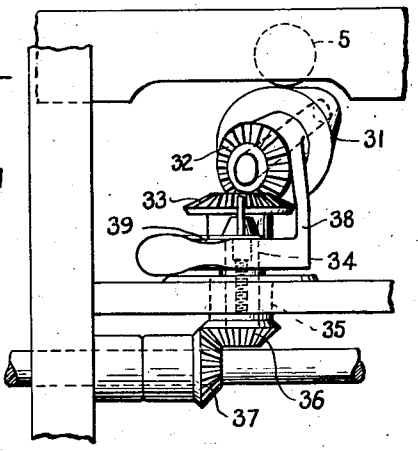
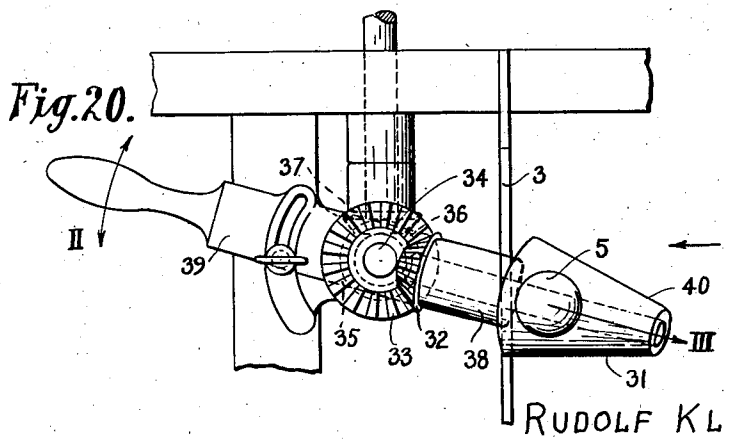


Fig. 20.



RUDOLF KLEMM

BY

Young, Emery & Thompson

ATTYS.

Patented Nov. 28, 1939 2,181,241

UNITED STATES PATENT OFFICE

2,181,241

PAPER SHEET FEEDING MECHANISM

Rudolf Klemm, Leipzig-Plagwitz, Germany, assignor to Gebruder Brehmer Maschinenfabrik, Leipzig-Plagwitz, Germany

Application June 29, 1938, Serial No. 216,611
In Germany July 6, 1937

19 Claims. (Cl. 271—52)

This invention relates to improved paper sheet feeding mechanism for use preferably in machines in which the sheets emerging from a device wherein they have been subjected to some particular operation are to be automatically fed horizontally to some other or similar operating device with a change however of their direction of travel. The invention will be found to be applicable with advantage to paper sheet folding machines of what is known as the buckle fold type in which sheets emerging from one folding device are fed horizontally to the next folding device by means of a stop rail or guide at right angles to their preceding direction in order to receive a cross fold therein.

The mechanism is of the well-known type in which a linear guide employed for directing the sheets in the desired direction is associated with a series of revolving elements such as rollers in contact with a variable number of friction elements between which the feed of the sheets may be controlled by varying either the number of the friction elements employed in contact with selected ones of the revolving elements or by the use of friction elements of different external character and/or weight.

Now this invention consists in an improved feed mechanism of the above type in which the driven revolving elements in individual cooperative contact with the friction elements are constructed to constitute relatively adjustable units in a substantially linear sheet propelling gear along the sheet guide enabling the feed of the sheets along the guide to be controlled change speed gear fashion at will by variation of the engaging faces between the contacting elements relatively to the guide so that either the speed of the sheets along said guide or the degree of contact or pressure of the sheet edge on the guide or both may be arbitrarily varied and adjusted as required with accuracy according to the size and nature of the paper stock in use.

According to one constructional form the revolving elements of the train may be constituted by a series of flat or slightly conical substantially horizontal discs upon which the sheet propelling contact with the corresponding friction elements may be differentially varied in the manner of a friction gear. According to other forms of the invention, the driven revolving elements may be conical or spherical, the latter preferably shaped as ball segments, the engaging faces of which with the corresponding friction elements may be varied by varying the position of their axes of rotation. The friction elements themselves may in all cases have the form of balls, rollers or brushes or like rotary bodies, which according to the particular form of revolving bodies employed may be associated with the guide in a definite relationship or may be separately adjustable relatively thereto.

