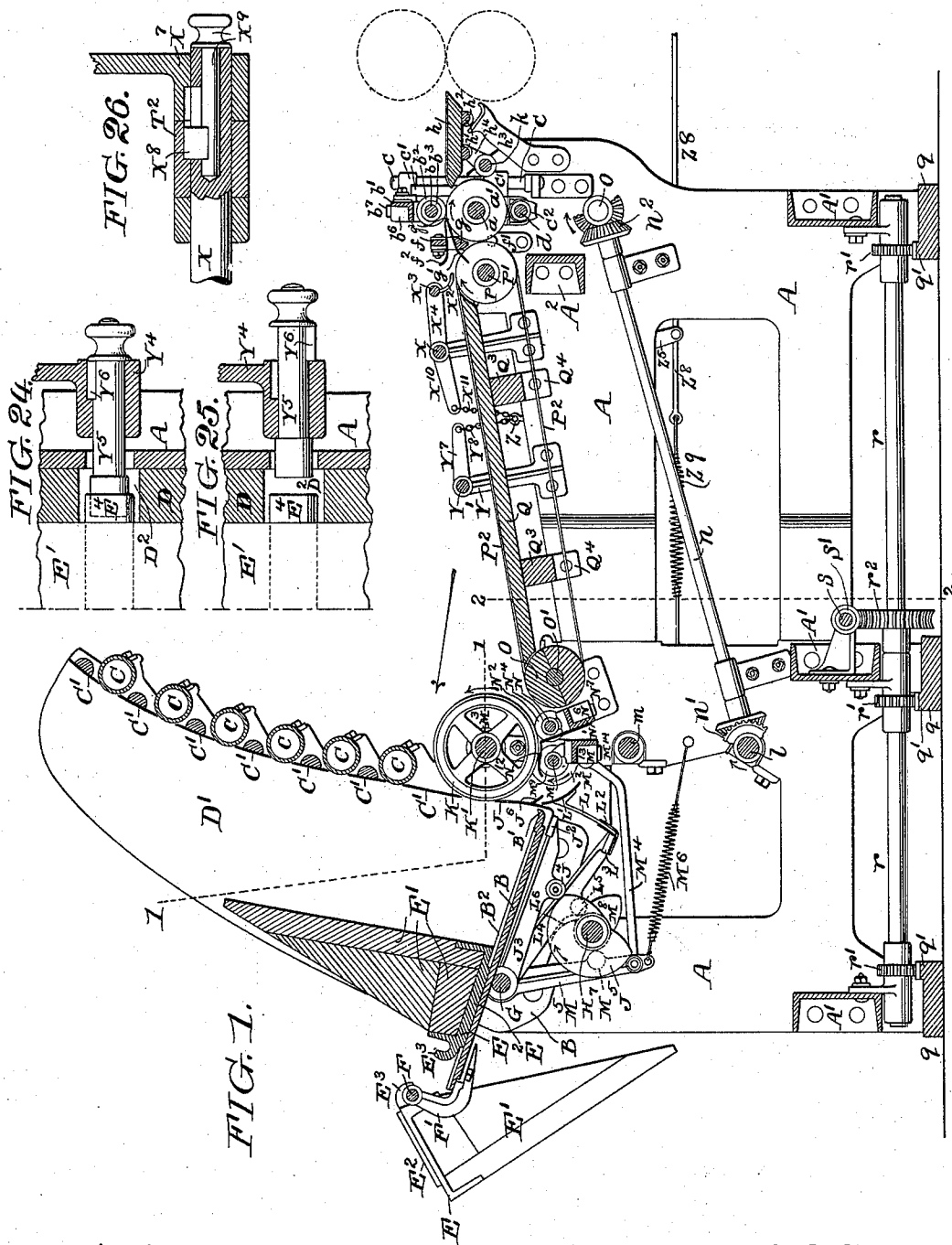


J. H. KNOWLES.
MACHINE FOR FEEDING SHEETS OF PAPER.

No. 535,380.

Patented Mar. 12, 1895.



WITNESSES:
Henry Dwyer
Am. L. Evans

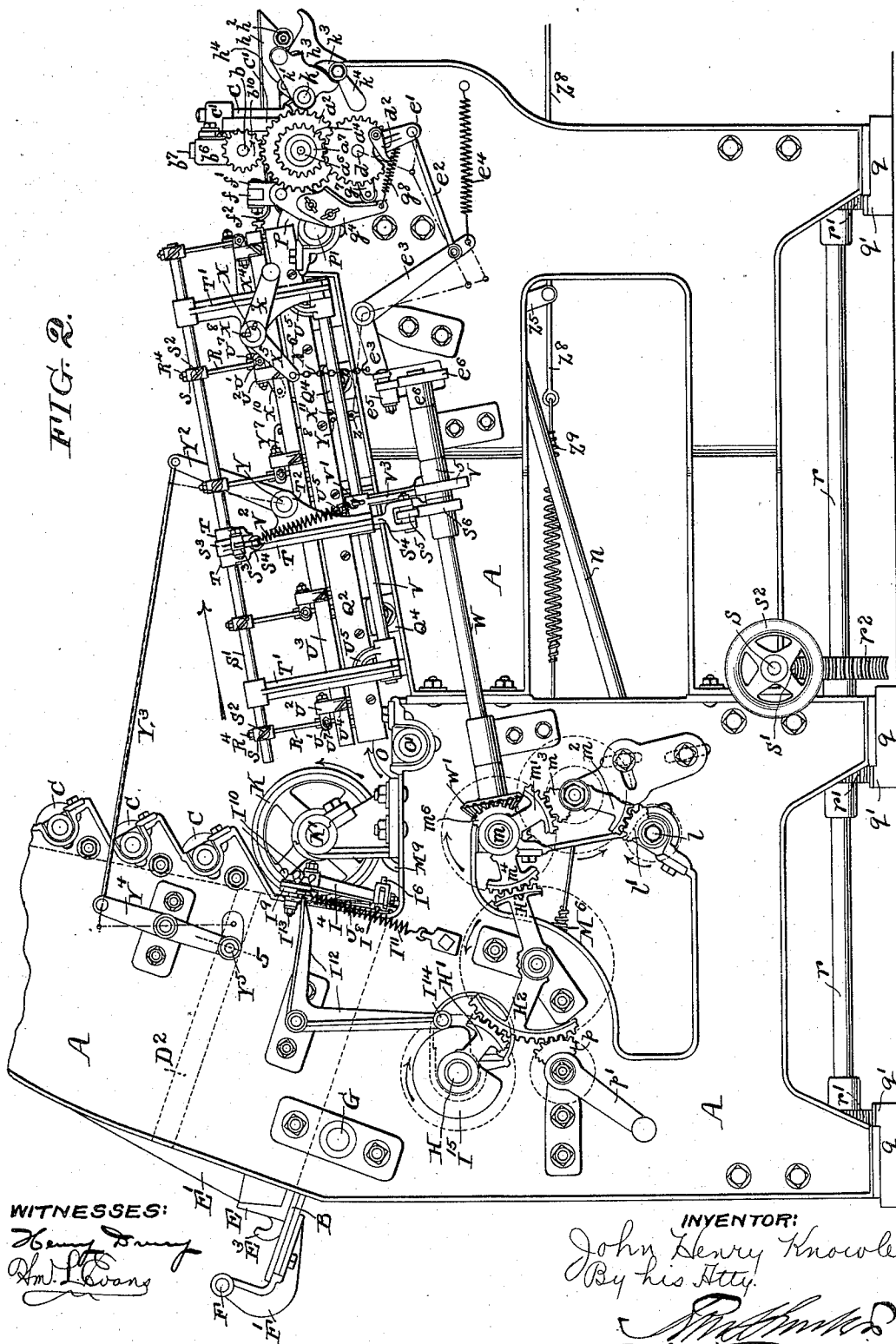
INVENTOR:
John Henry Knowles
By his Atty.
[Signature]

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FIG. 2.



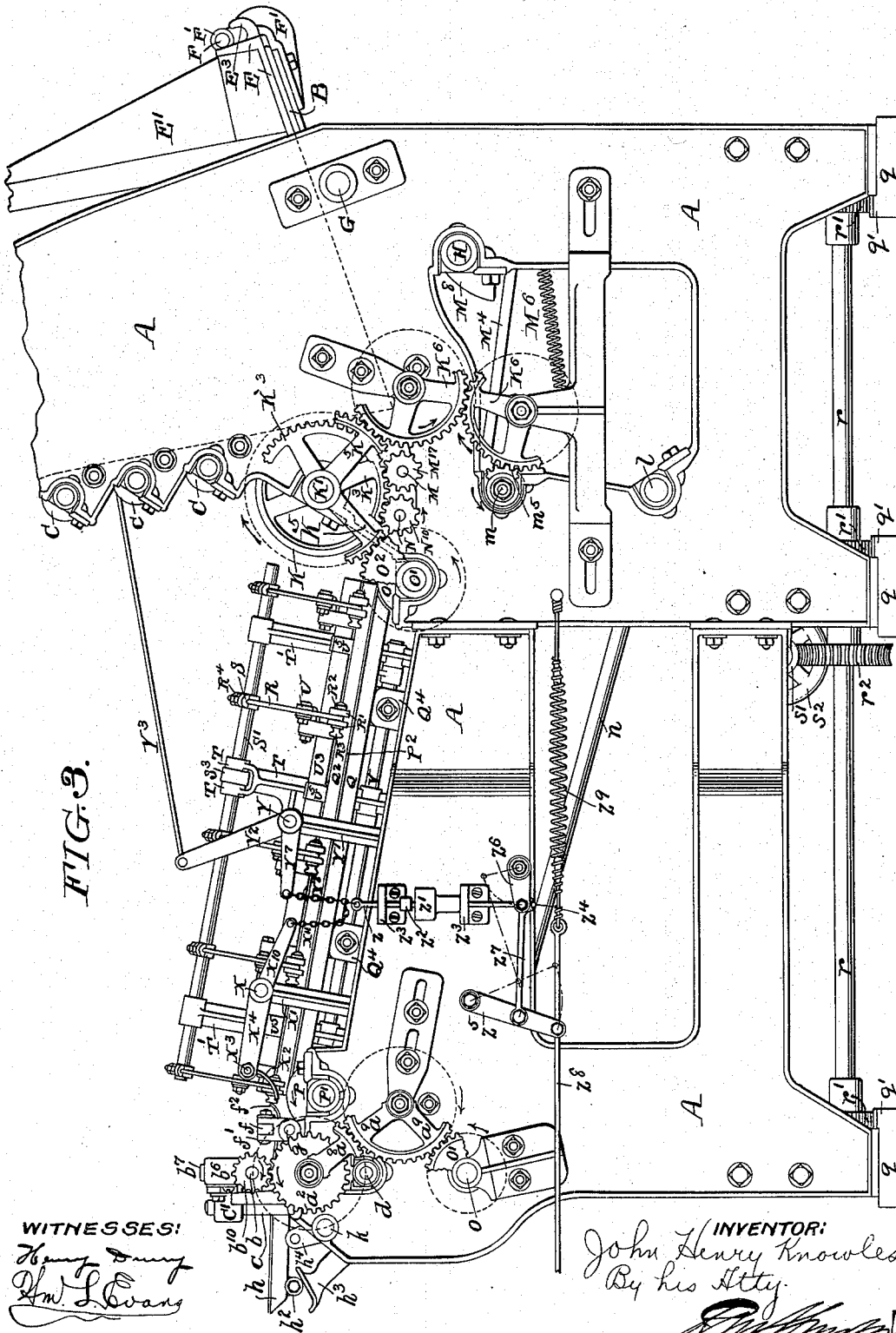
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10 Sheets—Sheet 3.

J. H. KNOWLES.
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(No Model.)

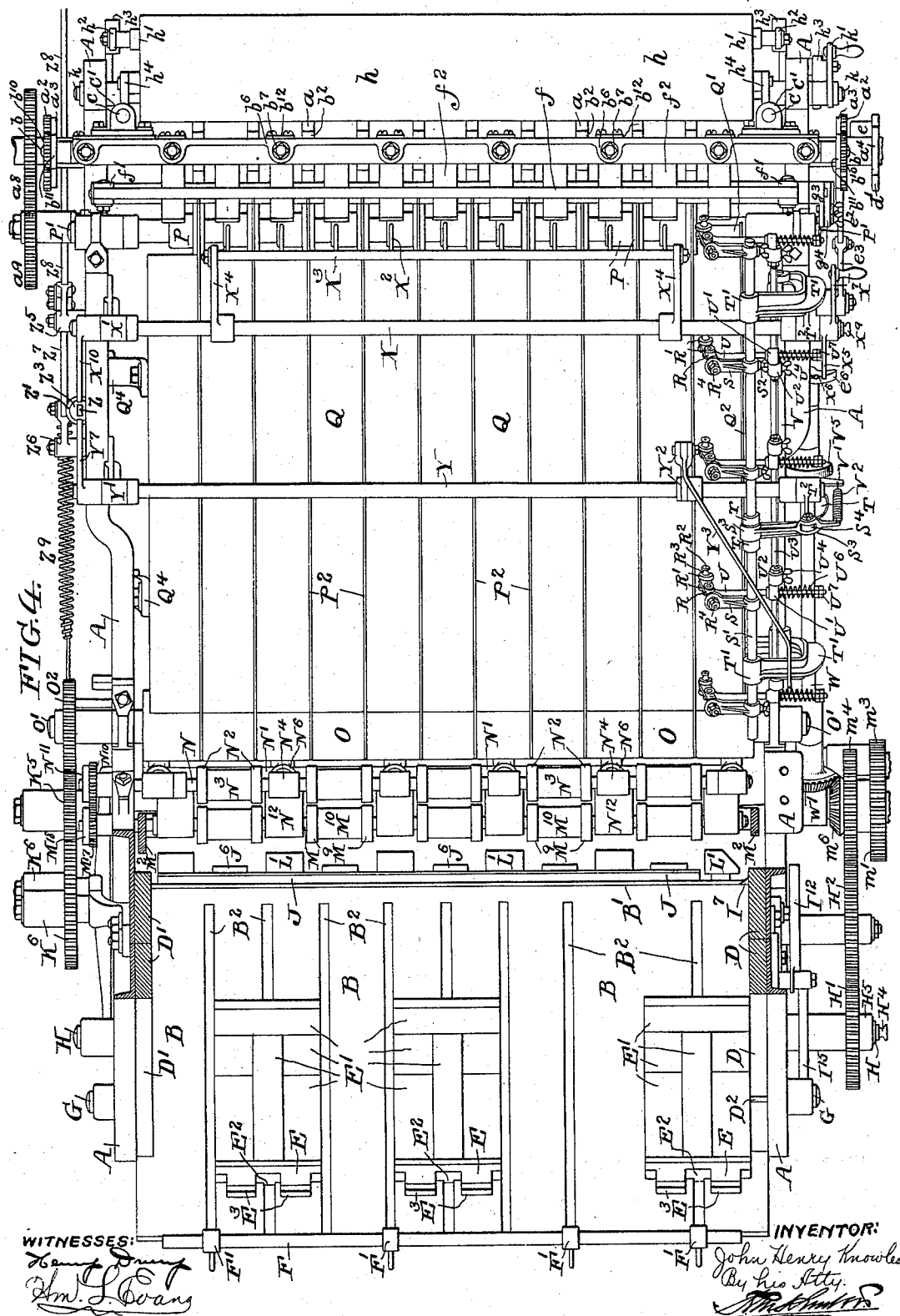
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J. H. KNOWLES.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

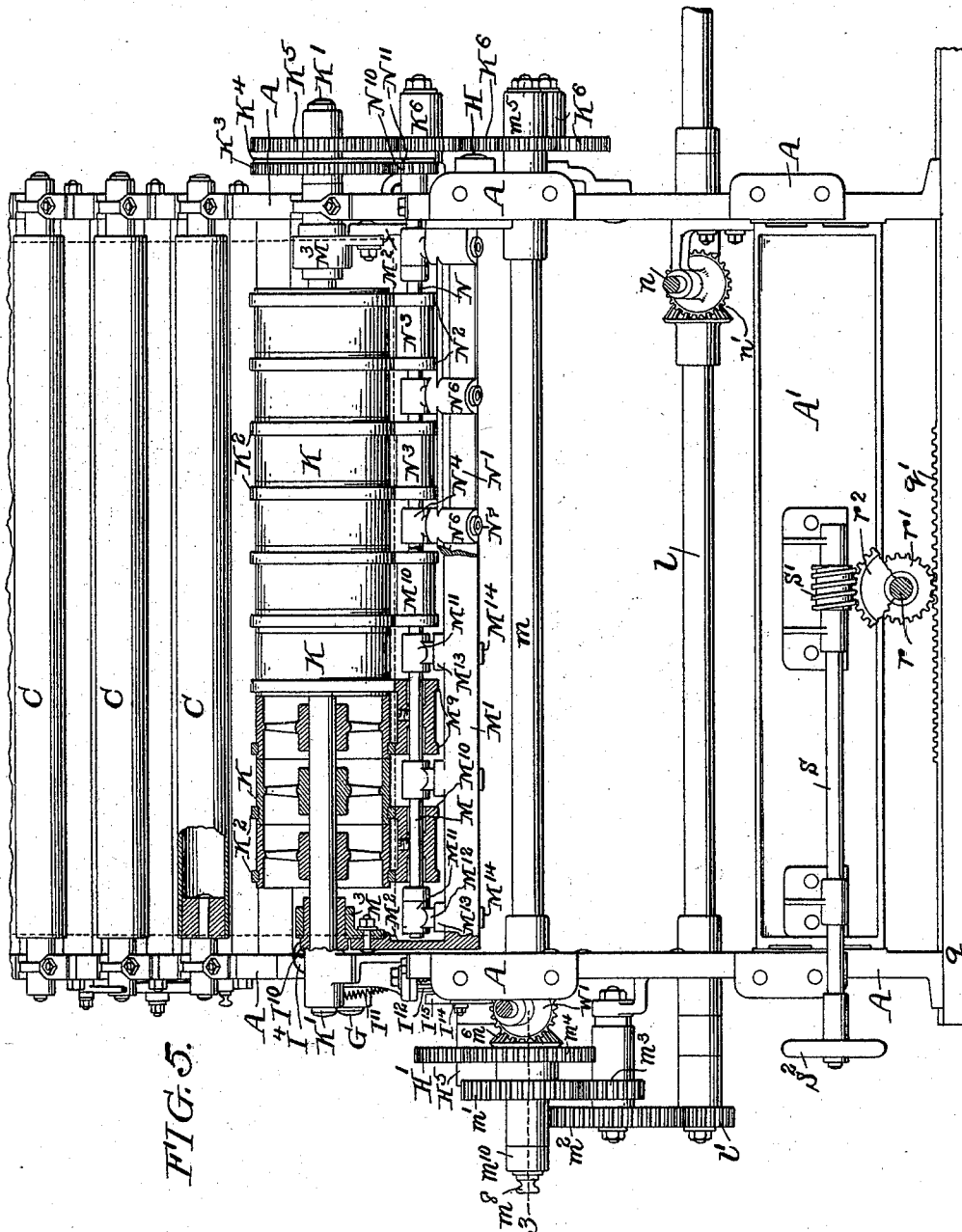
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WITNESSES:

Henry Dwyer
Am. L. Evans

INVENTOR:

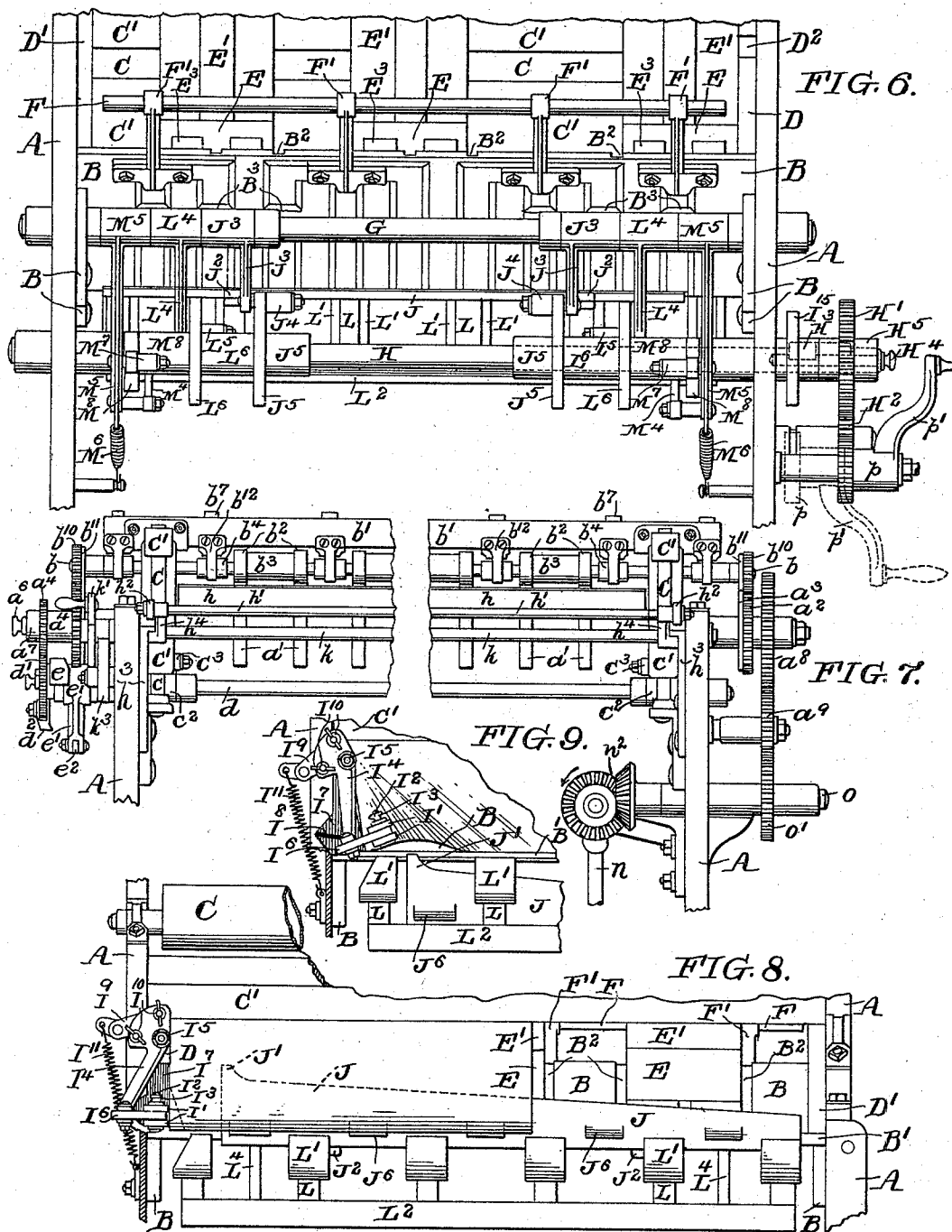
John Henry Knowles
By his Atty.

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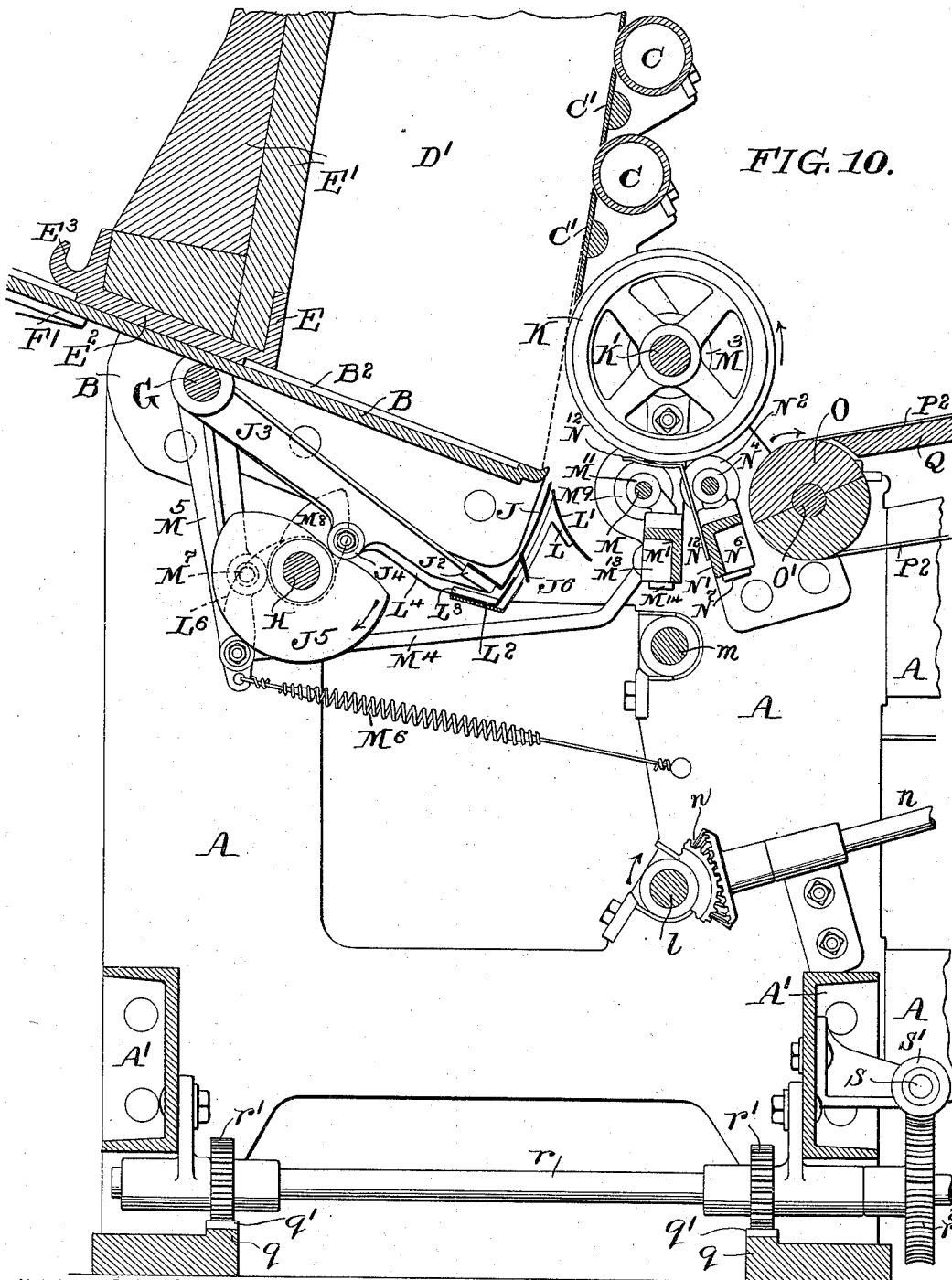
INVENTOR:
John Henry Knowles
By his Atty.
[Signature]

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WITNESSES:
Henry D. ...
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INVENTOR:
John Henry Knowles
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J. H. Knowles

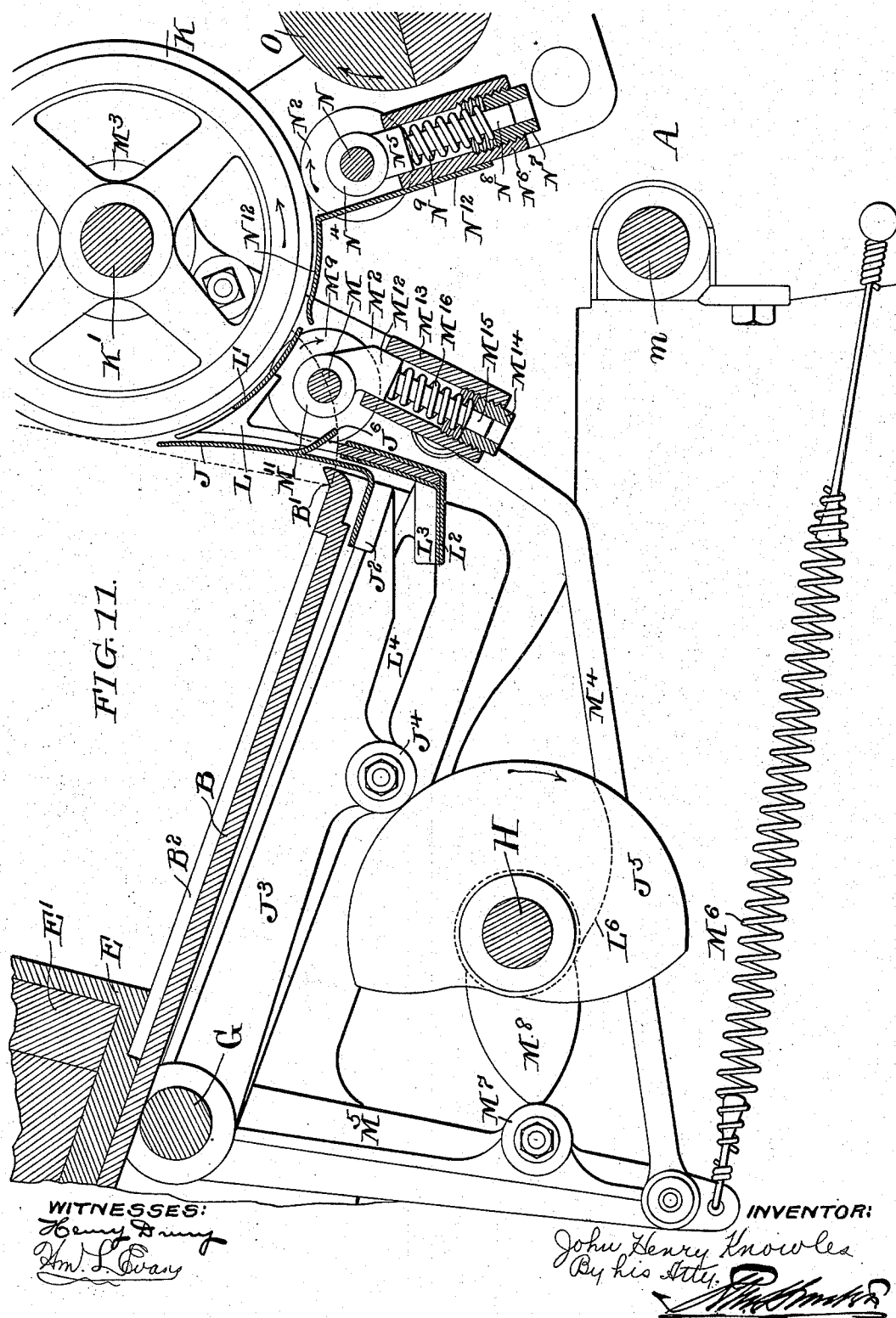
(No Model.)

10 Sheets—Sheet 8.

J. H. KNOWLES.
MACHINE FOR FEEDING SHEETS OF PAPER.

No. 535,380.

Patented Mar. 12, 1895.



(No Model.)

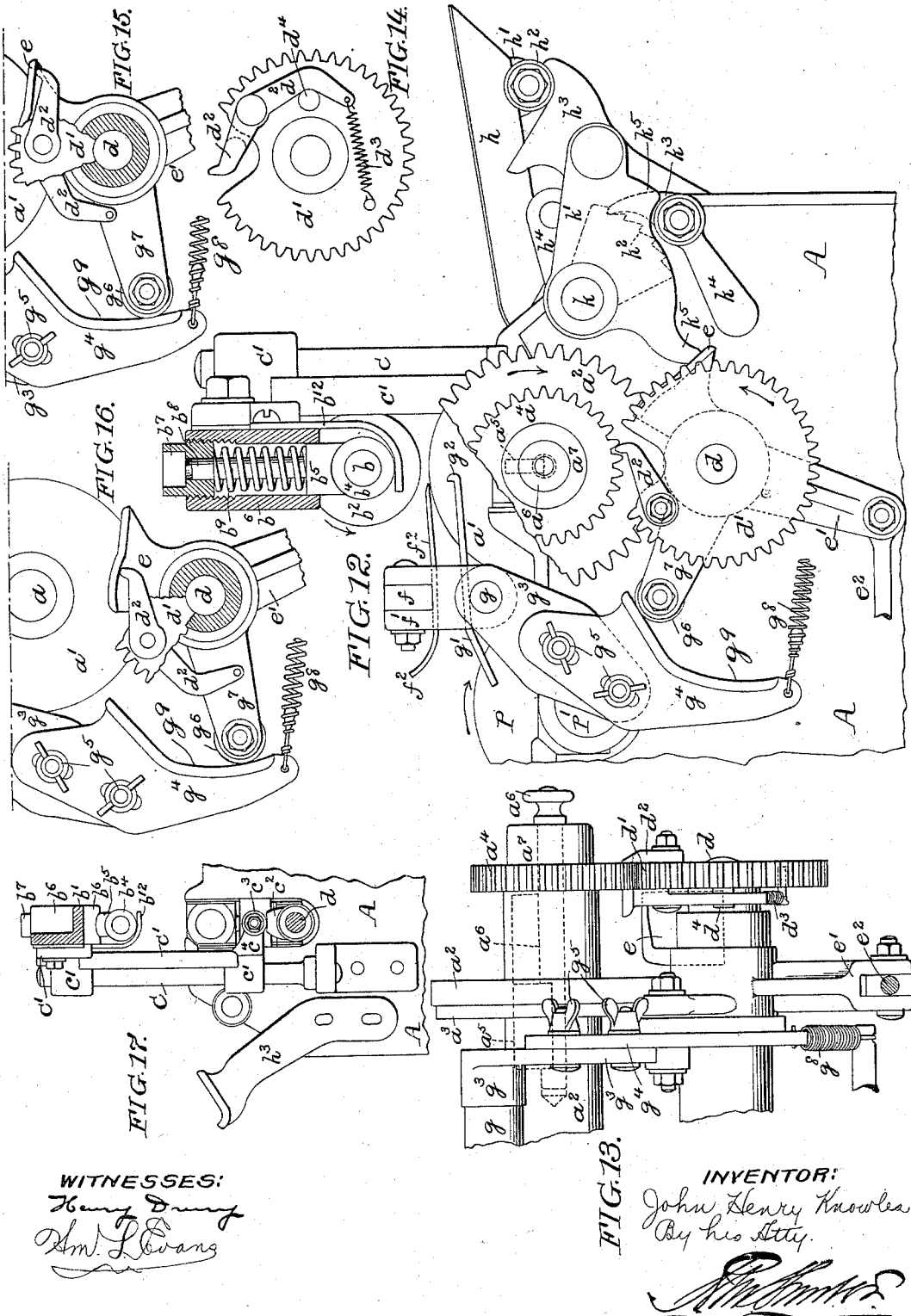
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J. H. KNOWLES.

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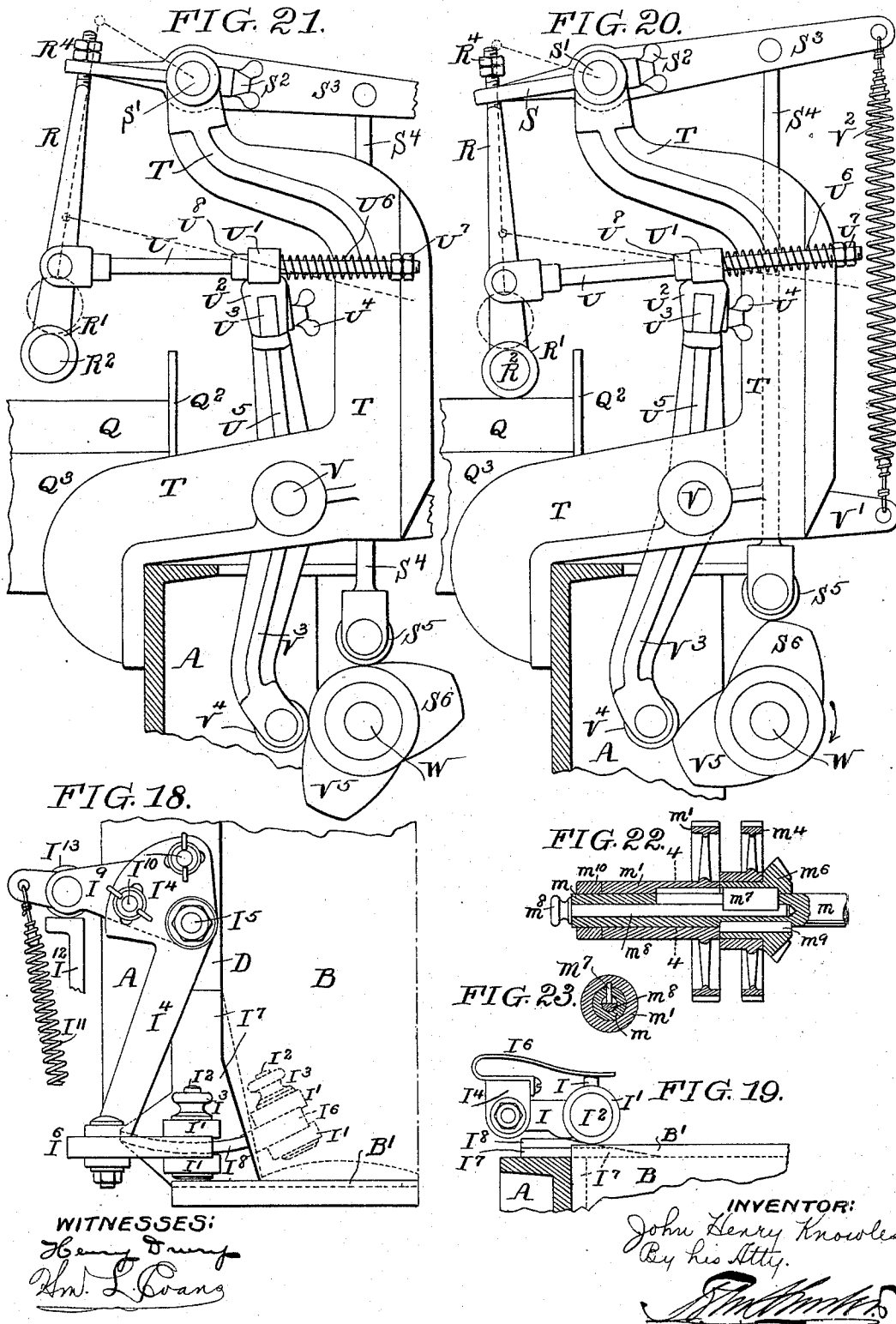
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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No. 535,380.

Patented Mar. 12, 1895.



UNITED STATES PATENT OFFICE.

JOHN HENRY KNOWLES, OF PHILADELPHIA, PENNSYLVANIA.

MACHINE FOR FEEDING SHEETS OF PAPER.

SPECIFICATION forming part of Letters Patent No. 535,380, dated March 12, 1895.

Application filed July 21, 1894. Serial No. 518,198. (No model.)

To all whom it may concern:

Be it known that I, JOHN HENRY KNOWLES, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Mechanism for Feeding Sheets of Paper, &c., of which the following is a specification.

My invention relates to mechanism for removing sheets of paper, &c., separately from a pack or pile and delivering them singly to any machine to which it is desired to supply successive sheets, and consists of certain improvements which are fully set forth in the following specification.

I have shown my invention embodied in an organized machine designed to separate the sheets from the pack or pile and deliver them in an accurately registered condition to the machine to be fed; but the mechanism may, if desired, be embodied in and become a part of the machine which acts upon the separately fed sheets.

While I have shown and described my machine as specially designed for separating and feeding rectangular sheets, it may, with proper modifications, be used for sheets or blanks of diamond or irregular shape.

I have shown my machine as specially designed for feeding sheets of paper to ruling machines but by omitting certain parts of the mechanism, as will be pointed out hereinafter, the machine is equally applicable for feeding other machines, such as printing and lithographic presses, machines for folding, punching, &c.

In the operation of my machine I prefer not to completely withdraw each sheet separately from the pack, but to advance the front edge of each sheet somewhat beyond the following sheet and while the sheets are in this relation to fully withdraw them from the pack and to lay them in the same relative positions upon a conveyer or apron, and to employ additional mechanism for acting upon the advanced edge of each sheet as it is delivered by the conveyer to complete the separation of the sheets from one another.

My invention embraces improvements in the device for holding the sheets in a pack or pile, whereby very long sheets are more securely supported in the holder and whereby

the followers are arranged and supported in an improved manner.

My invention also embraces improvements in the devices for individualizing sheets from the others in the pack or pile and for withdrawing the sheets when so individualized.

My invention also includes a device for registering the sheets while in a partly separated condition upon the conveyer after they have been removed from the pack and before they are completely or finally separated.

My invention includes a stop motion controlled by the sheets which are being fed to arrest the operation of the machine whenever there is any interruption or irregularity in the feeding of the sheets. I provide also a connection between the stop operating mechanism and the holding device whereby the machine will be stopped when the pack of sheets within the holder has reached a certain stage of depletion.

My invention further includes mechanism for accomplishing the final separation of the sheets as they pass from the conveyer, and means for variably operating this mechanism whereby the sheets may be delivered following one another in close succession, or with any desired space between them or with the edges of the sheets overlapped in either direction.

In addition to these improvements my invention includes also many other features of construction and combination of parts, all of which are fully set forth and claimed hereinafter.

I shall now refer to the accompanying drawings for the purpose of more particularly describing my invention.