To assist in the smooth travel of the sheets air nozzles or means of any approved type may be provided in addition to produce air streams in the direction of the feed and the driving arrangement for any of these forms of mechanism may be of any appropriate kind and may be individual to each unit or a joint one.

These various forms of the invention are illustrated more or less diagrammatically by way of example in the accompanying drawings in which:

Fig. 1 is a longitudinal elevation of a buckle folding machine associated with one form of the mechanism for use in cross feeding sheets according to this invention.

Fig. 2 represents a plan view thereof.

Fig. 3 is a front view of the mechanism.

Figs. 4 to 6 illustrate on a larger scale the essential constitutents of the mechanism at one of the feed points thereof.

Figs. 7, 8 and 9 illustrate in representations similar to Figs. 1, 2 and 3 respectively side elevation, plan view and front elevation of an alternative form of the invention and

Figure 10 is a diagram explanatory thereto.

Figs. 11 and 12 are respectively a side elevation and plan view of a third constructional form of the invention.

Figs. 13, 14 and 15 illustrate in three different views details of this particular form on an enlarged scale and

Figs. 16 and 17 show, respectively, in said elevation and plan view, diagrams explanatory of this particular arrangement, and

Figs. 18, 19 and 20 represent in elevation, plan view and rear view, respectively, a modification in which the driven revolving elements are constituted by truncated conical rollers.

In the arrangement shown in Figs. 1 to 6 the sheet 1 is assumed to have emerged from the ejecting rolls 2 and 3 of the buckle folding set *a* in the direction of the arrow I, longitudinally of the machine which is diagrammatically indicated on the right hand side of Fig. 1. On leaving the rolls 2 and 3 the sheet travels longitudinally over the feed table *b* at relatively high speed towards the feed mechanism *c* shown on the left. The latter consists in the main of a series of continually revolving circular plates or discs 4 the upper

horizontal faces of which are aligned to form a series of temporary sheet supports level with the plane of the sheets and extending transversely of the feed table towards the next folding mechanism which is indicated diagrammatically by the rolls *d* at the bottom of Fig. 2. Arranged above the discs 4 is a guide rail 5 extending more or less centrally over the whole of the discs as best shown in Fig. 2. By this rail the sheets emerging from the rolls 2, 3 are stopped and thereafter are guided along it at right angles to their previous direction. To this end the rail 5 is constructed to carry friction elements 6 (balls or rollers or the like) arranged each to rest freely on one of the discs 4 and adapted to brake the sheet passing between them and the corresponding discs to the rail 5 and thereafter to effect its travel along the rail, i. e., in the new direction by the cooperation between them and the revolving discs 4. The rail 5 together with the friction elements 6 (here shown as balls) is adjustable relatively to and from the folding section *a*, i. e., longitudinally of the feed table *b* according to the size of the sheets. The balls 6 are lodged in a horizontal limb or carrier 7 which is fitted to the vertical front face of the rail 5 as hereinafter described so as to be movable along the rail 5, i. e., adjustable thereon also longitudinally of the feed table. Thus the balls 6 may be set to operate at any desired point radially on the discs 4 and correspondingly to vary the degree of the frictional engagement of the sheets between them or in other words the mechanism may be adjusted to control the running speed of the sheets friction gear fashion and also the pressure component urging the sheets towards the guide rail 5 at will. The shafts or stems 8 of the discs 4 are fitted in bearings 9 provided in a bracket 10 and carry each a conical gear wheel 11 meshing with corresponding gear wheel 12 on a common shaft 13 (Figs. 3, 4 and 5). Mounted on the extreme end of the shaft 13 (see Fig. 3) is a conical gear wheel 14 engaging with a gear wheel 15 on a driving shaft 16 along which said latter gear wheel is displaceable. The bracket 10 which in its turn is movable and adjustable to and from the folding section *a* of the machine is slidingly supported in the frame as shown at 10'. The guide rail 5 itself is carried in adjustable bearers 17 which are mounted on the rear face of the bracket 10. The ball carrier 7 is secured to the vertical front face of the guide rail 5 by means of set screws 18 and has its lower horizontal limb provided with an upturned flange 7' through which the balls 6 extend down into contact with the corresponding discs 4 and which assists in guiding the oncoming sheets in their entry between the latter and the balls 6. The vertical limb of the ball carrier is provided with a slot 19 at every fixing point 18 (Figs. 3 and 4) enabling it to be displaced and adjusted along the guide rail 5 itself. By these various adjustments it is possible as already stated to vary the contact point between each ball 6 and its corresponding disc 4 friction gear fashion so as to be effective at any desired point on the revolving face of the disc. As will be understood from Fig. 6 the further this contact point is placed towards the circumference of the disc or in other words the further the balls are moved radially from the centre of the discs in the direction of arrow II the more rapid will be the cross feed of the sheets and the more this contact point is varied laterally by displacing the ball carrier in the direction of arrow III, i. e., in the new running direction of the sheets, the greater will be the pressure with which the sheets are urged to the guide rail.