Figure 1 is a longitudinal vertical section of my improved machine for feeding sheets of paper, &c. Fig. 2 is a side elevation of the machine with the upper portion of the holder broken away. Fig. 3 is a similar view of the opposite side of the machine. Fig. 4 is a plan view of the machine with part in horizontal section below the line 1, 1, of Fig. 1, and with the frictional withdrawing drum removed. Fig. 5 is a front elevation partly in section of that portion of the machine lying in the rear of the line 2, 2 of Fig. 1, and with the roll of the conveying apron removed and the upper por-

tion of the holder broken away. Fig. 6 is a rear elevation with the top of the holder and the lower portion of the machine omitted. Fig. 7 is a front elevation of part of the machine with the lower portion of the machine omitted. Fig. 8 is a front elevation looking in the direction of the arrow in Fig. 1 of a portion of the machine with the withdrawing devices removed to expose the individualizing mechanism. Fig. 9 is a similar view of part of the mechanism shown in Fig. 8 with the parts in a different position. Fig. 10 is a longitudinal vertical section of a portion of the machine on an enlarged scale showing certain parts in a different position from that shown in Fig. 1. Fig. 11 is a similar view on a still more enlarged scale and showing parts in another position. Fig. 12 is a detail side elevation partly in section of the spacing out mechanism. Fig. 13 is a rear elevation of a portion of the same. Fig. 14 is a detail view of the gear d' and attached parts looking in the direction opposite to Fig. 12. Figs. 15 and 16 show details of the spacing out mechanism in different positions. Fig. 17 is a view of the roll lifting device of the spacing out mechanism looking in a direction opposite to Fig. 12. Fig. 18 is an enlarged view of the buckling device looking in the direction of the arrow in Fig. 1. Fig. 19 is a bottom view of a portion of the same. Figs. 20 and 21 are views looking in the direction of the arrow in Fig. 2 and showing the side registering device with parts in different positions. Fig. 22 is a section on the line 3, Fig. 5 of the end of the counter driving shaft. Fig. 23 is a section of the same on the line 4—4 Fig. 22. Figs. 24 and 25 are similar sections each on the line 5 of Fig. 2 showing a detail of the stop-motion with parts in different positions in the two figures; and Fig. 26 is a detail section of an end of the stop-motion rocker shaft.

For the purpose of making the description of the detailed construction of the machine more clear, I shall refer to the different portions separately.

The frame of the machine.—This may be of any convenient form and construction. As shown A are the side frames connected together by suitable girths or braces A' , A^2 . The side frames are further supported by the bottom of the sheet holder, which operates as a girth across the machine, and by the cross brace rods which support the slats on the front of the holder. For convenience of construction I divide each frame side into rear and forward sections bolted together as shown. Upward extensions of the frame sides form the side frames of the sheet holder.

The sheet holding and supporting devices.—These devices are designed to hold a series of sheets on edge, preferably in a position inclined slightly forward, and to permit the sheets to be successively withdrawn from the front of the pack. In the drawings I have shown the preferable construction of these sheet holding devices; but it will be readily

understood that these devices may be modified and varied in construction without in any way affecting the other portions of my invention.

B is the bottom of the holder on which the edges of the sheets rest. This bottom extends entirely across the machine and is bolted to the side frames A.

The front of the holder may consist of any suitable support arranged at the proper inclination to the bottom B, with its lower edge sufficiently distant from the front edge of the bottom piece to permit the sheets to be separated from the pack and removed.

I prefer to construct the front of the holder in the manner shown in the drawings. As shown it consists of alternately arranged idler rollers C and slats C' , with the peripheries of the rollers projecting slightly beyond the faces of the slats so as to act upon the face of the foremost sheet. The rollers may be provided on their ends with journals supported in bearings held by the side frames A. The slats C' may be formed of sheet metal and attached to brace rods extending across the machine between the rollers and secured to the side frames A. The idlers C may be constructed in any suitable manner, but I prefer to construct them of metal tubes covered with felt or other material which will act with more or less friction upon the sheets. The rollers C act merely to assist the withdrawing devices in removing the foremost sheet from the holder by reducing the friction that would exist between the front of the holder and the sheet. The extreme lower edge of the front sheets in the holder is retained in position by a slightly projecting lip B' extending all across the front edge of the bottom of the holder.

In order to diminish the force with which the pack of sheets presses against the front of the holder and thereby lessen the friction of the sheets as they are withdrawn from the pack it is desirable to have the front of the holder as nearly vertical as possible so that the weight of the sheets will rest mainly on the bottom of the holder. I find it practical to construct the front of the holder with so small an inclination as ten degrees from the vertical. With such a front moderately stiff sheets are successfully supported, but if the sheets possess more than a certain degree of flexibility the longer sheets when supported at so small an inclination in a holder having a straight forward incline to its front have a tendency to bulge rearwardly at about the middle of their height. To prevent this I form the upper portion of the front of the holder with a slightly forward curvature whereby the upper parts of the longer sheets bend forward and rest upon the front and are consequently more firmly supported than they would be if resting against a front having a straightforward incline. In this manner very thin and flexible sheets of considerable length may be supported without any tendency to become disarranged.

The side cheeks of the holder may be formed by upward extensions of the side frames A as shown, and I prefer to face the cheeks on the inside with facings D, D', preferably of wood.

To hold the pack of sheets in place with the foremost sheet in contact with the front of the holder I prefer to employ followers resting on the bottom piece B. As shown in the drawings these followers may be constructed of a metal base piece E supporting a wooden frame E'. The base piece E may be provided with a tongue or tongues E² adapted to the grooves B³ in the upper face of the bottom B of the holder acting to guide the followers as they gravitate downward upon the bottom.

Owing to the peculiar mechanism by which the sheets are individualized in this machine, as will be hereinafter described, it is necessary that the sheets should always be placed in the holder with one of their side edges close against one of the sides of the holder. In a machine constructed as I have shown, the pack of sheets should always bear against the side cheek D of the holder. Hence, when sheets having a width less than the entire width of the holder are being fed, a portion of the holder adjacent to the side cheeks D' will be empty. A single follower extending entirely across the holder might be employed, but it would be inconvenient to operate, and, when narrow sheets were being fed, that side of the follower adjacent to the side cheeks D' would be unsupported by sheets, and the weight of such unsupported portion of the follower would press against that corner of the narrow pack of sheets which was nearest to the side cheek D', and thereby cause an undue pressure on that corner. If the pack were less than half the width of the holder the single follower would tilt toward the unsupported side and would render the operation of the follower entirely ineffective. Hence I prefer to employ several narrow followers and to provide means for adjusting them with the varying width of the sheets.

It is desirable for the successful operation of the peculiar individualizing device which I employ in this machine that that corner of the pack adjacent to the side cheek D should be under a constant and uniform pressure. Hence I provide one follower to operate upon that corner of the pack always, and this follower need not be adjustable. It is desirable that a follower should press upon or near to the corner of the pack opposite the side cheek D, but intermediate portions of the width of the pack need not be pressed upon by a follower if such intermediate portion have no considerable width. If very narrow sheets are placed in the holder the single follower adjacent to the side cheek D will be all that is required. With wider sheets a second follower is employed. With still wider sheets three followers may be used and more than three if necessary. The bottom B is provided with a series of grooves B³ and the followers may be shifted from one groove to another so

as to have any position desired and the grooves may be more or less numerous placed upon the bottom. Other means for adjusting the followers might be employed but the method shown is sufficient, in practice, as the followers do not require to be very accurately placed.

When the front of the holder is curved forward on its upper part, as described, followers may be employed of less height than would otherwise be required because the upper part of the pack, which falls over and rests upon the curved part of the holder, need not be pressed upon by followers.

To replenish the pack additional sheets are added from time to time. This is done by drawing back the followers and introducing the sheets between them and the back of the pack. Heretofore, when refilling the holder the followers have been either entirely removed from the holder or held back by hand, with more or less inconvenience to the operator, while the added sheets were being supplied.

I have provided my machine with a novel and convenient means for supporting the followers when not required to press upon the pack, and, when so supported to leave the entire holder free of incumbrance.

F is a rod extending across and somewhat above the rear edge of the bottom of the holder and supported therefrom by brackets F'. The rear ends of the bases E of the followers are provided with projections or hooks E³ adapted to engage the rod F. When a follower is to be removed it is first drawn up the incline of the bottom B of the holder until its further movement is obstructed by contact with the rod F, as shown in Fig. 3. The top of the follower is then turned over rearward and the hook E³ passes over and engages the rod, until the holder hangs downward suspended upon the rod as shown in Fig. 1. By this method of removing the followers from the bottom a follower does not require to be lifted by the operator as the base or heavy part of the follower is at all times resting upon the bottom B or upon the rod F. The follower is replaced in operative position by movements the reverse of those described for removing it. Each follower may be provided with two hooks E³, one to pass on each side of a bracket F' when the follower happens to come in line with such bracket.

When a follower is out of use because of narrow sheets in the holder or for other cause it may, while out of use, be allowed to hang on the rod F.

The sheet individualizing mechanism.—This mechanism consists of devices for individualizing the foremost sheet from others in the pack preparatory to the operation of the withdrawing mechanism. For the purpose of individualizing the sheets I employ a reciprocating frictional finger, by which a buckle or pucker is formed in the forward end of the sheet adjacent to one corner thereof and a

reciprocating individualizing blade, which passes first under the buckled or puckered corner of the sheet and thence along the entire edge of the sheet completely separating that edge from the other sheets in the pack. In describing this apparatus I shall refer more particularly to Figs. 1, 2, 4, 6, 8, 9, 10, 11, 18 and 19.

I is the reciprocating frictional buckling finger. That end of the finger that acts upon the sheets in the pack is provided with a proper frictional pad to act on the surface of the sheet to be buckled or puckered. As shown in the drawings, such pad may be provided by the peripheries of disks of rubber or other frictional material. There may be two such disks, I^1 , I^2 , one on each side of the finger I, secured to the finger by a bolt or pin I^3 which may be provided with a thumb nut I^4 . When in operation, the disks are clamped firmly against the finger by the bolt so that they cannot turn. Upon the reciprocation of the finger the fixed frictional disks rest upon the sheet and, by their frictional contact therewith, cause the corner of the outermost sheet in the pack to slide upon the sub-adjacent sheet and form a buckle or pucker in the edge of the sheet operated upon adjacent to the corner. The use of two frictional disks as shown gives a very secure and effective hold upon the sheet. By loosening the thumb nut I^4 the disks, or either of them, may be turned so as to present a fresh surface to the sheet and by removing the bolt I^3 the disk may be removed and replaced by others.

The means for mounting and reciprocating the frictional finger may be varied, but it is necessary, in order to produce the desired effect, that the path of the finger should lead diagonally from the corner inward on the sheet. A convenient method of producing this movement is that shown in the drawings where I^4 is an oscillating arm mounted on a stud I^5 which is secured to the inside of the side frame A. The finger I is pivoted to the lower end of the arm I^4 in such manner as to be unyielding in the plane of oscillation of the arm but capable of a free movement in a direction at right angles to such plane. By oscillating the arm I^4 the rubbing pads I^1 are caused to reciprocate in a curved path concentric with the stud I^5 , and, as the stud I^5 is placed near the side edge of the sheets and at a proper distance from the forward ends thereof, it will be readily perceived that such curved path is substantially diagonally inward from the corner of the sheet, and that, by an inward movement of the rubbing pads, the outermost sheet of the pack will be caused to turn or bend from a point along the side of the sheet approximately opposite the stud I^5 thereby producing a buckle or pucker in the lower edge of the sheet, as clearly shown in Fig. 9, and by dotted lines in Fig. 18.

It is essential that the friction pads I^1 should bear upon the sheets with a uniform pressure which should, however, be yielding in order

that the pads may accommodate themselves to any irregularities in the surfaces of the sheets. I therefore employ a spring I^6 which is rigidly attached at one end to the arm I^4 with its free end resting upon a projection from the finger I. The spring thus presses the padded end of the finger constantly toward the pack of sheets.

I^7 is a triangular corner guard secured by a rearward extension to the inside of the side frame A. The face of this guard covers a triangular portion of the corner of the pack of sheets and serves to hold that corner of the pack in proper position for the action of the buckling finger and also serves, by the friction created between the guard and the pack by the pressure of the pack against the guard, to insure the separation of but a single sheet from the pack by the action of the buckling finger, in accordance with a well known principle of such buckling devices. The separation of but a single sheet from the pack by the buckling device is further secured by the action of the edge lip B' . As clearly shown in Fig. 11, this lip offers a slight obstruction to the outward bending of the edge of the outermost sheet of the pack. In Fig. 11 the dotted curved line shows the curve followed by the sheet as it is bent outward from the pack. As the buckling finger makes its inward movement and turns the corner of the sheet, as previously explained, that portion of the forward edge of the sheet which lies opposite and adjacent to the buckling pads is removed by such turning action away from contact with the lip B' so that such portion of the edge of the sheet is not obstructed by the lip; but, at a point more or less distant from the buckling pads where the turning effect becomes less on the edge of the sheet, the retarding action of the lip B' operates to reduce the length of the buckle. If the sheets be thin and flexible the point where such retarding action of the lip B' will entirely overcome the turning action produced by the buckling pads will be very near such pads and a short buckle will be produced, but if the sheets be stiff the retarding action of the lip will be overcome to a greater distance by the turning action and a comparatively long buckle will be produced. Thus the action of the lip B' is to cause the buckles to assume a length corresponding approximately to the stiffness of the paper being operated upon, and this is in accord with a well known principle of such buckling devices; that the separation of but a single sheet from the pack is made more certain by producing as short a buckle as possible; thin and flexible sheets requiring shorter buckles than stiff sheets.

I^8 is a cam fixed on the outer face of the corner guard I^7 adapted to engage the finger I or a projection therefrom when the finger is withdrawn from the sheets, and thereby cause the finger and its frictional pad to lift away from the face of the pack. The cam is curved to correspond to the curved path of

the finger and is of such a shape as to cause the frictional pads to be lifted before they quite arrive at the edge of the guard. The cam should be of such height that the pads will be, at all times, lifted clear of the guard while moving over the same. Upon the inward movement of the finger I the frictional pads are carried slightly forward over the edge of the guard I⁷ and are then allowed to impinge against the sheet by the falling slope of the cam. The friction finger is kept pressed against the cam by the action of the spring I⁶.

In order to communicate an oscillating motion to the arm I⁴ I form it into a bell crank shape by a lateral extension or side arm I⁹, which, for purposes of adjustment I make in a separate piece from the arm I⁴ and secure it thereto by bolts having thumb nuts I¹⁰. By these means the arm I⁴ and lateral extension I⁹ may be clamped together in any position within the limit of adjustment provided for. The side arm I⁹ may be provided with a boss passing over the stud I⁵ so that both the arm I⁴ and the side arm I⁹ may oscillate on the stud, and thereby permit the relative positions of the two parts to be more accurately maintained in any adjusted position. The arm I⁹ is caused to oscillate intermittently and thereby through the connecting parts described to oscillate the arm I⁴ intermittently but always with the same amplitude of oscillation. By adjusting the relative position of the arm I⁴ and side arm I⁹ the path followed by the buckling pads may be caused to overlie the corner of the sheets beyond the guard I⁷ to a greater or less extent so as to give to the corner of the sheet a greater or less extent of pushing as may be found necessary in operating on sheets of different qualities or under different conditions. The cam I³ is extended outward to furnish support for the buckling finger when the arm I⁴ is adjusted so that the path of the finger is mostly outward from the sheets. If desired the same operative adjustment may be produced by providing means to vary the amplitude of oscillation of the arm I⁴ whereby as the amplitude of oscillation is varied the path followed by the buckling pads may be made longer or shorter and thereby cause the pads to move more or less beyond the guard I⁷, but the method of adjustment I have described is simple and effective.

Various methods may be employed to oscillate the side arm I⁹ and attached arm I⁴, but I prefer to employ that shown in the drawings where I¹¹ is a coil spring attached to the end of the side arm I⁹ and to the side frame A and tends normally to pull the side arm downward and to project the buckling pads over the sheets. The side arm I⁹ is moved upward and the buckling pads retracted by the action of the horizontal arm of a bell crank lever I¹² which acts on the side arm I⁹ through the medium of a friction roller I¹³ pivoted at or near the outer end of the side arm. The lever I¹² is pivoted on a stud suitably mounted

on the side frame A. The perpendicular arm of the lever I¹² is operated by a cam I¹⁵ mounted on and turning with the shaft H and of such shape as to give to the buckling pads the proper amplitude of movement and to cause the movements to be made at the proper times. The shaft H which carries the cam I¹⁵ is journaled in suitable bearings in the side frame A and is located below the sheet holder. The lever I¹² may be provided with a roller I¹⁴ to make contact with the cam I¹⁵.

J is the individualizing blade which preferably extends across the machine as shown in the drawings. The blade J may however extend only part way across the machine. The blade J is placed with its side parallel or nearly so with the face plane of the pack of sheets and has its line of action in or nearly in the same plane. The blade J is so located that it occupies a normal position with its edge below the front edge of the holder. The edge of the blade J is inclined relatively to the forward edges of the sheets forming the pack with the higher portion at the end adjacent to the buckling finger and the extreme end of the blade next to the buckling finger may be turned abruptly upward forming a pointed projection J' as clearly shown in Figs. 8 and 9. This projection J' is arranged exactly opposite the buckle or pucker formed in the sheet by the buckling finger. The plane of action of the individualizing blade is as near to the front surface plane of the pack of sheets as may conveniently be and closer to the pack than the outer surface of the buckle. When the blade J rises the projection J' first passes under the buckled or puckered portion of the sheet. As the blade continues to rise the inclined edge passes gradually under the entire edge of the sheet, and crowds the edge outward over the lip B', thus separating the edge of the outermost sheet positively from others in the pack. As soon as the projection J' has passed under the buckled sheet the buckler finger is retracted and withdraws the buckling pads sidewise into a position entirely outside of the plane of the side edges of the pack of sheets on that side and there remains at rest until the proper time to buckle the next sheet. In Fig. 8 a sheet is shown with the individualizing blade under the sheet and with the buckling device retracted.

Various means may be employed for reciprocating the blade J, but I prefer the method shown in the drawings. I construct the blade J of sheet metal and bend the lower part of the blade rearward approximately at right angles to the plane of action of the blade. The rearwardly bent part of the blade I attach to ear pieces J² carried on the ends of two or more rocker levers J³. The rocker levers J³ are supported by the rocker shaft G, journaled in suitable bearings in the side frames A and located below the sheet holder. The shaft G is placed very close against the

under side of the bottom of the sheet holder and where the bosses of the rocker arms encircle the shaft the ridges on the under side of the bottom are cut away to admit the bosses as shown at B³ in Fig. 6. Upward motion is given to the lever J³ and from thence to the blade J through the medium of frictional rollers J⁴ pivoted to the levers J³ by suitable cams J⁵ mounted on and turning with the shaft H. The lever J³ and blade J move downward by gravity.

The withdrawing devices.—These devices consist of a withdrawing roller or drum for withdrawing the sheets from the pack, means for operating upon the edge of the sheet previously individualized to bend it about the drum, and rollers for pressing the bent edge of the sheet against the drum. In describing these devices I shall refer more particularly to Figs. 1, 4, 5, 10 and 11.

K is the withdrawing drum mounted on a shaft K' which may be supported in bearings carried by the side frame A. This drum may be variously constructed as, for instance, with a continuous surface covered with proper frictional material for taking a fractional hold of the sheets; but I prefer to construct the drum of a series of short sections each mounted individually on the shaft K' and each surrounded externally with one or more rubber rings K² to act upon the sheet at intervals only. This construction is plainly shown in the sectional part of Fig. 5.

The drum K is placed opposite the front of the holder at a proper distance from the bottom of the same. The surface of the drum is placed near but does not press upon the front face of the pack, and has a constant rotation in the direction indicated by the arrow.

J⁶ are a series of lips standing forward from the surface of the individualizing blade J. In practice I form these lips by bending outward a portion of the substance of the blade J, as shown in the drawings. The lips are so located on the blade that they will be behind the individualized edge of the sheet when the blade is in its raised position and will bend the edge forward from the pack. Figs. 1 and 8 show the lips in this position.

L, L, are a series of fingers each provided on its upper end with a curved piece L', preferably of sheet metal. These fingers are adapted to reciprocate in a plane parallel to but slightly in front of the plane of action of the individualizing blade J. The pieces L' have an arc of curvature of slightly greater diameter than that of the outer surface of the drum K. In their normal positions the upper points of the fingers L are below the front edge of the holder and nearly touch the front surface of the blade J. When the fingers L are fully raised the top surfaces of the curved pieces L' conform closely to the surface of the drum K but without touching it, thus forming a continuous space of uniform width between the drum K and the whole

extent of the upper surface of the curved pieces L. After the blade J has completed its upward movement and the lips J⁶ have bent the lower edge of the sheet slightly forward the fingers L rise and their points pass behind the edge bent forward by the lips J⁶. As the fingers L continue to rise the edge of the sheet is engaged by the curved piece L' and still further bent forward until, on the completion of the rise of the fingers the edge of the sheet is bent about the surface of the drum K.

I prefer to place one finger L between each pair of lips J⁶ and also to place a finger between each exterior lip J⁶ and the adjacent side frame A. This arrangement is clearly shown in Figs. 4 and 8. The spaces between adjacent lips J⁶, or between adjacent fingers L are so narrow that the natural stiffness of the sheets is sufficient to prevent any material sagging of the edges of the sheets in such spaces. The spacing of the parts, as described, is necessary in order to prevent interference of parts during their respective movements. If desired, the curved pieces L' may be beveled away on one or both sides, and I prefer to do this on that piece which comes next to the buckling finger as shown in Fig. 8 to insure the more certain entrance of that particular curved piece behind the sheet.

I prefer to mount and operate the fingers L in a manner similar to the mounting and operation of the blade J. The lower ends of the fingers L are socketed and secured between horizontal strips of sheet metal L². These sheet metal strips are bent rearward on their lower edges approximately at a right-angle to the plane of action of the fingers L. The rearwardly bent parts of the sheet metal strips L² are attached to ear pieces L³ carried on the ends of two or more rocking levers L⁴. The rocking levers L⁴ are supported by the shaft G. Upward motion is given to the levers L⁴ and from thence to the fingers L, by suitable cams L⁵ mounted on and turning with the shaft H. The levers L⁴ may be provided with rollers L⁵ making contact with the cams L⁵. The levers L⁴ and fingers L move downward by gravity. If preferred other methods of operating the fingers L may be employed.

After the edge of the sheet is bent about the drum K a frictional roller, so mounted as to press against the drum K, moves over the bent edge of the sheet and, by pressing the bent edge against the drum, causes the sheet to be withdrawn from the holder.

M is the shaft of the roller mounted in any suitable bearings upon a swinging frame, but preferably mounted in bearings of peculiar construction which are hereinafter described. The frictional pressure roller carried by the shaft M is constructed of separate disks or spools adapted to the spaces between the fingers L and may be of any ordinary construc-

tion but I prefer to construct and mount them in a peculiar manner as hereinafter described.

M' is the cross bar of the swinging frame 5 which supports the shaft M.

M² are arms extending upward from either end of the cross bar M'. The upper ends of these arms each terminate in a boss M³ adapted to embrace an inwardly extending hub of the 10 bearings of the shaft K' of the drum K. When thus mounted the bar M' and the shaft M with its roller may be oscillated over a section of the periphery of the drum K. For convenience of construction I prefer to form 15 the bosses M³ separately from the arm M² and to bolt them thereto as shown. The arms M² are placed in line with the facings D, D', of the sides of the holder and do not interfere with the passing of the sheets. The position 20 occupied by sheets as related to the arms M² is shown by a dotted line in Fig. 5.

The oscillation of the bar M' and attached frictional roller may be accomplished in any good mechanical manner, for instance, by 25 means of one or more cam actuated levers M⁵, of which I prefer to use two, attached one to each end of the cross bar M'.

M⁴ are rods or connections each pivoted at one end to the bar M' and at the other end to 30 the lower end of a rocking lever M⁵. The levers M⁵ are supported by the shaft G and are operated by cams M⁸ on the cam shaft H. The levers M⁵, the frictional roller and intermediate connections are held normally in a 35 forward position by springs M⁶ between the levers M⁵ and the frame A. The levers M⁵ may be provided with rollers M⁷ making contact with the cams M⁸.

While the blade J and fingers L are operating, the bar M' and attached frictional roller 40 are in their normal position out of the line of action of those parts but, after the edge of the sheet has been bent against the drum K as described, the bar M' and its frictional roller 45 move forward and the disks of the frictional roller pass into the spaces between the fingers L and over the bent edge of the sheet and bind the sheet against the drum, so that the frictional surface of the drum causes the 50 sheet to move forward out of the holder. While the frictional roller is in this position the blade J and fingers L are each in the uppermost positions, as is clearly shown in Fig. 11. After the sheet has commenced to move 55 forward from the holder the frictional roller resumes its normal position, and the blade J and fingers L drop to their lowermost positions ready to operate upon another sheet.

M⁹ are the frictional disks of the oscillating 60 frictional pressure roller which are preferably constructed of rubber or other proper frictional material and arranged opposite the rings K² of the drum K. These disks are preferably mounted on spools M¹⁰, one pair 65 of disks on each spool, and each spool with its two disks is adapted to pass into each space between adjacent fingers L. The spools M¹⁰

are hollowed out on each end leaving a thin central portion which is mounted on the shaft M and secured thereto by a set screw or other 70 means. The shaft M is of small diameter and is provided with a series of bearings M¹¹ one being at either end of the shaft and one between each pair of spools M¹⁰. All the bearings M¹¹ and controlling parts are alike 75 each to the other. The bearings M¹¹ are provided with shoulders M¹² which fit into the upper ends of sockets M¹³ formed in the bar M'. In the lower ends of the sockets M¹³ are 80 screwed key plugs M¹⁴. Stems M¹⁵ extend from the shoulders M¹² passing through the sockets M¹³ into the key plugs M¹⁴. The bearings M¹¹, shoulders M¹² and stems M¹⁵ are preferably made in one piece and, when mounted 85 as described, are free to move vertically in the sockets M¹³ but are held firmly against any lateral displacement. About the stems M¹⁵ are placed coil springs M¹⁶ bearing against 90 the shoulders M¹² and key plugs M¹⁴, so as to project the bearings M¹¹ outward from the bar M' and, through the medium of the shaft M, cause the disks M⁹ to exert a constant pressure against the drum K. By turning 95 the key plug M¹⁴ the tension of the spring M¹⁶, and consequently the pressure of the disks M⁹ upon the drum K, may be varied. These constructions are most clearly shown in Figs. 5 and 11, and by them I am able, to a certain extent, to cause the disks M⁹ to exert an individual pressure against the drum K, and 100 to maintain the pressure exerted by the disks upon the drum the same in intensity each as the other notwithstanding the irregularities which may occur in the thickness of the sheets. The uniform distribution of pressure 105 by the disks M⁹ is produced by the combined operation of three peculiarities of construction: by a slight rocking of the spools M¹⁰ about their thin central mounting on the shaft M, by the flexibility of the thin shaft M and 110 by the spring pressed bearings at frequent intervals along the length of the shaft.

In the operation of the mechanism described it is not necessary to completely withdraw one sheet from the pack or pile before 115 another sheet is started therefrom, but, as soon as the forward edge of a sheet is sufficiently advanced by being partly withdrawn from the pack to allow the oscillating frictional pressure roller to make its return movement without passing off the edge of the 120 sheet, all the parts return to their normal positions, and the buckling finger passes between the pack and the outwardly bent sheet as it is being withdrawn and buckles another 125 sheet. The edge of such sheet is bent upward by another operation of the edge bending devices described against the sheet previously operated upon, the oscillating frictional pressure roller advances, and the withdrawal of a 130 second sheet is commenced before the sheet previously started has been completely withdrawn. The peculiar construction and operation of the devices are such as permit this

action without interference between any of the parts in their respective movements. The extent to which one sheet will be withdrawn before the succeeding sheet is started depends upon the peripheral speed of the drum K as related to the frequency of action of the individualizing mechanism. In general I prefer to rotate the drum K as slowly as possible so as to move the sheets from the pack with the least amount of sliding action between adjacent sheets. When long sheets are being fed, as many as six sheets may be in process of withdrawal from the pack at one time.

To secure certainty of action between the oscillating frictional pressure roller and the drum K I prefer to drive the oscillating frictional pressure roller positively and not depend, for the driving of that roller, upon the contact of the roller with the drum K as such driving contact becomes very uncertain when several thicknesses of paper lie between the roller and the drum, and would result in irregularity in the withdrawal of the sheets. Hence I extend one end of the roller shaft M and place thereon a gear M¹⁷ driven from a gear K³ on the shaft K' of the drum K. As the oscillating friction pressure roller oscillates about the drum the gear M¹⁷ oscillates similarly about the gear K³ and thus the oscillating frictional pressure roller is, at all times, whether in process of oscillation or at rest, driven with the proper speed relatively to the drum K. If preferred the oscillating frictional pressure roller may be gear driven from both ends. Shoulders M¹⁸ and K⁴ on the gears M¹⁷ and K³, respectively, of the same diameter as the pitch circles of the gears, by rolling contact prevent the gears from being forced into too close engagement by the spring pressed bearings of the shaft M.

The action between the oscillating frictional pressure roller and the drum K is constant and sufficient to complete the withdrawal of the sheets from the pack, but I prefer to assist the roller by a second frictional pressure roller which may be constructed, mounted and driven the same as the oscillating frictional pressure roller except that it is not necessary to oscillate it. I will here only mention the several parts of this assistant roller and reference may be made for further details to the previous description of similar parts of the oscillating frictional pressure roller.

N is the shaft of the assistant frictional pressure roller.

N' is the cross bar which supports the bearings of the shaft N. This bar extends entirely across the machine and is secured at either end by flanges to the side frames A. N² are the frictional disks of this roller mounted on spools N³.

N⁴ are the bearings of the shaft N having shoulders N⁵ fitting into sockets N⁶ in the bar N'.

N⁷ are the key plugs screwed in the bottom of sockets N⁶ and N⁸ the stems of the bearings projecting into the key plugs.

N⁹ are the coil springs about the stems N⁸.

N¹⁰ is the gear on end of shaft N driven by gear K⁴ on shaft K and N¹¹ is the shoulder on the gear N¹⁰.

When the oscillating frictional pressure roller is in the position shown in Fig. 11 the forward edge of the sheet, as it begins its movement from the pack, would, if unsupported, fall below the line of contact between the assistant frictional pressure roller and the drum. Hence I provide means for directing and supporting the sheet until the oscillating frictional pressure roller shall have resumed its normal position.

N¹² are fingers preferably constructed of sheet metal and secured to the side of the cross bar N'. These fingers extend upward and are bent rearward conforming to the periphery of the drum K and have a slight downward curvature at their extremities to insure the passage of the edge of the sheet over the fingers. These fingers are preferably of the same width as the curved pieces L' of the fingers L and are located immediately in front of them. The fingers N¹² guide the sheet under the drum K into the bite between the assistant frictional pressure roller and the drum. When the spools M¹⁰ are in their normal position they occupy the spaces between adjacent fingers N¹². After the sheet has passed under the action of the assistant frictional pressure roller it is under the action of both of the pressure rollers at once with the result of a very certain and steady withdrawal from the pack.

Sheet registering mechanism.—Owing to imperfect adjustment of the pack or of some of the sheets, or to inaccuracies in the operation of the withdrawing devices, sheets will, at times, be out of proper alignment after they have been withdrawn from the holder; and to restore such sheets to their proper position I employ a device to register the sheets after they have left the holder and before they are delivered to mechanism which is to produce the final and complete separation of the sheets. The registering devices which I employ consist of a conveyer to receive the sheets as they are withdrawn from the pack and to convey them away from the holder, front stops to temporarily stop the forward movement of each sheet in succession and a side registering device for bringing the sheets into line while so stopped. In describing this part of my invention I shall refer more particularly to Figs. 1, 2, 3, 4, 20 and 21.

The conveyer which I employ consists of traveling bands or cords supported by suitable rollers or disks and may be designated as a conveying apron.

O is the rear roller of the conveying apron mounted on the shaft O' which may be supported in bearings carried by the side frames

A. This roller is placed in proper relation to the drum K to receive the sheets carried forward thereby.

P are disks forming the front roller of the conveying apron, mounted on the shaft P' which may be supported in bearings also carried by the side frame A. The front roller of the apron I prefer to form of disks instead of using a continuous roller like the roller O, in order to admit certain parts into the spaces between the disks.

P² are the bands or cords which pass about and connect the rollers O and P and which receive and support the sheets from the holder.

I have shown the conveying apron inclined slightly upward, but this is unimportant.

Q is a platform or apron board below the bands P² and serves to uphold the bands from sagging by the weight of the sheets which they carry. This platform may have a forward side extension Q' to support the forward edge of the sheets at the side where they are operated upon by the side registering fingers, and may have a side edge Q², against which the sheets may be registered.

Q³ are the cross bars which support the platform Q and these cross bars may be supported by brackets Q⁴ carried by the side frames A.

The front stops used for retarding the sheets while being operated upon by the side registering device may be of any proper construction and may be operated in any convenient manner. The stops which I prefer to employ are a part of the final separating device and will be described in detail when I describe that device. The front stops are reciprocating and, at one period of their reciprocation, they pass across the pathway of the sheets. A sheet in its movement strikes the stops and is temporarily stopped. The side registry then takes place after which the front stops reciprocate out of the pathway of the sheet and the sheet passes forward.

As the sheets pass from under the drum K, by the action of the withdrawing devices in the manner described, they will be laid upon the conveying apron with several sheets underlying one another but with the top sheet always in advance of the underlying sheets. The surface speed of the conveying apron should be equal to or somewhat in excess of that of the drum K, so as to keep the sheets straight and flat as they pass from the drum. In order that the longer sheets may pass out from under the action of the withdrawing drum and be free upon the conveyer before they strike the front stops, those stops must be placed at a distance from the drum K at least equal to the length of the longest sheet designed to be fed by the machine and the conveyer must be of a length to span the distance between the drum and the front stops. When shorter sheets are fed several sheets may lie free upon the apron at the same time. As the sheets pass over the conveyer the ad-

vanced free top sheet strikes against the front stops and is thereby held stationary while the underlying sheets continue their forward movement. The distance between the forward edges of successive sheets as related to the surface speed of the conveyer is such that after the top sheet is stopped and before the sheet next underlying the top sheet can reach the front stop on its forward movement sufficient time will elapse to permit the top sheet to be registered or moved into proper alignment and to allow the front stops to reciprocate and permit the passage of the registered top sheet and to return to intercept the next sheet.

R are the side registering fingers of which there may be several distributed along the side edge of the conveyer. In the drawings I have shown five such fingers. These fingers terminate in frictional rubbing pads adapted to engage the surface of the sheet to be registered along its side edge. These rubbing pads may be constructed like the rubbing pads of the buckling finger I with two frictional rubbing disks R' secured to the fingers R by bolts or pins R² provided with thumb nuts R³. For further details of these rubbing pads reference may be had to the previous description of the buckling finger.

The fingers R are operated to drop upon the sheet at the proper time and give a short quick lateral stroke and then to rise and remain elevated until the next sheet is in position to be registered. The mechanism which I employ to effect these movements consists of a combination of levers or arms, rods and cams.

S are arms rigidly secured to a rocking rod S' as by thumb screws S². The rod S' may be supported by suitable bearing standards T and T' carried by the side frame A. There may be one arm S for each finger R. The fingers R are loosely secured to the inwardly projecting ends of the arms S, and for this purpose each finger R may be provided with a slender upward limb inserted through a hole in the end of an arm S and supported by nuts R⁴ on the top of the finger. When the rod S' is rocked so as to elevate the arms S, the fingers R are lifted by the nuts R⁴ away from the sheet. (See Fig. 21.) When the rod S' is rocked so as to lower the arms S the fingers R are allowed to drop upon the sheet. (See Fig. 20.) The nuts R⁴ are so adjusted that, when the fingers R rest upon the sheet, the ends of the arms will pass a short distance below the nuts R⁴ so that the entire weight of the fingers rests upon the sheet, and the arms S merely steady the fingers R without supporting them, and by varying the adjustment of the nuts R⁴ the time during which the finger R will rest upon the sheets may be varied.

U are rods which give the lateral movement to the registering fingers R. There may be one of these rods for each finger attached by a proper pivot to the finger at a point between

the rubbing pads of the finger and the arm S. The outer end of each rod U may be connected to a swivel piece U' swiveled in a clamp piece U² clamped upon a vibrating rod U³, as by thumb nuts U⁴. The vibrating rod U³ may be upheld by rocker arms U⁵ firmly secured to a rocking rod V supported in bearings formed in the standards T and T'. The rocking of the arms U⁵ by the rod V communicates an intermittent vibrating or oscillating movement to the rod U³ about the shaft V. The intermittent vibratory motion of the rod U³ is communicated through rods U and attachments to each registering finger R. The movements of the parts are so timed that the fingers commence their outward movement to register the sheets at or just before the instant that the fingers drop on the sheet and the fingers are lifted from the sheet at or just before the completion of the registering stroke. The fingers then return to their inward position over the sheets and there remain suspended until the next sheet is to be registered.

The movements of the registering fingers are made rapidly and their action draws the sheet operated upon squarely against the side registering strip Q².

It will sometimes happen that the sheet will strike the registering strip Q² before a registering finger has completed its outward movement. Under such conditions if the finger have a positive registering stroke, any further outward movement of the finger after the edge of the sheet has come in contact with the strip Q² will bend or buckle the sheet, and when the finger is lifted and releases the sheet the recoil of the buckled part would spring the edge of the sheet away from the strip Q² and destroy the registration, and the short kink or buckle thus put into the edge of the sheet might tear or injuriously mark it. It is therefore desirable that the registering fingers shall have a yielding outward or registering stroke whereby the fingers may be permitted to stop by being held against further movement by the stiffness of the sheet between the pads of the registering fingers and the side stop when the sheet is stopped by coming into contact with the side stop. Hence I communicate this movement to the fingers through the medium of springs of proper tension. For this purpose the rods U are extended through the swivels U' and carry coil springs U⁶ retained by adjustable nuts U⁷. These rods U are free to move in their swivels and the springs, which bear at one end against the swivels and at the other end against the nuts U⁷, tend to keep the rods U in their normal position with shoulders U⁸ on the rods in contact with the swivels. When the swivels U' oscillate outward they operate the rods U through the medium of the springs U⁶. If, in the course of an outward movement of any registering finger, the edge of the sheet adjacent to the finger registers against the registering strip Q² be-

fore the outward movement of the swivel U' is completed then the registering finger is stopped by the friction of its friction pad upon the registered sheet, but the swivel U' continues its movement and, during the remainder of the outward movement of the swivel after the registering finger has ceased to move, the spring U⁶ is compressed. If one end of the sheet strikes the strip Q² before the other then the fingers at the registered end of the sheet stop while the fingers at the other end continue their forward movement until that end also is registered, so that a sheet out of line with the registering strip Q² will be brought into proper position. The registering fingers are so arranged relatively to the edge of the sheet that the frictional pads of the fingers shall seize the sheet as near its side edge as they will operate and perform the functions assigned to them so that a relatively short stretch of the sheet shall lie between the pads and the side stop thereby reducing to a minimum the tendency of the sheets to buckle under the action of the pads. The nuts U⁷ may be adjusted to vary the tension of the springs U⁶.

To adapt the registering fingers to sheets of different degrees of flexibility the nuts R⁴ or the nuts U⁷ or all of them may be adjusted. By adjusting the nuts R⁴ the time during each outward stroke of the fingers R that the fingers will be in operative contact with the sheets may be varied and by adjusting the nuts U⁷ the force with which the fingers draw upon the sheet will be varied.

S³ is a projecting arm attached firmly to the rocker rod S' and V' is a similar projecting arm attached to the rocker rod V.

V² is a coiled spring connecting the ends of the arms S³ and V' and tending to draw the ends of these arms toward one another, and thus to maintain them and their respective rocker rods and attached parts in their normal positions with the registering fingers advanced and suspended over the sheets.

W is a cam shaft supported in bearings secured to the side frame A.

S⁴ is a rod pivoted to the arm S³ and passing therefrom downward through a vertical bearing formed in the standard T. The rod S⁴ is provided on its lower end with a frictional roller S⁵ adapted to be operated upon by the cam S⁶ which is secured to and turns with the shaft W. The cam S⁶ through the medium of the roller S⁵, rod S⁴ and arm S³ rocks the rod S' to depress the inward ends of the arms S and lowers the registering fingers. The fingers are elevated by the spring V².

V³ is an arm attached firmly to the rocker rod V and extending down therefrom. The arm V³ may form with the lever V', a single construction having a common hub as shown. A frictional roller V⁴ pivoted to the lower end of arm V³ is adapted to be operated upon by the cam V⁵ which is secured to and turns with the shaft W. The cam V⁵ through the medium of roller V⁴ and arm V³ rocks the rod

V and through the further medium of the connecting parts described produces the outward or registering movement of the registering fingers R. The fingers are moved inward by the spring V².

The cams S⁶ and V⁵ are of the proper shape and move at the proper time to produce such movements of the registering fingers as I have described.

By operating the thumb screws S² and U⁴ the arms S and clamps U² may be moved along the rods S' and V³ respectively, and adjusted longitudinally so as to place the fingers R in such positions along the edge of the sheet as may be best adapted to various conditions and to sheets of different lengths.

Any of the fingers R may at any time be thrown out of operative contact with the sheet without operating the thumb screw U⁴ or disturbing the longitudinal adjustment of a finger. This may be required when all of the fingers are not to operate at once upon a sheet, or when short sheets are being operated upon in which case all those fingers in the rear of the sheet should be put out of action. The fingers are put out of action by operating the thumb screw S² and turning the arms S about the rod S' until the finger R is elevated above the normal position. When the finger is thus elevated the arm S may be again clamped on the rod S' by the screw S². The registering fingers when thus lifted will go through their usual movements but will not descend low enough to touch the sheets. In Figs. 20 and 21 the dotted lines indicate the position of the parts when the fingers are elevated.