By means of the series of these gear-like units forming what may aptly be termed a substantially linear sheet propelling gear train, the running speed of the sheets may therefore be readily varied within wide limits in a simple manner and independently thereof the pressure component urging the sheet to the guide may be finely controlled according to the quality of paper employed.

Referring now to the alternative arrangement shown in Figs. 7 to 10 the sheets to be folded are again supplied in the direction of the arrow I emerging from the ejecting rollers 1 of the first buckle folding set *a* on to the cross feed table *b* and travelling thereover to the guide rail 3 as in the preceding example. In this instance however the rotary disc-like members 4 are constituted by obliquely positioned discs 4 preferably of a shallow conical shape and as shown are not spaced apart as in the previous example but form a series in which the adjacent discs overlap scale fashion, thus forming a more continuous surface. Supported on each of these discs is again a ball, roller or the like 5 adapted to brake the oncoming sheet as before in known manner and thereafter to cooperate with its corresponding disc 4 to impart to it the necessary transport force in the new direction. The shafts or stems 8 of these discs 4 are appropriately inclined, the obliquity being preferably equal to the angle of the conicity of the discs so that the cone line upon which the contacting bodies 5 operate and which constitute the track for the travel of the sheets is approximately horizontal. By choosing the position of the cone so that this contacting line is not at a right angle to the guide rail for the sheets but is slightly inclined thereto as hereinafter mentioned by reference to Fig. 10, a pressure component is created by which the sheet is urged to the guide rail and is therefore safely held in contact therewith during its travel along said rail.

By displacing the balls 5 upon the corresponding cone faces 4 both this contacting force and the speed of the sheets may here again be regulated at will. To this end the carrier in which the balls 5 are seated is again adjustable together with the guide 3 and also independently thereof relatively to the feed cones 4 and all parts may be appropriately adjusted according to the size of the sheets. The drive for the cone discs 4 may be of any suitable type. As shown each cone stem 8 carries a worm gear 7 meshing with an adjacent worm gear 8 on a common shaft 9. This shaft 9 receives its drive in any desired manner from the main driving gear of the folding machine (Figure 9).

Fig. 10 shows how by preference the balls 5 are placed to operate in contact with the respective cone disc 4 along a line *x,y* which is slightly inclined from the horizontal in order to insure the requisite contact force between sheet and guide rail 3. By lateral displacement of the ball in the direction of the arrow III this force may be varied within fine limits and by varying the distance of the ball from the guide rail 3 radially of the disc 4 in the sense of arrow II it is possible again also to adjust the degree of the feed speed.

In a further constructional form of the invention represented in Figs. 11 to 15 the flat or plate-like discs are replaced by revolving semi-spherical members or ball segments 10. With this arrangement as will be apparent the individual feed elements may as a whole be smaller enabling them