The stop motion devices.—In describing these devices I shall refer more particularly to Figs. 1, 2, 3, 4, 24, 25 and 26.

X is an oscillating rod or rock shaft extending across the front end of and slightly elevated above the conveying apron. The shaft X may be supported by bearings T² and X' carried by the side frame A and the bearing T² may form part of a standard T' which supports bearings for the registering devices. Fingers X² carried by the shaft X rest at intervals upon the sheets as they pass upon the conveyer. A convenient method of attaching these fingers to the shaft X is that shown in the drawings, where the fingers are shown fastened to a rod X³ upheld in the ends of arms X⁴ carried by the shaft X. When the fingers rest upon a sheet they are upheld by the sheet and thereby prevented from descending below the surface plane of the conveyer, but if no sheet be on that part of the conveyer when the fingers descend, their own weight and the weight of the rod X³ carry the fingers below the surface plane of the conveyer and rock the shaft X beyond a certain normal position, and in so doing put in operation certain mechanism which stops the machine. I have placed the fingers X² so that their line of action is over the extreme forward end of the apron, because this end of

the apron is covered only by the single advanced free end of the top sheet of the series upon the conveyer.

I prefer not to allow the fingers X² to rest upon the sheets at all times, as they would then exert a dragging action which would tend to retard the advancing top sheet, and their presence on the sheets would seriously interfere with the registering action. Hence I provide means for retaining the fingers normally raised above the sheets and allowing them to drop and rest upon the sheets for but a single instant during the passage of each sheet. It is convenient to have the fingers touch the sheets either immediately before or, (as in the mechanism that I have shown) immediately after the registering of the sheet.

X⁵ is a lever securely fastened on one end of the shaft X.

X⁶ is a yielding or flexible connection (shown as a small chain) attached at one end to the end of the lever X⁵ and at the other end to such cam operated devices as may be employed to rock the shaft X. In the drawings I have shown the flexible connection attached to the horizontal arm of a bell crank lever e³ which operates parts of the spacing out device, because the lever happens to have the proper movements to control the stop motion fingers. When in the position shown in Fig. 2 the horizontal arm of the bell crank lever is depressed and through the medium of the flexible connection and other connecting parts holds the stop motion fingers raised above the surface of the conveyer in the position shown in Fig. 3. When the horizontal arm of the bell crank lever e³ is raised the flexible connection X⁶ is released, and the weight of the fingers X² and of the rod X³ causes the fingers to drop on the sheet and in dropping to rock the rod X and raise the lever X⁵. The amplitude of movement of the horizontal arm of the bell crank lever e³ is sufficiently great to permit the fingers to fall below the surface of the apron, if their descent is not checked by contact with a sheet. If the fingers are stopped by contact with a sheet the flexible connection becomes slack during the extreme upward portion of the movement of the horizontal arm of the bell crank lever e³ but on the descent of that arm the flexible connection becomes taut and again depresses the lever X⁵ and lifts the fingers and holds them suspended until the time comes for their next depression. Other devices may be used to elevate the fingers.

If the stop motion be not required under any conditions of feeding I provide means for permanently maintaining the fingers X² in an elevated position.

X⁷ is a crank arm fixed on the same end of the rod X as is the lever X⁵ and may be joined to a common hub with that lever as shown. By lifting the lever X⁷ the rod X is rocked and the fingers X² elevated. When the lever X⁷ is lifted a key X⁸ operated by a pin X⁹ and sliding in a key way in the rod X is pushed

into a corresponding key socket in the bearing T² as shown in Fig. 26 whereby the shaft is prevented from turning. When the stop motion fingers are operating, the key X⁸ is withdrawn from the bearing T² and slides into a socket in the hub of the lever X⁷, the pin X⁹ being, at such times, drawn out from the end of the rod. When the fingers are locked in their raised position the flexible connection X⁶ is sufficiently slack to permit the horizontal arm of the bell crank lever e³ to make its usual movements without operating the lever X⁵.

Y is a rod or shaft in the rear of the rod X and similarly supported by bearings T² and Y¹.

Y² is an arm fixed on the rod Y near one end thereof.

Y³ is a rod connecting the upper end of the arm Y² to the upper end of a rocking lever Y⁴ pivotally mounted upon the side A of the holder. When the lever Y⁴ is rocked then through the medium of rod Y³ and arm Y² the shaft Y is rocked also.

Y⁵ is a pin passing through the lower end of the lever Y⁴ and through an opening in the side of the holder.

E⁴ (see Figs. 24 and 24) is a bolt or projection standing out sidewise from the forward edge of that follower which moves adjacent to the side cheek D of the holder. As this follower moves over the bottom of the holder the bolt E⁴ moves in a passage way or groove D² cut in the face of the side cheek D. The pin Y⁵ does not pass all the way through the side of the holder but reaches inward sufficiently to lie in the path of the bolt E⁴. As the sheets are gradually removed from the pack and the follower slides down the bottom B and reaches a certain position the bolt E⁴ will strike the pin Y⁵, as shown in Fig. 24, and, as the follower moves still farther downward, the bolt will move the pin and the lower end of the lever Y⁴ forwardly thereby rocking the shaft Y through the connections described, and in so doing put into operation certain mechanism which will cause the stopping of the machine. The dotted lines in Fig. 2 show the parts in this position. All the parts are returned to their normal positions on the removal of the follower by gravity and it will be seen, by reference to the drawings, that all the parts are so disposed as to favor gravitation in the direction of the return of the parts.

I place the lever Y⁴ nearly to the front face of the holder so that the lever will not be operated until the sheets are nearly exhausted out of the holder.

While it is not necessary to employ the lever Y⁴ and the device controlled thereby to operate the stop motion when the sheet holder becomes emptied, because the fingers X² will operate it when the last sheet passes from under them, I prefer to employ these devices, because if the operation of the machine is not stopped until the last sheet has passed from the conveyer it will be necessary when the feeding apparatus is started again with a fresh

supply of sheets, to operate the apparatus for some time before the machine to which the sheets are to be delivered can be started in order that the proper number of sheets may be withdrawn and brought under the drum K and upon the conveyer to bring the most forward of the fresh supply of sheets into position to be fed to the machine which is to receive them, and there would be a liability that the most forward of the new series of sheets would not pass into proper relative position to the rearmost sheet of the former series for perfect feeding. To remedy these evils I provide the stop motion on the side of the holder which stops the machine before the last sheets have passed out of it. When sheets are again supplied after the stop on the side of the holder has operated, it will be readily perceived that the entire mechanism can be put in motion without disconnecting the feeding mechanism from the machine to be fed or in any wise interrupting the succession of the sheets.

When it is desired to have all the sheets in the holder removed or when, for any other reason, the stop motion on the side of the holder is not required, the pin Y⁵ may be withdrawn out of the pathway of the bolt E⁴ as shown in Fig. 25. A key Y⁶ attached to the pin Y⁵ which when the pin is pushed inward slides into a socket in the boss on the lower end of the lever Y⁴ will prevent the accidental return of the pin when it is withdrawn, if the pin be turned so that the end of the key will rest against the solid part of the boss. The total withdrawal of the pin may be prevented by a shoulder on its inner end.

On one end of each of the rocking rods X and Y and preferably on the same side of the machine are secured levers X¹⁰ and Y⁷. The lever X¹⁰ tilts upward whenever the fingers X² move downward and the lever Y⁷ tilts upward whenever the stop on the side of the sheet holder is operated. Yielding or flexible connections X¹¹ and Y⁸ are attached to the outer ends of the levers X¹⁰ and Y⁷ respectively and to a vertical rod Z. The connections X¹¹ and Y⁸ may be small chains, and, if preferred, the two chains may be joined to the rod Z by a link or links common to the two chains as shown in Fig. 3. The flexible connection X¹¹ is of such length as to remain slack when the fingers X² are raised and become taut whenever the fingers rest upon the sheet. The slackened connection is clearly shown in Fig. 3. If the fingers X² are sustained on their descent by the presence of a sheet under them the flexible connection X¹¹ is merely straightened out and does not lift the rod Z, but if there be no sheet under the fingers and they descend to their lowermost position and by their weight and that of the rod X³ raise the lever X¹⁰, the flexible connection X¹¹ will be pulled upward and the rod Z will be lifted. When the rod Z is thus lifted by the connection X¹¹ the other flexible connection Y⁸, which at other times is taut, will be slackened. When

the lever Y^4 is rocked in the manner described the resulting rocking of the rod Y will raise the lever Y^7 and pull the connection Y^8 upward and lift the rod Z . At this time the connection X^{11} will become slack. Thus by the operation of the parts described the rod Z may be lifted upon the absence of a sheet from the forward end of the conveyer, or whenever the pack in the holder is reduced below a certain normal thickness by the withdrawal of sheets. The lifting of the rod Z puts in operation the devices which stop the mechanism.

The device for effecting the stopping of the mechanism on the lifting of the rod Z may be of any convenient construction. The apparatus which I have shown is substantially the same as the stop motion mechanism described in the patent to me, No. 531,438, dated December 25, 1894, to which reference may be had for full details.

In the drawings of the present application Z' is the balance weight on the rod Z .

Z^2 is the stop collar also carried by the rod Z . Z^3 are stop brackets carried by the side frame A and serve also as guides for the rod Z . The hub of the balance weight resting on the lower bracket supports the rod in its lower or normal position and the stop collar by striking the upper stop bracket limits the upward movement of the rod.

Z^4 is the hook on the lower end of the rod Z .

Z^5 and Z^6 are the levers pivoted to frame A , and Z^7 is the connection between the levers. Z^8 is the rod connecting with the belt shifting clutch or other motion arresting device, and Z^9 is the spring to draw back the rod Z^8 when permitted to do so by the releasement of the parts which sustain the spring. The dotted lines in Fig. 3 show the position of the parts when released.

The final spacing out and separating devices.—These devices consist of a pair of feeding rollers, means for intermittently raising the top one of the rollers, stop gages for causing the presentation of the sheets to the rollers at precise intervals and an adjustable feed guide or table to direct the sheets as they pass from the rollers. In describing this device I shall refer more particularly to Figs. 1, 2, 3, 4, 7, 12, 13, 14, 15, 16 and 17.

The lower feeding roller consists of a series of disks a' secured on a shaft a supported by bearings which may be carried by the side frame A . The upper feeding roller consists of a series of disks b^2 secured on the shaft b . The disks b^2 may be mounted on the shaft b in any well known manner and the shaft may be supported by bearings of any suitable construction but I prefer to mount the disks in the same manner and to provide bearings of the same description as I have shown in my oscillating frictional pressure roller of the withdrawing device previously described. Hence I will here only mention the several parts of the disks and bearings and reference may be made to the previous description of

similar parts of the oscillating frictional pressure roller.

b' is the cross bar which supports the bearings of the shaft b . This bar is extended entirely across the machine and suitably supported from the side frames A .

b^3 are the spools on which the disks b^2 are mounted.

b^4 are the bearings of the shaft b having shoulders b^5 fitted into sockets b^6 in the bar b' .

b^7 are the key plugs screwed in the top of the sockets b^6 and b^8 the stems of the bearings projecting into the key plugs and b^9 are the coil springs about the stems b^8 .

The disks a' and b^2 may be composed externally of any preferred frictional material for seizing upon the sheets passing between them. The disks a' and b^2 are disposed opposite to one another and may be placed as shown with one disk a' and its opposed disk b^2 opposite to each disk P of the front roll of the conveying apron. The disks must be properly placed to receive the sheets as they pass from the conveyer. As each free advanced top sheet on the conveyer is presented to the feeding rollers it is seized by the rollers, which turn in the direction indicated by the arrows in the drawings and the sheet is removed from the conveyer by the rollers.

The top roller b^2 is positively driven from the lower roller a' through the medium of gears a^2 and b^{10} and there may be one pair of such gears on each end of the rollers as shown. These gears have shoulders a^3 and b^{11} respectively of the same diameter as the pitch circles of the gears, which, by rolling contact, prevent the gears from being forced into too close engagement by the spring pressed bearings of the shaft b .

For certain purposes in the operation of my feeding machine it is necessary that the top roller b^2 should be intermittently raised from the roller a' . Various means may be employed to raise the top roller but I will describe the devices which I prefer to employ for that purpose. On either side of the machine I mount a vertical rod c secured to a side frame A by a bracket. On each rod c I mount a sliding bearing c' preferably having an upper and lower boss connected by a tie. The bosses encircle the rods and slide vertically thereon and, because of the tie between them, the bosses when moved must move simultaneously. Each upper boss of the bearing c' is securely fastened to and supports an end of the cross bar b' .

d is a shaft below the bottom feeding roller and is supported in bearings carried by the side frames A . Cams c^2 secured to and turning with the shaft d operate through the medium of friction rollers c^3 pivoted to brackets c^4 attached to the lower bosses of the bearing c' to give an upward movement to the bearings and to the attached bar b' thereby raising the rollers b^2 away from the rollers a' . The parts are returned by their own weight to their lowermost position when the lower

surface of the cam c^2 is presented to the friction roller c^3 . To cause the spring pressed bearings b^4 to follow the upward movement of the bar b' I place lifting fingers b^{12} under each bearing and fasten the fingers to the side of the bar b' . When the bar rises the fingers engage the bearings and lift them also. The bar b' in its descent passes slightly lower than necessary to place the disks a' and b^2 in contact, and the fingers b^{12} pass below the bearings b^4 so that these bearings can be free to press the disks a' against the disks b^2 with the full force of the springs b^9 .

The extent to which the disks b^2 must be raised is small and need only be sufficient to relieve the pressure on the sheet between the disks a' and b^2 . The teeth of the connecting gears a^2 and b^{10} are made longer than usual so that, in the rise of the disks b^2 , the teeth of the gears do not pass out of contact.

If the shaft d be turned intermittently the bar b' will be lifted intermittently, and to turn the shaft d intermittently I place on the end of the shaft an intermittently operated gear the periods of rotation of which are controlled so as to conform synchronously with the movements of the individualizing mechanism which divides the successive sheets from the pack.

d' is a gear secured on the end of the shaft d and having a portion of its periphery cut away. a^4 is a gear on the shaft a in constant rotation. The gear d' is driven by the gear a^4 except at times when the cut away portion of the periphery of the gear d' comes opposite the gear a^4 when the gear d' may come to rest.

d^2 is a pawl pivoted on one side of the cut away part of the periphery of the gear d' . The end of this pawl is shaped the same as a tooth of the gear d' . When the cut away part of the periphery of the gear d' is opposite the gear a^4 and the gear d' at rest the pawl has a normally depressed position being held in the depressed position by a guard. When the guard is removed a spring forces the pawl against the gear a^4 and the pawl engages a tooth of that gear as shown in Fig. 12. The rotation of the gear a^4 carries the pawl rearward and thereby causes the gear d' to rotate until the teeth of the gear d' on the side of the cut away part of its periphery opposite from the pawl are brought into engagement with the gear a , whereupon the gear d' is driven by the gear a by the engagement of the teeth of the gears, until the gear d' has made one complete revolution and the cut away part of its periphery has again come opposite the gear a^4 whereupon the gear d' will come to rest if the pawl d^2 is at that time depressed. In order that the teeth of the gear d' may accurately engage the teeth of the gear a^4 when the gear d' is moved forward by the pawl it is necessary when the pawl is projected that its engaging lip should occupy such a position on the periphery of the gear d' as would be occupied by a tooth of that

gear if the teeth were regularly continued over its periphery. In the drawings the lip occupies a position which would thus be occupied by the second tooth from the tooth which first engages the gear a^4 when the gear d' is moved forward by the pawl.

d^3 is a spring connecting a rearwardly extending arm of the pawl d^2 to a pin driven into the face of the gear d' and tends to project the lip of the pawl forward.

d^4 is a pin projecting from the face of the gear d' against which the rearward arm of the pawl d^2 strikes when the lip of the pawl is projected into operative position and limits the outward movement of the lip. In Fig. 14 the pawl is shown in operative position.

e is the guard which controls the movements of the pawl d^2 , and, through the pawl and the gear d' and connecting mechanism, the periods of intermission in the raising of the rollers b^2 . The guard e is provided with a boss which passes over a projecting hub of a bearing of the shaft d and is free to oscillate thereon and such oscillation will be concentric with the shaft d and gear d' . The guard engages an inwardly projecting corner of the operating lip of the pawl. When the cut away part of the periphery of the gear d' is opposite the gear a^4 the guard e is in the position shown in Fig. 16 and the pawl is held depressed by the guard and the gear d' is at rest. When the guard is oscillated into position shown in Fig. 12 it releases the pawl which is then projected by the spring d^3 into engagement with the gear a^4 and the gear d' is set in motion as described. Before the gear d' can make a complete revolution the guard e returns to its normal position. As soon as the gear d' has reached the position shown in Fig. 15 the pawl engages a flaring extension of the guard and the further turning of the gear drags the pawl under the incline of the flaring extension and depresses the pawl so that by the time that the cut away part of the periphery of the gear d' has come fully opposite the gear a^4 the pawl will be fully depressed, as shown in Fig. 16, and the gear d' may again come to rest.

It should be noted that whenever the gear d' is in the position shown in Fig. 12 and is at rest, the cam c^2 is in the position shown in Fig. 17 and the disks b^2 are elevated. The end of the outward part of the cam c^2 may be made concave so that the frictional roller c^3 may rest in this concave place on the cam whenever the gear d' is at rest under the conditions described. This arrangement operates as a brake upon the gear d' and prevents accidental turning in either direction when it should be at rest, as in order to turn the gear, the bar b' and attached parts must be slightly elevated to bring the frictional roller out of the concavity and this circumstance offers a resistance to the turning of the gear. For the same reason the friction roller c^3 which falls into the concavity at the instant that the gear d' and attached parts are re-

leased from the gear a^4 , operates to overcome the momentum of the gear d' and to bring it to rest after it has been released from the gear a^2 .

5 e' is a lever extending downward from the boss of the guard e .

10 e^3 is a bell crank lever pivoted to the side frame A and the lower end of the downwardly extending arm of this lever is connected by a rod e^2 to the lower end of the lever e' .

15 e^4 is a spring connecting the end of the downwardly extending arm of the bell crank lever e^3 to a pin secured to the side frame A and tends to draw the downwardly extending arm of the bell crank lever normally forward and, through the medium of the connecting rod e^2 and lever e' , to maintain the guard e in its normal position to depress the pawl d^2 . The rearward end of the horizontal arm of the bell crank lever e^3 carries a frictional roller e^5 which is operated on by a cam e^6 secured to and turning with the shaft W. The cam in turning elevates the horizontal arm of the bell crank lever and thereby, through the connecting parts described, moves the guard e forward from over the pawl d^2 . The cam e^6 is shaped to give a very quick oscillation to the guard e with a comparatively long interval of rest. The dotted lines in Fig. 2 show the position of the bell crank lever and connected parts when moved to their outward limit by the cam.

At times, for certain kinds of feeding, it is not required to raise the disks b^2 but have the disks a' and b^2 running together continuously. At such times the roller elevating mechanism must be thrown out of operation. I therefore provide a stop by which the gear a^4 may be disconnected from the shaft a . I secure the gear a^4 to the shaft a by a key a^5 controlled by a pin a^6 . When the pin is drawn out the key binds the gear a^4 to the shaft a and the gear rotates, but when the pin is pushed in as shown by dotted lines in Fig. 13 the key slides into a socket made for it in the hub of the gear a^2 and the gear a^4 is disconnected from the shaft a and may come to rest although the key and pin revolve, being driven by gear a^2 which is connected to shaft a by means independent of the key a^5 . A collar a^7 prevents endwise movement of the gear a^4 . This stop for the gear a^4 may be constructed similarly to the stop hereinafter described in connection with the countershaft m and reference may be here had to the description of that stop.

When the roller elevating mechanism is out of operation with the disks a' and b^2 in permanent contact, the low part of the cam c^2 is under the friction roller c^3 and the gear d' is turned so that the pawl d^2 is away from the gear a^4 . The gears a^4 and d' are at rest but the guard e continues to oscillate without operating the pawl which is not then in the track of the movement of the guard. At such times the shaft a turns loosely within the hub of the

gear a^4 . Fig. 2 shows the parts in this position.