to be more closely associated and each individual element to be made adjustable by itself and therefore individually controllable driving forces to be exerted upon the sheet as may be desirable for instance for the separation of sheets following each other rapidly in dense succession. Moreover due to the individual adjustability of these ball-shaped members 10 it is possible for the balls 5 or the like co-operating therewith to be seated on the guide rail 3 itself in an immovable position because both the contacting pressure and the feed speed are here controlled by the arbitrary adjustment of each member 10 in space within wide limits. The driving arrangement may again be similar to that in the examples above described. As shown most clearly in Figs. 13, 14 and 15 each ball segment 10 is provided with a stem 11 adapted to rotate in a bearing arranged in a bracket 12. Mounted on each stem 11 is a conical gear wheel 13 meshing with an adjacent gear wheel 14 which is carried by a shaft 15 likewise rotating in a bearing provided in the bracket 12. This shaft 15 carries at its other end a gear wheel 16 meshing with a similar gear wheel 17. The latter is secured to a shaft 18 coinciding with the vertical axis of the ball gear unit 5, 10 and carrying a conical gear wheel 19 which in turn meshes with a similar gear wheel 20 mounted on a shaft 21. This shaft 21 carries a gear wheel 22 meshing with a similar gear 23 through an intermediate gear wheel 22*a*. The gear wheel 23 is mounted on the main shaft 24 which coincides with the horizontal axis or centre of the ball segments 10 and about which the whole of this drive is oscillable in a vertical sense in a bearing frame 25. Each bearing bracket 12 which houses the shafts 11 and 15 of each gear unit 10, 5 is rotatable horizontally about the shaft 18. It is so mounted on the bearing frame 25 as to enable it and with it the cooperating gear unit to be turned about this shaft 18 in a horizontal sense and to be adjusted over a graduation 27 on the bearing frame by means of a pointer 26 and secured in the adjusted position. By means of a slot 28 moreover in a frame portion 30 the bearing 25 may be secured in the desired position with the aid of a screw 29. Each ball gear unit 10, 5 may therefore be adjusted both in a horizontal and in a vertical sense without influencing its continued rotation. The horizontal adjustment by means of the pointer 26 influences the degree of pressure between the sheet and the guide rail 3 while the vertical adjustment about the axis 24 with the aid of the screw 29 enables the feed speed of the sheets to be controlled during their travel. In the position shown in Fig. 13 it is a maximum. In the vertical position of the stem 11 it would be equal to zero. Figs. 16 and 17 show diagrammatically in elevation and plan view a position of the vertical displacement of the ball segment 10 wherein the cross feed of the sheet would be influenced by the movement performed by the engagement of the contacting elements within the circle *z*. By reference to the foregoing, it will be understood that the pressure component forcing the sheet to the guide 3 is here varied by turning the axis 15 in a horizontal plane in the direction of arrow II. For varying the speed of the sheets along guide 3, the axis 11 would be adjusted in a vertical plane in the sense of arrow III.

The smooth travel of the sheets over the feed table to the guide may be assisted by the creation on the feed table of an air cushion. As will be observed from Figs. 1, 7 and 11, the table *b* is here composed of boards of a formation which enables air to be blown from below between them, for example, by the association of the gaps between them with compressed air nozzles so shaped and arranged as to force jets of air over the table in the direction of the travel of the sheet or to any part of the table in order to support the sheet and reduce friction outside the sheet propelling train of the mechanism proper.

I claim:

1. Paper sheet feeding mechanism comprising in association with a stationary horizontal sheet feed table a guide rail for directing the sheets thereover and arranged to be adjustable thereto, a series of rotary members parallel with the guide rail and adapted to present to the sheets a train of consecutive substantially horizontal rotating surfaces aligned with the guide rail and operated to urge the sheets along and towards the guide rail, a corresponding series of rolling bodies in individual co-operative contact with corresponding rotating members in front of the guide rail, means for adjusting the rolling bodies relatively to the axes of the rotary members and also independently longitudinally of the guide rail, thereby enabling the points of contact between the rotating members and their co-operating rolling bodies and accordingly both the contact forces of the sheets with the rail and the feed speed of the sheets to be controlled at will.

2. Paper sheet feeding mechanism according to claim 1 in which the train of the consecutive horizontally rotating surfaces is constituted by a series of discs aligned with the guide rail in the plane of feed of the sheets and driven to rotate in a direction to urge the sheets towards the guide rail which extends over the faces of the discs in adjustable relation thereto.

3. Paper sheet feeding mechanism according to claim 1 in which the train of consecutive sheet feeding surfaces is constituted by a series of driven rotating discs shaped and arranged to overlap one another scale fashion so as to form an unbroken substantially horizontal moving support for the sheets along and parallel with the guide rail.