The stop gages are placed immediately in the rear of the feeding rollers and, when constructed as I have shown in the drawings, consist of an upper stationary and a lower oscillating member, and each member consists of a series of flat fingers of greater or less width, one stationary and one oscillating finger being opposed each to the other and together constitute a pair, and I preferably place one pair between adjoining disks of the feeding rolls and also one pair between each exterior disk and the side frame of the machine.

f is a stationary bar extending across the machine and may be supported by standards f' carried by the side frames A.

f^2 are fingers fastened rigidly on the bottom of the bar f . These fingers extend forward in line with and almost to the intaking line of the rollers a' and b^2 . The rear end of the fingers may be turned upward to form guides for leading the sheets under the fingers.

g is an oscillating bar extending across the machine below the bar f and supported by bearings which may be formed in the standards f' . This bar may be of triangular cross section the better to fit into the triangular space between the disks P and a' as shown in Fig. 1, so as to bring the top of the bar below the surface of the conveying apron.

g' are fingers fastened rigidly on the top of the bar g . These fingers extend forward to the same line as do the fingers f^2 and by the oscillating of the bar g the fingers g' may be made to touch the fingers f^2 at their forward ends, which is their normal position, and to recede therefrom. The fingers g' terminate forwardly in small abrupt lips g^2 turned at right angles to the fingers g' and tending toward the fingers f^2 . When the forward ends of the fingers are in contact the lip g^2 will intercept any sheet, of which the front edge passes between the fingers and strikes against the lips, and will stop such sheet until the fingers separate. If a sheet be seized by the disks a' and b^2 and is being drawn by them from the conveyer, when the fingers g' return to their normal position, as they usually will before the sheet is fully withdrawn, the lips g^2 rest against the under side of the sheet and the sheet is drawn by the rollers from between the fingers. The rear ends of the fingers g' are bent downward and pass into the spaces between the disks P of the front roller of the conveyer apron and in this position it is impossible for any sheet carried by the conveyer to pass under the fingers.

For oscillating the bar g it is convenient to employ a cam lever attached to the bar, operated by an oscillating friction roller. I make use of a cam lever consisting of two parts, a part g^3 attached to the end of the bar g and a part g^4 adjustably secured to the part g^3 by bolts having thumb nuts g^5 .

g^6 is a frictional roller carried on the end of a lever g^7 which may be joined to the hub of the guard e as shown, so that the lever e^1 , guard e and lever g^7 shall oscillate in unison.

5 The frictional roller g^6 engages a cam shaped surface g^9 on the edge of the part g^4 of the cam lever.

g^8 is a spring attached to the lower end of the cam lever and to a pin on the side frame
10 A and tends normally to swing the cam lever forward and bring the ends of the stop fingers in contact. When the lever g^7 oscillates upward it operates through the frictional roller g^6 upon the cam surface g^9 of the cam lever g^4 ,
15 which is made of the proper shape for that purpose, to swing the cam lever outward and separate the stop fingers. When the levers g^7 oscillate downward the spring g^8 causes the cam surface of the cam lever to follow the
20 roller and the stop fingers are again joined. By operating the thumb nuts g^5 the two parts of the cam lever may be adjusted so as to bring the cam surface into exact position to secure precision in the described movements.

25 h is the adjustable feed table which may be lightly constructed of wood made smooth by a top cover of sheet metal and may be mounted on cross bars h' . On the ends of the most forward cross bar I place friction rollers h^3 and
30 provide brackets h^3 carried by the side frames A on the upper inclined edge of which the friction rollers rest and thereby support the forward end of the table.

k is a rocker shaft supported in bearings or
35 bosses in the side frame A.

h^4 are levers pivoted to the end of the rear-most of the cross bars h' and carried by the rock shaft k , and supporting the rear end of the table. When the shaft k is rocked the
40 rear end of the table is moved by the lever h^4 and the forward end of the table by being dragged over the inclined edges of the brackets h^3 is moved also. The position of the shaft k , the length of the levers h^4 and the
45 shape of the incline on the brackets h^3 may be such that when the shaft k is rocked the rear end of the feed table will practically follow the curve of the disks a' of the bottom feeding roller and the upper surface of the
50 table will always be directed toward any required line of delivery of the sheet which may be the line of contact of the intaking rollers of a ruling machine, and in Fig. 1 such rollers are represented by the dotted lines.

55 k' is a hand lever secured on an end of the shaft k and may have a section of ratchet toothing k^2 formed on the side of it adapted to be engaged by a pawl k^3 which may be pivoted to the side frame A. A weighted lever
60 end k^4 to the pawl may retain it normally in engagement with the ratchet. By operating the hand lever and pawl the table h may be supported in as many different positions as there are teeth in the ratchet. Stop points
65 k^5 may be provided on the hand lever k' adapted, by contact with the hub of the

ratchet or with the stud which supports it, to limit the movement of the hand lever.

By making proper adjustments, in the operating of my spacing out and separating device I am able to take the partially separated sheets from the conveyer and deliver them over the feed table in either one of four distinct orders of succession,—with their adjacent edges in contact, with spaces of any
75 width between adjacent edges, with the forward edge of each sheet lying under the rear edge of the sheet which precedes it or with the forward edge of each sheet lying over the rear edge of the sheet which precedes it. 80
These four different arrangements of sheets constitute four styles of feeding, and in feeding ruling machines, it may be necessary to feed sheets in either one of these four ways; but whatever the way of feeding it is necessary to use the stop fingers to secure accuracy
85 in the succession of the sheets. Because the line of contact of the stop fingers is placed as close as possible to the line of intake of the feeding rollers, it follows that when the sheets
90 are released by the stop fingers they are so quickly seized between the feeding rollers that no slipping can occur between the stop fingers and these rollers. Some slipping in the withdrawing of the sheets from the holder
95 will invariably occur and as the sheets are laid on the conveyer their forward edges will not be altogether equidistant, but the operation of the stop fingers remedies this defect and the sheets are seized by the feeding
100 rollers at precisely equal circumferential intervals.

For feeding sheets with their adjacent edges in contact I throw the roller elevating mechanism out of operation and adjust the
105 speed of the feeding rollers so that they will pass each sheet between them in the exact time that the sheets are successively delivered by the stop gages from the conveyer. For feeding sheets with spaces between the
110 adjacent edges I keep the roller elevating mechanism out of operation and adjust the speed of the feeding rollers so that they will pass a sheet between them and also turn a circumferential distance equal to the length of space
115 which is to be between the sheets before the next sheet is delivered from the stop gages. For feeding sheets with the forward edge of each sheet lying under the rear edge of the sheet which next precedes it the roller elevating
120 mechanism is also maintained out of operation and the speed of the feeding rollers is so adjusted that each succeeding sheet is delivered by the stop gages before the feed rolls have completely passed the preceding sheet
125 between them and the extent by which the adjacent edges of the sheets will underlie one another depends upon the speed of the feed rolls as related to the frequency of dropping of the stop gages. This latter is a very important
130 mode of feeding as it enables the ruling machine to use constantly depressed pens, while

5 ruling sheets with unruled margins, because, in the operation of the ruling process, each sheet forms a mask for that portion of the sheet which it overlies and prevents such portion
 10 being ruled. The accuracy with which my device delivers the sheets renders this practicable. In each of the three ways of feeding last mentioned I maintain the feed table in a practically horizontal position as shown in
 15 Fig. 1 so that the sheet will be guided smoothly from the feeding rollers. Instead of varying the speed of the feeding rollers to produce these three ways of feeding, the same effects may be produced by keeping the speed of the
 20 feed rolls constant and making equivalent variations in the speed of the mechanism which removes the sheets from the pack and delivers them to the feeding rollers. Thus, supposing the mechanism to be adjusted to
 25 feed sheets with their edges in contact, if the speed of the feeding rollers be unchanged, but if the mechanism which delivers the sheets to the feeding rollers be made to go slower the sheets will be delivered to the feeding rollers
 30 less rapidly and will be fed by those rollers with spaces between adjacent edges of the sheets. Contrariwise, if the mechanism which delivers the sheets to the feeding rollers be made to go faster the sheets will be delivered
 35 to the feeding rollers more rapidly and will be fed by the rollers with the forward edge of each sheet lying under the rear edge of the sheet which next precedes it.

40 For feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it, I put the feed roller elevating mechanism into operation and lower the feed table into one of the positions permitted by the ratchet k^2 , for instance into
 45 the position shown in Fig. 12. As the guard e and lever g^7 which respectively control the roller elevating and stop gage operating mechanism move in unison, it will be noted that the disks a' and b^2 are brought into contact
 50 at the same instant that the stop fingers separate, and that, at that instant or after the extremely small interval during which the sheet is being pushed over the small distance from the stop gages to the line of intake of the feeding rollers, the feeding rollers seize the sheet
 55 and take it forward and will continue to move it forward until the gear d' has made one complete revolution and the top roller b^2 is raised as described; but, by the time the top roller is raised, the forward edge of the sheet will have reached the intake rollers of the ruling machine and will have been seized by them and will be completely withdrawn by them after the roller b^2 is raised. The feed table
 60 h is made of such length that the sheets will have just been fairly taken by the intaking rollers of the ruling machine by the time the roller b^2 rises. At the instant that the forward edge of the sheet is seized by the intaking rollers of the ruling machine the rear portion of the sheet will extend rearward to a greater or less distance according to its length

between the rollers a' and b^2 and between the stop gages and over the forward end of the conveyer, and such portion of the sheet is
 70 withdrawn by the said intaking rollers while the roller b' is raised. In this manner of feeding the rollers a' and b^2 have their speeds adjusted to move the sheet from two to three
 75 times as fast as the sheet is moved by the intaking rollers of the ruling machine. Hence, when the latter rollers have so far withdrawn a sheet that its rear edge passes over the disks a' of the bottom feeding roller, the more rapidly moving frictional surfaces of those disks,
 80 operating on the rear edge of the sheet will snap that edge suddenly downward upon the table h more rapidly than it would naturally be laid thereon by the force of gravity alone and the rear part of the sheet is then drawn
 85 over the feed table. The parts are so adjusted in speed that, as soon as the rear edge of a sheet passes the intaking line of the rollers a' , b^2 , the roller b^2 drops and seizes the next sheet, and, because the feeding rollers move
 90 rapidly as described, the forward edge of the sheet last seized is moved forward faster than the rear edge of the preceding sheet is receding and overtakes that edge before it can be withdrawn from the table h ; and, because
 95 the said rear edge is depressed on the table h , the said forward edge passes over the said rear edge and overshoots it and is taken by the intaking rollers of the ruling machine before the rear edge of the preceding sheet has
 100 passed between them. Thus the sheets are received into the ruling machine with each forward edge overlapping the rear edge of the preceding sheet. The movements described are repeated for each sheet.

105 *The driving mechanism.*— l is the main driving shaft supported in bearings carried by the side frames A and receives power in any suitable manner either from the machine which is being supplied with sheets or from
 110 any other suitable source.

m is a counter driving shaft supported in bearings carried by the side frames A and carrying a gear m' driven by a gear l' on the main driving shaft through the medium of
 115 intermediate gears m^2 and m^3 . The gear m^3 may be mounted on the hub of the gear m^2 and both gears carried by a common stud secured to the side frame A. Gears l' and m^3 of different sizes may be used and, by changing the size of one of these gears or of both of them, the speed of the counter shaft as related to the speed of the main driving shaft may be varied through a range of considerable latitude.

125 The cam shaft H is driven by a gear m^4 on the counter shaft m through an intermediate gear H^2 transmitting power to the gear H' on the shaft H. The gears m^4 and H' are of the same size and the cam shaft makes one turn
 130 to each revolution of the countershaft.

The withdrawing drum K is driven by a gear m^5 on the countershaft m through intermediate gears K^6 , K^6 , transmitting power to

the gear K^5 on the shaft K' of the drum. By changing the size of the gear m^5 the speed of the drum as related to the speed of the countershaft may be varied.

- 5 The oscillating and the assistant frictional pressure rollers M and N are driven from the drum K as has been described.

The rear roll of the conveyer apron is driven from the gear K^5 on the shaft K' of the drum K gearing into the gear O^2 on the shaft O' . The forward roll of the conveyer is driven by the friction of the bands P^2 from the rear roll O.

- 15 The side cam shaft W is driven from a miter bevel gear m^6 on the countershaft m gearing with a similar gear W' on the shaft W.

n is a side shaft supported by bearings carried on the inside of the side frame A and is driven by a pair of bevel gears n' from the main driving shaft l .

- 20 o is a short shaft supported by a suitable bearing carried by the side frame A and is driven by a pair of bevel gears n^2 from the side shaft n .

25 The bottom feeding roller of the spacing out and separating device is driven from a gear o' on the shaft o through an intermediate gear a^9 transmitting power to the gear a^8 on the shaft a of the feeding roller. By changing the size of the gear a^8 the speed of the feeding roller a may be varied.

By the method of driving described the reciprocating parts of the sheet individualizing, the withdrawing, the registering, the stop motion and the spacing out device each makes one and but one complete movement with each sheet fed, but the several parts in movement will not all operate upon the same sheet at the same time. Whenever the speed of the countershaft is varied all the reciprocating movements vary likewise. It is by varying the speed of the countershaft that the machine is adjusted to feed sheets of different lengths moving slow for long and fast for short sheets; but the feeding rollers a' and b^2 do not partake of these changes of speed with the countershaft as these rolls should run at the same speed for all lengths of sheets in the same manner of feeding, when the speed of the ruling machine is not altered.

When my feeding machine is driven directly from a shaft of the ruling machine, as I prefer, any change in the speed of the ruling machine changes the speed of the entire feeding machine including the feeding rollers, correspondingly. The speed of the feeding rolls may be changed to suit different manners of feeding without affecting the speeds of the other parts of the machine.

- 60 It is desirable to supply my machine with stops one of which I provide on the end of the countershaft m . Such a stop for light running machinery of this character may be constructed as shown particularly in Figs. 22 and 23.

m^7 is a key adapted to slide in a groove cut in the shaft m . The movement of the key

may be controlled by a pin or rod m^8 which passes lengthwise through a hole bored from the end of the shaft. The pin may be cut away on one side opposite the key. The pin, having been inserted in the hole the key is put down through its groove in the shaft and fitted into the cut away place on the side of the pin. When the pin is moved lengthwise the key will be moved with it in the slot in the shaft. When the pin is drawn out the upper part of the key slides into a groove in the hub of the rear m' and binds it to the shaft so that the gear and the shaft must turn together and the machine is driven. When the pin is pushed inward it enters a socket or groove in the hub of the bevel gear m^6 and leaves the gear m' loose on the shaft. The bevel gear m^6 is secured to the shaft by means independent of the key m^7 for instance by a key m^9 .

m^{10} is a collar to prevent longitudinal movement of the gear m' . When the pin m^8 is pushed inward the countershaft and all the feeding machine except the feeding rollers will be at rest and no sheets will be fed. This stop is used whenever it is desired to operate the machine to which the feeder is attached for cleaning or other purposes without operating the feeder, or when it may be desired to turn the feeder by hand power.

I provide a similar stop on the end of the cam shaft H, shown more particularly by dotted lines in Fig. 6 where H^3 is the sliding key and H^4 the pin which controls it. The gear H' is secured to the shaft when the key is drawn out and is loose on the shaft when the key is pushed in. When pushed in the key enters a socket in the hub of the cam I^{15} . The cam I^{15} is secured to the shaft by means independent of the key H^3 .

H^5 is a collar to prevent longitudinal movement of the gear H' . When the pin H^4 is pushed in the cam shaft H and the parts operated by it will remain at rest but all other parts of the feeder will continue their usual movements. This stop is used whenever it is desired to carry off the sheets which lie upon the conveyer and under the withdrawing drum without withdrawing more sheets from the holder as, for the purpose of changing the sheets in the holder for others of a different size or quality. This stop may also be used when all the sheets in the holder have been exhausted to stop the individualizing mechanism while the sheets on the conveyer are fed away.

When a pack of sheets is first put in the holder and there are no sheets upon the conveyer, it is frequently desirable to advance the sheets as far as the feeding rollers before the machine to be fed is driven so that the delivery of the sheets may commence simultaneously with the starting of the machinery. Hence I provide means to turn the feeder by hand until the sheets are advanced as stated. It may also be desirable to turn the feeder by hand at times to feed trial sheets. In de-

scribing my hand operating device I shall refer more particularly to Figs. 2 and 6.

p is a gear loosely mounted on a stud secured to the side frame A and may gear, for instance, into the intermediate gear H^2 as that will allow the gear p to have a right handed movement for hand turning. p' is a hand crank attached to the gear p . When the crank is turned in the proper direction, the gears p and H^2 being in mesh and the stop pin m^8 pushed in, the feeder will be hand operated. When the feeder is power driven the gear p may be pushed inward on its stud to the position shown by dotted lines in Fig. 6, so as to prevent the crank from being power driven.

The side adjustment.—To adjust the sheets sidewise with reference to the medial line of the machine being supplied with sheets I provide that the entire feeding machine shall be laterally adjustable, and to this end I cause the feet of the machine to rest on transversely disposed floorways or tracks q along which the machine may be moved. r is a shaft supported in bearings held one by each of the cross braces A' so that the shaft shall be held lengthwise of the machine near to the tracks q . r' are gears secured to shaft r and operating in racks q' held by the tracks q . When the shaft r is turned the gears operate on the racks and cause the machine to be moved over the tracks. To turn the shaft r I provide a shaft s at right angles to the shaft r and supported by bearings held by one of the cross braces A' . A worm s' on shaft s operates into a worm wheel r^2 on shaft r . A hand wheel s^2 on the outer end of the shaft s affords means to turn the shaft. When the hand wheel s is turned the machine is adjusted sidewise.

Operation of the machine.—From the foregoing description of the machine its operation in feeding sheets will be readily understood.

A pack of sheets is adjusted in the holding device and the entire machine adjusted in reference to the medial line to which the sheets are to be fed. The followers E are then put in place, the speeds of the various parts are adjusted to suit the length of the sheets to be fed and the spacing out and separating device adjusted to produce the character of feeding required. The machine is hand operated, if desired, to bring the sheets forward to the feeding rollers and the operating stops are put in engagement. The machine is then started in operation. The buckling finger moves forward and forms a buckle or pucker in the edge of the most forward sheet in the pack, the individualizing blade then rises, passing first under the buckled or puckered part of the edge and thence along the entire edge of the sheet and behind that edge, and the lips on the face of the blade also pass behind the separated edge bending that edge somewhat forward. As the individualizing

blade rises the buckling finger returns to its normal position, as it returns dragging back the buckled corner of the sheet against which the frictional pad of the finger is resting over the beveled corner guard until the pads are raised from the sheet by contact with the guard thus straightening out the buckled corner. The edge bending fingers then rise passing behind the separated edge of the sheet and bending that edge about the periphery of the withdrawing drum. The power driven oscillating frictional pressure roller then makes a rearward oscillation passing over the bent edge of the sheet and by pressing that edge against the withdrawing drum produces friction on the sheet whereby the sheet is started out of the holder. As the sheet advances its forward edge passes between the power driven assistant frictional pressure roller and the withdrawing drum, and then the combined action of the oscillating frictional pressure roller and of the assistant frictional pressure rollers in conjunction with the withdrawing drum operates to complete the withdrawal of the sheet from the holder and to lay it upon the conveying apron. As soon as the edge of the sheet has passed under the influence of the assistant frictional pressure roller the oscillating frictional pressure roller returns to its normal position and the individualizing blade and the bending fingers drop to their lowermost positions. The buckling finger then buckles the next sheet and the entire cycle of movements described is repeated and so on for each sheet. When the front edge of the advanced free top sheet on the conveyer reaches the front stops it is stopped and, during such stopping, the registering device operates to register the sheet. The stop gages then release the sheet and it is seized by the feeding rollers and delivered to the mechanism which is to perform a subsequent operation upon it. By adjusting the speed of the withdrawing drum the sheets are caused to strike the stop gages at the proper instant to be stopped by them for registration or spacing out purposes.

It is apparent that many details of construction shown are not material to my invention and may be varied in many ways without departing from it and that, in adapting my improved feeding mechanism to different purposes, features of the mechanism not required for such purposes may be omitted. Thus for feeding a ruling or other machine in which it is not necessary that the forward edge of one sheet shall overlap the rear edge of another the roll elevating mechanism of the separating and spacing out device may be omitted, or, if preferred, in feeding such machines the entire separating and spacing out device may be omitted except the stop gages, in which case the feeder is placed so that the stop gages come as close as possible to the line of intake of the intaking rollers of the machine to be fed. In feeding a printing

machine or other machine having intaking grippers such grippers may seize the sheet directly from the stop gages.

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

1. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front forwardly curved on its upper part to form a convex surface for the sheets to lean against for the better support of the sheets, with means for withdrawing the outermost sheet in the pack from the lower edge of the holder.

2. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front formed of a series of rollers so disposed as to form a forward curve to the upper part of the front for the better support of the sheets, with means for withdrawing the outermost sheet in the pack from the lower edge of the holder.

3. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front constructed of a series of alternately arranged slats and rollers disposed so as to form a forward curve to the uppermost part of the front for the better support of the sheets, with means for withdrawing the outermost sheet in the pack from the lower edge of the holder.

4. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having a single inclined bottom piece reaching entirely across the holder and having an inclined front, the lower edge of which is sufficiently distant from the front edge of the bottom piece to permit the sheet to be separated from the pack and removed, a raised lip or edge along the entire front of the bottom piece adapted to retain in position the extreme lower edge of the sheets, and means for withdrawing the outermost sheet in the pack from under the inclined front of the holder.