4. Paper sheet feeding mechanism according to claim 1, in which the guide rail is adjustable parallel to itself at right angles to the series of the discs and is provided with a horizontal limb constructed as a carrier to hold the rolling bodies freely in individual contact with the horizontal sheet receiving faces of the discs and adapted to be adjustable relatively to and along the guide rail at will.

5. Paper sheet feed mechanism comprising in association with a horizontal feed table an adjustable guide rail, a carrier containing a series of rolling bodies in front of the guide rail and a corresponding series of rotary members of substantially spherical shape which are driven to constitute a train of ball shaped supports in front of the guide rail in individual contact each with one of the rolling bodies and are adjustable to the feed plane of the sheet by Cardan joint suspension whereby both the adjustment of the contact pressure of the sheets along the guide rail and of the feed speed may be effected solely by adjustment of the axes of rotation of the spherical members.

6. Paper sheet feed mechanism according to claim 5 in which the adjustment of the axes of rotation of the driven spherical members may be effected independently one of the other.

7. Paper sheet feed mechanism according to claim 1 in which the driven rotating sheet feed-

ing surfaces are constituted by a series of truncated cones arranged parallel with the guide rail each in contact with one of the rolling bodies carried by the guide rail and so inclined that their consecutive lines of contact with said bodies and the sheets form a supporting surface rotating in a substantially horizontal plane coincident with the plane of feed of the sheets.

8. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual coperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, and means for varying the position of the engaging faces between the contacting revolving and friction elements relatively to the sheet guide to enable the feed of sheets along said guide to be controlled change speed fashion at will.

9. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, and means for displacing the rotatable friction elements upon the corresponding revolving elements radially of the latter for varying the speed of the sheets and angularly thereto for varying the pressure of the sheets on the sheet guide.

10. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling feed train for the sheets along said guide, and means for causing the sheets to be fed between surfaces of the contacting elements set to travel at different speeds, change speed fashion at will by varying the position of the axes of rotation of the driven revolving elements.

11. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, and means for varying the engaging faces between the contacting elements change speed fashion by varying the position of the axes of the driven revolving elements individually in said series to vary the feed speed of sheets between the contacting elements at will.

12. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements being in the form of flat discs rotatable about vertical axes in a direction to urge the sheets towards the sheet guide to an extent variable by the frictional contact with the corresponding friction elements according to the position of the latter relatively to the periphery of the discs.

13. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train being in the form of a series of shallow conical discs arranged to rotate about axes so inclined that the consecutive lines of contact thereon with the corresponding friction elements form a driven sheet supporting surface coincident with the plane of feed of the sheets.

14. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train being in the form of a series of discs arranged to overlap one another scale fashion so as to form an unbroken substantially horizontal moving support for the sheets along the guide.

15. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train being in the form of a series of ball segments journalled to be adjustable so as to enable the contact pressure and the feed speed of the sheets along the guide to be affected solely by adjustment of the axes of rotation of the ball segments.

16. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train being in the form of a series of ball segments journalled in movable bearings so as to be adjustable by displacement of their axes of rotation in angularly offset planes.

17. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train, being in the form of a series of truncated cones journalled to rotate about axes so inclined to the sheet guide that the lines of contact of consecutive cones with the corresponding friction elements form a driven sheet supporting track coincident with the plane of feed of the sheets.

18. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, said elements being aligned to form between them a substantially linear propelling gear train for the sheets along said guide, said driven revolving elements of the sheet propelling train being in the form of a series of truncated cones journalled in movable bearings enabling the angular position of said cones to be

adjusted by angular displacement of their axes of rotation in the plane of the sheets to regulate the contact pressure of the sheets on the guide, and means for adjusting the corresponding friction elements on said cones independently to vary the feed speed of the sheets.

19. A paper sheet feeding mechanism comprising a sheet guide, a series of driven revolving elements, a series of freely rotatable friction elements in individual cooperative contact with said revolving elements, a feed table for conveying sheets thereto, and air nozzles whereby an air cushion is created on the feed table to reduce friction thereon and to enhance the travel of the sheets thereover in the requisite direction.

RUDOLF KLEMM.