5. In a machine for feeding sheets successively from a pack, the combination with a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined front and an inclined bottom piece reaching entirely across the holder, of a series of followers laterally adjustable upon the bottom of the holder and adapted to press upon and force the sheets downward upon the inclined bottom.

6. In a machine for feeding sheets successively from a pack, the combination of a holder

adapted to support a pack of sheets upon their edges in an approximately vertical position and having an inclined bottom, one or more followers resting upon the inclined bottom and adapted to press upon and force the sheets downward thereon, an engaging device carried by said follower and a holding device for supporting the followers when they are removed from the bottom located in a position relatively to the bottom such that, when a follower is to be removed the follower may be drawn across the bottom and the engaging device may be brought into connection with the holding device and the follower while supported by the holding device be brought into a position substantially below the inclined bottom so as not to obstruct the passage into the holder and without requiring the follower to be lifted.

7. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position and having an inclined bottom, one or more followers resting upon the inclined bottom and adapted to press upon and force the sheets downward thereon, each follower being provided with a hook or hooks, and a rod or shaft to receive the said hook or hooks when the followers are removed from the bottom extending across the bottom near its rear edge in a position relatively to the bottom such that, when a follower is to be removed, the follower may be drawn across the bottom and turned away therefrom and its hook or hooks passed over the rod or shaft so that the follower will be supported in a hanging position without requiring the follower to be lifted.

8. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the outermost sheet in the pack, means to operate and guide said finger to bring it into contact with the said outermost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the inclined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet the movements of said blade being so timed as related to the movements of the said buckling finger

that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, and a withdrawing device to operate upon the separated edge and withdraw the sheet from the pack.

9. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the outermost sheet in the pack, means to operate and guide said finger to bring it into contact with the said outermost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the inclined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet, the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, means to bend outward the separated edge, and frictional rollers adapted to seize the outwardly bent edge and to withdraw the sheet from the pack.

10. In a machine for feeding sheets from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the foremost sheet in the pack, means to operate and guide said finger to bring it into contact with the said foremost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining

the buckle in said edge of the sheet, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the inclined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, and a withdrawing device to operate upon the separated edge and withdraw the sheet from the pack.

11. In a machine for feeding sheets from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the foremost sheet in the pack, means to operate and guide said finger to bring it into contact with the said foremost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the inclined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, means to bend outward the separated edge, and frictional rollers adapted to seize the outwardly bent edge and to withdraw the sheet from the holder.

12. In a machine for feeding sheets from a pack, the combination of a holder adapted to

support a pack of sheets upon their edges in an approximately vertical position, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the foremost sheet in the pack, means to operate and guide said finger to bring it into contact with the said foremost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the inclined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet, the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, means to bend outward the separated edge, frictional rollers adapted to seize the outwardly bent edge and to withdraw the sheet from the holder, and a conveying apron to receive the sheets as they are delivered from the frictional rollers.

13. In a machine for feeding sheets, the combination of a support for a pack of sheets, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the outermost sheet in the pack, means to operate and guide said finger to bring it into contact with the said outermost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved near one corner thereof and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a stationary guard over the corner of the pack of sheets adjacent to the buckling finger, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the most advanced part of the in-

clined edge will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet, the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its inclined edge shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, and a withdrawing device to operate upon the edge separated by the blade and withdraw the sheet from the pack.

14. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, a buckling finger adapted to operate upon and form a buckle in that edge of the foremost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof and to temporarily maintain the buckle in the said edge, a stationary guard over the corner of the pack of sheets adjacent to the buckling finger, a movable blade having an edge inclined relatively to the forward edges of the sheets forming the pack adapted to enter an advanced part of its inclined edge first under said buckle while the buckle is temporarily maintained by the buckling finger and thence to pass its inclined edge under and separate the entire edge of the sheet from other sheets in the pack, and a withdrawing device to operate upon the edge separated by the blade and withdraw the sheet from the pack.

15. In a machine for feeding sheets, the combination of a support for a pack of sheets, a buckling finger adapted to operate upon and form a buckle in an edge of the outermost sheet in the pack, a fixed raised lip along the edge of the support to retard the edge of the sheet while being buckled and thereby regulate the length of the buckle according to the character of the sheets being operated upon, and a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack.

16. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined front and an inclined bottom, a buckling finger adapted to operate upon and form a buckle in the lower edge of the foremost sheet in the pack, a raised lip along the front edge of the bottom of the holder to retard the edge of the sheet while being buckled and thereby regulate the length of the buckle according to the character of the sheets being operated upon, and a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack.

17. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an oscillating arm adapted to move about a point adjacent to a side edge of the pack and having its plane of oscillation parallel to the face of the pack, a buckling finger provided at one end with a frictional pad for operating on the surface of the sheet to be buckled and at the other end pivotally attached to said arm, a spring adapted to press the padded end of the finger toward the sheets, means to oscillate said arm so as to move the rubbing pads of the buckling finger over a curved path diagonally inward over the corner of the sheets in a direction such that a buckle will be formed in that edge of the outermost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof, a stationary guard over the corner of the pack of sheets adjacent to the buckling finger, a stationary cam on the outer surface of the guard to engage the buckling finger when it is retracted and raise its frictional pads clear of the guard and a movable blade having an edge inclined relatively to the forward edges of the sheets forming the pack adapted to enter an advanced part of its inclined edge first under said buckle and thence to pass its inclined edge under and separate the entire edge of the sheet from other sheets in the pack.

18. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an oscillating arm adapted to move about a point adjacent to a side edge of the pack and having its plane of oscillation parallel to the face of the pack, a buckling finger provided at one end with a frictional pad for operating on the surface of the sheet to be buckled and at the other end pivotally attached to said arm, a spring adapted to press the padded end of the finger toward the sheets, means to oscillate said arm so as to move the rubbing pads of the buckling finger over a curved path diagonally inward over the corner of the sheets in a direction such that a buckle will be formed in that edge of the outermost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof, a stationary guard over the corner of the pack of sheets adjacent to the buckling finger, a stationary cam on the outer surface of the guard to engage the buckling finger when it is retracted and raise its frictional pads clear of the guard and a movable blade having an edge inclined relatively to the forward edges of the sheets forming the pack adapted to enter an advanced part of its inclined edge first under said buckle and thence to pass its inclined edge under and separate the entire edge of the sheet from other sheets in the pack, and means for adjusting the connections between said oscillating arm and the means that oscillate it whereby the path followed by the rubbing pads of the buckling finger may be caused to overlie the corner of

the sheets beyond the guard to a greater or less extent.

19. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an oscillating arm adapted to move about a point adjacent to a side edge of the pack and having its plane of oscillation parallel to the face of the pack, a buckling finger provided at one end with a frictional pad for operating on the surface of the sheet to be buckled and at the other end pivotally attached to said arm, a spring adapted to press the padded end of the finger toward the sheets, a side arm attached to said oscillating arm, a spring attached to said side arm adapted normally to retain the buckling finger in a forward position, cam devices to operate said side arm and connected parts so as to move the rubbing pads of the buckling finger in a curved path diagonally inward over the corner of the sheets in a direction such that a buckle will be formed in that edge of the outermost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof, a stationary cam to engage the buckling finger when it is retracted and lift it away from the sheets, and a movable blade having an edge inclined relatively to the forward edges of the sheets forming the pack adapted to enter an advanced part of its inclined edge first under said buckle and thence to pass its inclined edge under and separate the entire edge of the sheet from other sheets in the pack.

20. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an oscillating arm adapted to move about a point adjacent to a side edge of the pack and having its plane of oscillation parallel to the face of the pack, a buckling finger provided at one end with a frictional pad for operating on the surface of the sheet to be buckled and at the other end pivotally attached to said arm, a spring adapted to press the padded end of the finger toward the sheets, a side arm attached to said oscillating arm, a spring attached to said side arm adapted normally to retain the buckling finger in a forward position, cam devices to operate said side arm and connected parts so as to move the rubbing pads of the buckling finger in a curved path diagonally inward over the corner of the sheets in a direction such that a buckle will be formed in that edge of the outermost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof, a stationary cam to engage the buckling finger when it is retracted and lift it away from the sheets, and a movable blade having an edge inclined relatively to the forward edges of the sheets forming the pack adapted to enter an advanced part of its inclined edge first under said buckle and thence to pass its inclined edge under and separate the entire edge of the sheet from other sheets in the pack, and

means for adjusting the position of said side arm relatively to said oscillating arm whereby the path followed by the rubbing pads of the buckling finger may be caused to overlie the sheets to a greater or less extent.

21. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets on their edges in an approximately vertical position having an inclined bottom and an inclined front, an oscillating arm adapted to move about a point adjacent to a side of the holder, a buckling finger provided at one end with a frictional pad for operating on the surface of the sheet to be buckled and at the other end pivotally attached to said arm, a spring adapted to press the padded end of the finger toward the sheets, a side arm attached to said oscillating arm, a spring attached to said side arm adapted normally to retain the buckling finger in a forward position, a cam to operate said side arm and connected parts so as to move the rubbing pads of the buckling finger in a curved path diagonally inward over a corner of the sheet thereby forming a buckle in the edge of the outermost sheet in the pack near one corner thereof, power transmitting connections between the cam and side lever, and a stationary cam to engage the buckling finger when it is retracted and lift it away from the sheets.

22. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, a buckling finger mounted adjacent to the pack of sheets and adapted to seize upon the surface of the outermost sheet in the pack, means to operate and guide said finger to bring it into contact with the said outermost sheet at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved and then to cause it to move in a direction diagonally inward along said most advanced edge of the sheet so as to cause a portion of that edge to be buckled and then to cause the finger to assume temporarily a state of rest thereby temporarily maintaining the buckle in said edge of the sheet, a reciprocating blade having a slanting edge with a pointed projection from the high end of the edge, means to give a reciprocating movement to said blade, means to support and guide said blade so that when it moves its inclined edge will move in a plane adjacent to the surface of the pack and so that the said pointed projection from the edge of the blade will move in a line directed toward the opening under said buckle when the buckle is formed in the edge of the sheet, the movements of said blade being so timed as related to the movements of the said buckling finger that when the blade moves toward the pack its pointed projection shall enter first under the buckle formed in the edge of the sheet by the buckling finger while the said buckle is temporarily maintained by the finger and thence pass under and separate the entire edge of the sheet from other sheets in the pack, and a

withdrawing device to operate upon the separated edge and withdraw the sheet from the pack.

23. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, a buckling finger adapted to seize upon the surface of the foremost sheet in the pack at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved, means to operate said buckling finger to bring the finger first into contact with the sheet and then to cause it to move in a direction so related to said most advanced edge of the sheet as to cause a portion of that edge to be buckled and then to temporarily maintain the buckle in said edge, a reciprocating blade having a slanting edge with a pointed projection from the high end of the edge, means to reciprocate said blade in a plane adjacent to the surface of the pack and to cause its pointed projection to enter first under the buckle in the edge of the sheet while the said buckle is temporarily maintained by the buckling finger and thence to pass its inclined edge under the entire edge of the sheet and separate it from other sheets in the pack, means to bend outward the separated edge, and frictional rollers adapted to seize the outwardly bent edge and withdraw the sheet from the holder.

24. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, a buckling finger adapted to seize upon the surface of the foremost sheet in the pack at a point on that edge of the sheet which lies most advanced in the direction in which the sheet is to be moved, means to operate said buckling finger to bring the finger first into contact with the sheet and then to cause it to move in a direction so related to said most advanced edge of the sheet as to cause a portion of that edge to be buckled and then to temporarily maintain the buckle in said edge, a movable blade having an edge inclined relatively to the forward edge of the sheets forming the pack, means to move said blade in a plane adjacent to the surface of the pack and to cause its inclined edge to enter first under the buckle in the edge of the sheet while the said buckle is temporarily maintained by the buckling finger and thence to pass under the entire edge of the sheet and separate it from other sheets in the pack, cam devices to operate said blade, means to bend outward the separated edge, and frictional rollers adapted to seize the outwardly bent edge and to withdraw the sheet from the holder.

25. In a machine for feeding sheets, the combination of a support for a pack of sheets, an individualizing device adapted to operate upon that edge of the outermost sheet which lies most advanced in the direction in which the sheet is to be moved and to separate that edge from other sheets in the pack, a with-

drawing drum mounted adjacent to the pack adapted by frictional contact to seize upon the surface of a sheet when the sheet is pressed against it, means for bending the separated edge of the sheet outward from the pack around the surface of the drum, a power driven oscillating frictional pressure roller adapted to pass over the bent edge of the sheet and press the sheet against the surface of the drum and thereby cause the sheet to be withdrawn from the pack, and power devices to operate the said individualizing device and the said edge bending means to cause the individualizing device to act upon and individualize a series of sheets and to cause the edge bending means to bend outward the edge of each sheet after it is individualized while sheets previously individualized and bent outward are in process of withdrawal from the pack whereby a series of overlapping sheets may be acted upon simultaneously by the withdrawing drum and pressure roller.

26. In a machine for feeding sheets, the combination of a support for a pack of sheets, a buckling finger adapted to operate upon and form a buckle in that edge of the outermost sheet in the pack which lies most advanced in the direction in which the sheet is to be moved near one corner thereof, a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the pack adapted by frictional contact to seize upon the surface of a sheet when the sheet is pressed against it, means for bending the separated edge of the sheet outward from the pack around the surface of the drum, a power driven oscillating frictional pressure roller adapted to pass over the bent edge of the sheet and press the sheet against the surface of the drum and thereby cause the sheet to be withdrawn from the pack, and power devices to operate the said buckling finger, the said movable blade and the said edge bending means to cause the buckling finger and movable blade to act upon and individualize a series of sheets and to cause the edge bending means to bend outward the edge of each sheet after it is individualized while sheets previously individualized and bent outward are in process of withdrawal from the pack, the buckling finger being moved in each operation away from the front of each sheet that has been individualized and after the individualized sheet is bent outward passed between the pack and the outwardly bent sheet to operate upon the surface of the next sheet, whereby a series of overlapping sheets may be acted upon simultaneously by the withdrawing drum and pressure roller.

27. In a machine for feeding sheets, the combination of a support for a pack of sheets, a buckling finger adapted to operate upon and form a buckle in that edge of the outermost sheet in the pack which lies most advanced

in the direction in which the sheet is to be moved near one corner thereof, a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the pack adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, means for bending the separated edge of the sheet around the surface of the drum, and a power driven oscillating frictional pressure roller adapted to pass over the bent edge of the sheet and press the sheet against the surface of the drum and thereby cause the sheet to be withdrawn from the pack, a power driven stationary frictional pressure roller adapted to operate upon the sheet as it passes from the oscillating frictional pressure roller to assist in the withdrawal of the sheet from the pack and to guide the same upon a conveyer, and a conveyer to receive the sheets as they are delivered from the frictional rollers.

28. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, an individualizing device adapted to separate an edge of the foremost sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, and a pressure roller adapted to pass over the bent edge of the sheet and press the edge against the surface of the drum and thereby cause the sheet to be withdrawn from the holder.

29. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, an individualizing device adapted to separate an edge of the foremost sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, and a power driven oscillating frictional pressure roller having a series of disks adapted to pass between the edge bending fingers and over the bent edge of the sheet sustained by the fingers and to press the edge against the surface of the drum and thereby cause the sheet to be withdrawn from the holder.

30. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined

bottom and an inclined front, a buckling finger adapted to operate upon and form a buckle in an edge of the foremost sheet in the pack near one corner thereof, a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, and a power driven oscillating frictional pressure roller having a series of disks adapted to pass between the edge bending fingers and over the bent edge of the sheet sustained by the fingers and to press the edge against the surface of the drum and thereby cause the sheets to be withdrawn from the holder.

31. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, a buckling finger adapted to operate upon and form a buckle in an edge of the foremost sheet in the pack near one corner thereof, a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack, a series of lips attached to said blade and moving with it and adapted to bend outward the edge of the sheet when the blade passes under it, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of a sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the bent edge of the sheet and to lift that edge and curve it around the surface of the drum, and a power driven oscillating frictional pressure roller having a series of disks adapted to pass between the edge bending fingers and over the bent edge of the sheet sustained by the fingers and to press the edge against the surface of the drum and thereby cause the sheet to be withdrawn from the holder.

32. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, an individualizing device adapted to separate an edge of the foremost sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, a power driven frictional pressure roller mounted on a transverse bar suspended by arms or rods

in such manner that the roller may oscillate concentrically over a section of the periphery of the withdrawing drum, and means for oscillating the pressure roller to cause it to pass over the bent edge of the sheet to press the edge against the surface of the drum and cause the sheet to be withdrawn from the holder.

33. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, an individualizing device adapted to separate an edge of the foremost sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, cam devices to operate the said fingers, a power driven frictional pressure roller mounted on a transverse bar suspended by arms or rods in such manner that the roller may oscillate concentrically over a section of the periphery of the withdrawing drum, and cam actuated devices for oscillating the pressure roller to cause it to pass over the bent edge of the sheet to press the edge against the surface of the drum and cause the sheet to be withdrawn from the holder.

34. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom and an inclined front, an individualizing device adapted to separate an edge of the foremost sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, a power driven oscillating frictional pressure roller having a series of disks adapted to pass between the edge bending fingers and over the bent edge of the sheet sustained by the fingers and to press the edge against the surface of the drum and thereby cause the sheet to be withdrawn from the holder, a power driven stationary frictional pressure roller adapted to operate upon the sheet as it passes from the oscillating frictional pressure roller to assist in the withdrawal of the sheet from the holder and to guide the same upon a conveyor, guide fingers adapted to direct the edge of the sheet as it passes from the oscillating to the stationary frictional pressure roller, and a conveyor to receive the sheets as they are delivered from the frictional rollers.

35. In a machine for feeding sheets, the combination of a holder adapted to support a pack of sheets upon their edges in an ap-

proximately vertical position having an inclined bottom and an inclined front, a buckling finger adapted to operate upon and form a buckle in an edge of the foremost sheet in the pack near one corner thereof, a movable blade having a slanting edge adapted to enter first under said buckle and thence to pass under and separate the entire edge of the sheet from other sheets in the pack, a withdrawing drum mounted adjacent to the front of the holder adapted by frictional contact to seize upon the surface of the sheet when the sheet is pressed against it, reciprocating fingers adapted to pass behind the separated edge of the sheet and to bend that edge around the surface of the drum, a power driven oscillating frictional pressure roller having a series of disks adapted to pass between the edge bending fingers and over the bent edge of the sheet sustained by the fingers and to press the edge against the surface of the drum and thereby cause the sheets to be withdrawn from the holder, a power driven stationary frictional pressure roller adapted to operate upon the sheet as it passes from the oscillating frictional pressure roller to assist in the withdrawal of the sheet from the holder and to guide the same upon a conveyer, guide fingers adapted to direct the edge of the sheet as it passes from the oscillating to the stationary frictional pressure roller, and a conveyer to receive the sheets as they are delivered from the frictional rollers.

36. In a machine for feeding sheets, the combination of a support for a pack of sheets, an individualizing device adapted to operate upon that edge of the outermost sheet which lies most advanced in the direction in which the sheet is to be moved and to separate that edge from other sheets in the pack, an edge bending device to bend the separated edge outward from the pack, a withdrawing device to seize upon the separated edge after it is bent outward and withdraw the sheet from the pack, a conveyer to receive the sheets as they pass from the withdrawing device, power devices to operate the said individualizing device and the said edge bending device to cause the individualizing device to act upon and individualize a series of sheets and to cause the edge bending device to bend outward the edge of each sheet after it is individualized while sheets previously individualized are in process of withdrawal from the pack and power devices to operate the said withdrawing device independently of the operations of the individualizing and the edge bending devices so that the withdrawing device can act continuously upon the series of sheets without interfering with the action of the individualizing and edge bending devices all combined and operated so that a series of overlapping sheets will be acted on simultaneously by the withdrawing device and be placed upon the conveyer in a series lying one upon another with the forward edge of

each sheet somewhat advanced beyond the forward edge of the next following sheet.

37. In a machine for feeding sheets, the combination of a support for a pack of sheets, an individualizing device adapted to operate upon that edge of the outermost sheet which lies most advanced in the direction in which the sheet is to be moved and to separate that edge from other sheets in the pack, an edge bending device to bend the separated edge outward from the pack, a withdrawing device to seize upon the separated edge after it is bent outward and withdraw the sheet from the pack, a conveyer to receive the sheets as they pass from the withdrawing device, power devices to operate the said individualizing device and the said edge bending device to cause the individualizing device to act upon and individualize a series of sheets and to cause the edge bending device to bend outward the edge of each sheet after it is individualized while sheets previously individualized are in process of withdrawal from the pack and power devices to operate the said withdrawing device independently of the operation of the individualizing and the edge bending devices so that the withdrawing device can act continuously upon the series of sheets without interfering with the action of the individualizing and edge bending devices all combined and operated so that a series of overlapping sheets will be acted on simultaneously by the withdrawing device and be placed upon the conveyer in a series lying one upon another with the forward edge of each sheet somewhat advanced beyond the forward edge of the next following sheet, and means to vary the speed with which the withdrawing device shall withdraw the sheets from the pack relatively to the frequency of action of the individualizing device whereby the number of sheets which may be in process of withdrawal from the pack at the same time and the extent by which the forward edges of the sheets shall be advanced beyond one another when they are laid upon the conveyer may be varied.

38. In a sheet feeding machine in which the sheets are placed upon a conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet the combination with the conveyer of stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, two or more side registering fingers arranged at intervals along the side edge of the conveyer each finger being provided with a frictional pad adapted to engage the side edge of the free top sheet of the series of sheets upon the conveyer, means to operate said fingers so as to cause them to act simultaneously upon the edge of the sheet to draw the sheet laterally, a side registering stop against which the sheet is drawn by the registering fingers, and a feed board below the surface of the conveyer to

sustain the sheets when acted upon by the registering fingers.

39. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, a series of side registering fingers R provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers and to move the sheet laterally against a side stop, a feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a stationary side stop to determine the side alignment of the sheets when they are moved against it by the registering fingers, means to move the fingers R laterally with an intermittent reciprocating movement, means to raise and drop the fingers R and to time the rising and dropping of the fingers relatively to their lateral movements so that the fingers may drop upon the edge of the sheet at or soon after the commencement, and may rise from the sheet at or shortly before the termination of the lateral movement of the fingers toward the side stop, and means to vary the times of dropping and rising of the fingers relatively to their lateral movements whereby the fingers may be caused to act upon the sheet during a greater or less portion of the lateral movement of the fingers when they move toward the side stops so as to vary the operative effect of the fingers upon the sheet and adapt those effects to sheets of different thicknesses or degrees of flexibility.

40. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, a series of side registering fingers provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers and to move the sheet laterally against a side stop, a feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a stationary side stop to determine the side alignment of the sheets when they are moved against it by the registering fingers, means to move the registering fingers laterally with an intermittent reciprocating movement, means to raise and drop the fingers at the proper times, and a yielding connection between each registering finger and the means which reciprocate it laterally so arranged that the finger will be operated through the medium of the yielding connection when the finger is moved toward

the side stop whereby the fingers may yield and stop whenever the resistance to the movement of the finger in drawing the sheet laterally exceeds a certain normal amount.

41. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, side registering fingers R provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers, and to move the sheet laterally against a side stop a feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a side stop to determine the side alignment of the sheets when they are moved against it by the registering fingers, the rods U pivoted to fingers R, swivels U' through which the rods U pass, means to vibrate the rods U through the medium of swivels U' to give the horizontal movement to fingers R, means for raising and lowering the fingers R at the proper times, and coil springs U⁶ about the rods U so disposed in relation to swivels U' that the outward or registering stroke shall be given to the rod U and fingers R through the spring whereby a yielding stroke may be given to the fingers R when in the act of registering the sheets.

42. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, side registering fingers R provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers and to move the sheet laterally against a side stop, a feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a side stop to determine the side alignment of the sheets when they are moved against it by the registering fingers, the rocker rod S', oscillating lever S carried by the rod S' and adapted to support the fingers R at their upper ends, the rocker rod V, arms U⁵ carried by rocker rod V, the rod U³ supported by arms U⁵, clamp pieces U² on the rod U³, swivel pieces U' swiveled into clamp pieces U², rods U connected with the pieces U' and pivoted to fingers R and cam devices to rock the rods S' and V intermittently whereby the proper movements for registering the sheet will be communicated to the fingers R, substantially as and for the purpose described.

43. In a machine for feeding sheets from a pack, the combination of a support for a pack

of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, stop fingers adapted to engage the front edges 5 of the sheets successively as they pass upon the conveyer to arrest their forward movement, side registering fingers provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers and to 10 move the sheet laterally against a side stop, a feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a side stop to determine the side alignment of the sheets when they 15 are moved against it by the registering fingers, arms and rods to support the registering fingers, supports for said arms and rods arranged longitudinally along the side of the 20 conveyer, adjustable connections between said arms and rods and their supports whereby the said arms and the registering fingers may be adjusted to different positions upon their supports along the side of the conveyer and 25 means to operate said arms and rods adapted to communicate motion to said arms and rods and to the registering fingers in whatever position they may be adjusted to register the sheets.

30 44. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, 35 stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward movement, side registering fingers R provided with frictional pads adapted to engage the side 40 edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers, and to move the sheet laterally against a side stop, a feed board below the surface of the conveyer to sustain the sheets when acted upon 45 by the registering fingers, a side stop to determine the side alignment of the sheets when they are moved against it by the registering fingers, the rocker bar S', arms S carried by the bar S' and adapted to support fingers R at their upper ends, the rod U³, clamp pieces 50 U² carried by the rod U³, connections between the rod U³ and fingers R, the arms S and clamp pieces U² being adjustably secured to their respective bar and rod so that the arms and clamp pieces, the fingers R and connecting 55 parts may be adjusted to different positions along the side of the conveyer, and means to operate the bar S' and rod U³ whereby motion will be communicated from the bar and rod through the connecting parts to the 60 fingers R in whatever position the fingers may be adjusted, to register the sheet.

45. In a machine for feeding sheets from a pack, the combination of a support for a pack 65 of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack,

stop fingers adapted to engage the front edges of the sheets successively as they pass upon the conveyer to arrest their forward move- 70 ment, side registering fingers R provided with frictional pads adapted to engage the side edge of a sheet upon the conveyer when the sheet is arrested by the stop fingers, and to move the sheet laterally against a side stop, a 75 feed board below the surface of the conveyer to sustain the sheets when acted upon by the registering fingers, a side stop to determine the side alignment of the sheets when they are moved against it by the registering fin- 80 gers, the rocker bar S', arms S carried by the bar S' and adapted to support fingers R at their upper ends, the rod U³, clamp pieces U² secured on the rod U³, swivel pieces U' carried by clamp pieces U², rods U connected 85 with swivels U' and pivoted to fingers R, means to operate the bar S' and rod U³ so that motion will be communicated from the bar and rod through the connecting parts to the 90 fingers R to register the sheet, and means for adjusting the levers S to the rod S' in a raised position so that the fingers R in their movements will be held away from contact with the sheets for the purpose described.

46. In a machine for feeding sheets from a 95 pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, a shaft arranged across the conveyer, depend- 100 ing fingers attached to said shaft in a series along its length, cam devices embracing an arm having a constant amplitude of vibration for rocking the shaft to cause the fingers to descend at intervals upon the conveyer, a 105 flexible or yielding connection between the said arm and the shaft which by bending or yielding whenever the fingers are arrested in their descent by coming into contact with a sheet upon the conveyer will permit the vi- 110 bratory movement of constant amplitude in said arm to be converted into a rocking motion of variable amplitude in said shaft, stopping devices for stopping the operation of the machine, and a connection between the stop- 115 ping devices and the rocking shaft, all combined and operated so that the machine will be stopped whenever a sheet is not present upon the conveyer under the fingers when they descend. 120

47. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, 125 a shaft arranged across the conveyer, depending fingers attached to said shaft in a series along its length, cam devices for rocking the shaft to cause the fingers to descend at intervals upon the conveyer, a yielding or flexible 130 connection between the cam devices and the shaft, stopping devices for stopping the operation of the machine, a connection between the stopping devices and the rocking shaft,

all combined and operating so that the machine will be stopped whenever a sheet is not present upon the conveyer under the fingers when they descend, and a hand lever by which the shaft may be rocked to lift the fingers away from the conveyer, and means for locking the shaft with its fingers in a permanently raised position, whereby the stopping devices may be thrown out of operation whenever these devices are not required to act.

48. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, a shaft arranged across the conveyer carrying horizontal arms, a rod supported by the horizontal arms, a series of fingers carried by the rod, the fingers and their rod being so placed in relation to the shaft that their weight, if unrestrained, will cause the shaft to rock and permit the fingers to descend upon the conveyer there to be sustained by a sheet or if there be no sheet to descend below the conveyer, means for controlling the shaft whereby the fingers will be held above the conveyer except at intervals when they are allowed to descend, a stopping device for stopping the operation of the machine, and a connection between the stopping device and the rocking shaft, all combined and operating so that the machine will be stopped whenever the fingers descend below the surface of the conveyer.

49. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, means for removing the sheets successively from the pack, a conveyer to receive the sheets as they are removed from the pack, a shaft arranged across the conveyer, depending fingers attached to said shaft in a series along its length, means for rocking the shaft in such manner that the fingers will descend at intervals upon the conveyer and be sustained in a certain normal position by a sheet upon the conveyer, or if there be no sheet will descend below the conveyer, a motion arresting device for stopping the operation of the machine, an arrangement of levers combined to form a toggle joint, a connection between the motion arresting device and the toggle, a spring acting on the toggle to normally bend it and operate the motion arresting device, a rod having a hook adapted to engage the joint of the toggle, and a yielding or flexible connection between the rod and the rocking shaft, all combined and operating so that the machine will be stopped whenever the sustaining fingers descend below their said normal position.

50. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom, means for withdrawing the sheets successively from the pack, a follower resting on the inclined bot-

tom and adapted to press upon and force the sheets downward thereon, and a stop motion device actuated by the follower as it passes down the inclined bottom to stop the operation of the machine whenever the pack of sheets in the holder becomes to a certain extent reduced by the withdrawal of sheets.

51. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom, means for withdrawing the sheets successively from the pack, a follower resting on the inclined bottom and adapted to press upon and force the sheets downward thereon, a rocking lever pivotally attached to a side of the holder, a pin carried by an end of the rocking lever, a bolt carried by the follower adapted to engage said pin when the follower reaches a certain position as it passes down by the side of the holder, stopping devices for stopping the operation of the machine, and a connection between the stopping devices and the rocking lever, all combined and operating so that the machine will be stopped whenever the pack of sheets in the holder becomes to a certain extent reduced by the withdrawal of sheets.

52. In a machine for feeding sheets successively from a pack, the combination of a holder adapted to support a pack of sheets upon their edges in an approximately vertical position having an inclined bottom, means for withdrawing the sheets successively from the pack, a follower resting on the inclined bottom and adapted to press upon and force the sheets downward thereon, a rocking lever pivotally attached to a side of the holder, a pin carried by an end of the rocking lever, a bolt carried by the follower adapted to engage said pin when the follower reaches a certain position as it passes down by the side of the holder, stopping devices for stopping the operation of the machine, and a connection between the stopping devices and the rocking lever, all combined and operating so that the machine will be stopped whenever the pack of sheets in the holder becomes to a certain extent reduced by the withdrawal of sheets, and means for changing the relative position of said pin and bolt to allow the follower to pass without operating the stopping device.

53. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an individualizing device adapted to individualize the outermost sheet from others in the pack, a removing device for removing the individualized sheet from the pack, a conveyer to receive the sheets as they pass from the removing means, a stop gage across the forward end of the conveyer consisting of an upper stationary and a lower oscillating member the lower member terminating forwardly in a lip or edge adapted to rest against the upper member and when so resting to engage the sheets along their advanced front

edges to arrest their forward movement, and means for periodically oscillating said lower member to release the sheets thereby regulating the feeding of the sheets so that they will be delivered at precise intervals to the devices which are to receive them.

54. In a machine for feeding sheets from a pack, the combination of a support for a pack of sheets, an individualizing device adapted to individualize the outermost sheet from others in the pack, a removing device for removing the individualized sheet from the pack, a conveyer to receive the sheets as they pass from the removing means, a stop gage across the forward end of the conveyer comprising an upper member consisting of a horizontal stationary bar carrying a series of fingers and a lower member consisting of a horizontal oscillating bar also carrying a series of fingers, the fingers of the lower member terminating forwardly in a lip or edge adapted to rest against the upper stationary fingers, and cam devices for intermittently oscillating said lower member whereby the sheets passing upon the conveyer will be alternately stopped and released so as to regulate the delivery of the sheets to the devices which are to receive them.

55. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, and means for adjusting the speed of the feeding rollers relatively to the frequency of releasement of the sheets by the stop fingers, whereby the sheets may be removed from the conveyer successively with their adjacent edges in contact or with spaces of any width between adjacent edges or with the forward edge of each sheet lying in advance of the rear edge of the sheet which next precedes it.

56. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement

of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, intaking rollers to receive the sheets from the feeding rollers having a relatively slower surface speed than the feeding rollers, a depressed feed table between the feeding rollers and the intaking rollers and means for elevating the top feeding roller when the forward edge of each sheet has reached the intaking rollers and to lower it when the rear edge of each sheet has passed from between the feeding rollers, all operating together substantially as described for feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it.

57. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, intaking rollers to receive the sheets from the feeding rollers having a relatively slower surface speed than the feeding rollers, a depressed feed table between the feeding rollers and the intaking rollers and means for elevating the top feeding roller consisting of a horizontal bar upon which the feeding roller is mounted, vertical guides for directing the movements of the bar and intermittently operated cam devices for raising and lowering the bar, all operating together substantially as described for feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it.

58. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, intaking rollers to receive the sheets from the feeding rollers having a relatively slower surface speed than

the feeding rollers, a depressed feed table between the feeding rollers and the intaking rollers, means for elevating the top feeding roller consisting of a horizontal bar upon which the feeding roller is mounted, vertical guides for directing the movements of the bar and intermittently operated cam devices for raising and lowering the bar, all operating together substantially as described for feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it, and a stop for throwing the cam devices of the roll elevating mechanism out of action to stop that mechanism when it is not required for use.

59. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, intaking rollers to receive the sheets from the feeding rollers having a relatively slower surface speed than the feeding rollers, a depressed feed table between the feeding rollers and the intaking rollers, and means for elevating the top feeding roller consisting of a horizontal bar upon which the feeding roller is mounted, vertical guides for directing the movements of the bar, cam devices for raising and lowering the bar, a shaft carrying the cams of the cam devices, a gear a^4 for intermittently driving the cam carrying shaft, a gear d' on the cam carrying shaft gearing with the gear a^4 and having a portion of its periphery cut away, a spring actuated pawl d^2 carried by the gear d' , and a guard e for controlling the pawl d^2 , all operating together substantially as described for feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it.

60. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they

are released by the stop fingers and to remove them from the conveyer, intaking rollers to receive the sheets from the feeding rollers having a relatively slower surface speed than the feeding rollers, a depressed feed table between the feeding rollers and the intaking rollers, means for elevating the top feeding roller consisting of a horizontal bar upon which the feeding roller is mounted, vertical guides for directing the movements of the bar, cam devices for raising and lowering the bar, a shaft carrying the cams of the cam devices, a gear a^4 for intermittently driving the cam carrying shaft, a gear d' on the cam carrying shaft gearing with the gear a^4 and having a portion of its periphery cut away, a spring actuated pawl d^2 carried by the gear d' and a guard e for controlling the pawl d^2 , all operating together substantially as described for feeding sheets with the forward edge of each sheet lying over the rear edge of the sheet which next precedes it, and a stop for throwing the gear a^4 of the roll elevating mechanism out of action to stop that mechanism when it is not required for use.

61. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, and an adjustable feed table to direct the sheets as they pass from between the feeding rollers.

62. In a machine for feeding sheets from a pack, the combination with a support for a pack of sheets, a conveyer to receive the sheets when they are withdrawn from the pack and to convey them therefrom, means for withdrawing the sheets from the pack and placing them upon the conveyer lying one upon another in a series with the forward edge of each sheet somewhat advanced beyond the forward edge of the next succeeding sheet, stop fingers adapted to engage the advanced front edges of the sheets successively as they pass upon the conveyer to arrest the forward movement of the sheets and to periodically release them, feeding rollers to receive the sheets as they are released by the stop fingers and to remove them from the conveyer, the feed table h having projections therefrom, brackets h^3 having an inclined edge adapted to support and direct the movements of the forward part of the table by engaging the projections therefrom, the shaft k , levers h^4 carried by the shaft k and pivoted to the rear

part of the table whereby the table may be moved whenever the shaft k is rocked, the hand lever k' secured to shaft k , a section of ratchet toothing k^2 carried by lever k' , and the pawl k^3 adapted to engage the ratchet on the lever k' whereby the table h may be retained in any adjusted position substantially as described.

63. In a machine for feeding sheets, the combination with a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, means for withdrawing the sheets from the pack in such manner that the withdrawal of each sheet shall be commenced before the preceding sheet has been fully withdrawn from the pack whereby the sheets when withdrawn shall lie one upon another in a series with the forward edge of each sheet more or less advanced beyond the forward edge of the next following sheet, a conveyer arranged to receive the withdrawn sheets and feeding rollers for removing the sheets from the conveyer, of a power distributing or counter shaft from which the withdrawing device and conveyer are driven, a main power shaft from which the counter shaft and feeding rollers are driven, and a stop between the countershaft and the main driving shaft whereby the countershaft and parts driven therefrom may be stopped without stopping the main power shaft and parts driven therefrom, for the purpose described.

64. In a machine for feeding sheets the combination with a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, an individualizing device adapted to separate an edge of the outermost sheet from other sheets in the pack, a withdrawing device to operate upon the separated edge and withdraw the sheet from the holder, and a conveyer arranged to receive the withdrawn sheets, of a cam shaft from which the individualizing device is operated, a power distributing or countershaft from which the cam shaft, the withdrawing device and conveyer are driven, and a stop between the cam shaft and the countershaft whereby the cam shaft, the individualizing device and parts connected therewith may be stopped while the other parts of the feeder continue in operation, for the purpose described.

65. In a machine for feeding sheets, the combination with a holder adapted to support a pack of sheets upon their edges in an approximately vertical position, means for withdrawing the sheets from the pack in such manner that the withdrawal of each sheet shall be commenced before the preceding sheet has been fully withdrawn from the pack whereby the sheets when withdrawn shall lie one upon another in a series with the forward edge of each sheet more or less advanced beyond the forward edge of the next following sheet, a conveyer arranged to receive the withdrawn sheets, of a power distributing or countershaft from which the withdrawing device and conveyer are driven, power devices to drive

the countershaft, a stop between the countershaft and the power devices whereby the countershaft and parts driven therefrom may be disconnected from the power devices, and a hand operated device for driving the countershaft and parts connected therewith by hand when the stop is disengaged for the purpose described.

66. In a machine for feeding sheets successively from a pack, the combination of two frictional rollers adapted to pass or feed sheets successively between them, one of the rollers consisting of a series of spools each spool carrying a frictional disk at each end and each spool mounted by a narrow central portion upon a thin and flexible shaft, a series of bearings adapted to said shaft at intervals along its length, and springs adapted to press upon each of said bearings, all combined and arranged to cause the disks to press against the opposed roller with a uniform but yielding pressure so as to conform individually to the irregularities of the sheets passing between the disks.

67. In a sheet feeding machine, the combination of two or more floor ways or tracks disposed transversely to and adapted to support the machine, a gear rack carried by each of said ways, a longitudinal shaft attached to the machine at right angles to said ways, gears on said shaft adapted to gear one into each of said racks, a worm wheel on said shaft, a cross shaft attached to the machine parallel to said ways, a worm on said cross shaft adapted to operate said worm wheel, and a hand device attached to and adapted to turn said cross shaft, all constructed substantially as shown and described for the purpose of adjusting the sheet feeding machine and the sheets fed thereby sidewise in reference to the medial line of the machine being supplied with sheets.

68. In a machine for feeding sheets successively from a pack, the combination of two frictional rollers adapted to pass or feed sheets successively between them, one of the rollers consisting of a series of disks mounted on a thin and flexible shaft, a series of bearings adapted to said shaft at intervals along its length each provided with a stem, a series of sockets adapted to receive the stems of the bearings a bar adapted to connect and support said sockets, and a spring about each of said stems adapted to press upon each of said bearings, all combined and arranged to cause the disks to press against the opposed roller with a uniform but yielding pressure so as to conform individually to the irregularities of the sheets passing between the disks.

69. In a machine for feeding sheets successively from a pack, the combination of two frictional rollers adapted to pass or feed sheets successively between them, one of the rollers consisting of a series of disks mounted on a thin and flexible shaft, a series of bearings adapted to said shaft at intervals along its length each provided with a stem, a series of

sockets adapted to receive the stems of the bearings, a bar adapted to connect and support said sockets, and a spring about each of said stems adapted to press upon each of said
5 bearings, all combined and arranged to cause the disks to press against the opposed roller with a uniform but yielding pressure so as to conform individually to the irregularities of the sheets passing between the disks, and a
10 key plug inserted in an end of each of said

sockets adapted to bear upon said springs and to adjust the tension thereof whereby the pressure of the disks against the opposed roller may be varied.

In testimony of which invention I have here- 15
unto set my hand.

JOHN HENRY KNOWLES.

Witnesses:

ERNEST HOWARD HUNTER,
C. H. NEWCOMB.