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SHEET SEPARATOR AND FEEDER.

APPLICATION FILED JULY 11, 1908. RENEWED MAY 6, 1913.

1,167,367.

Patented Jan. 4, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

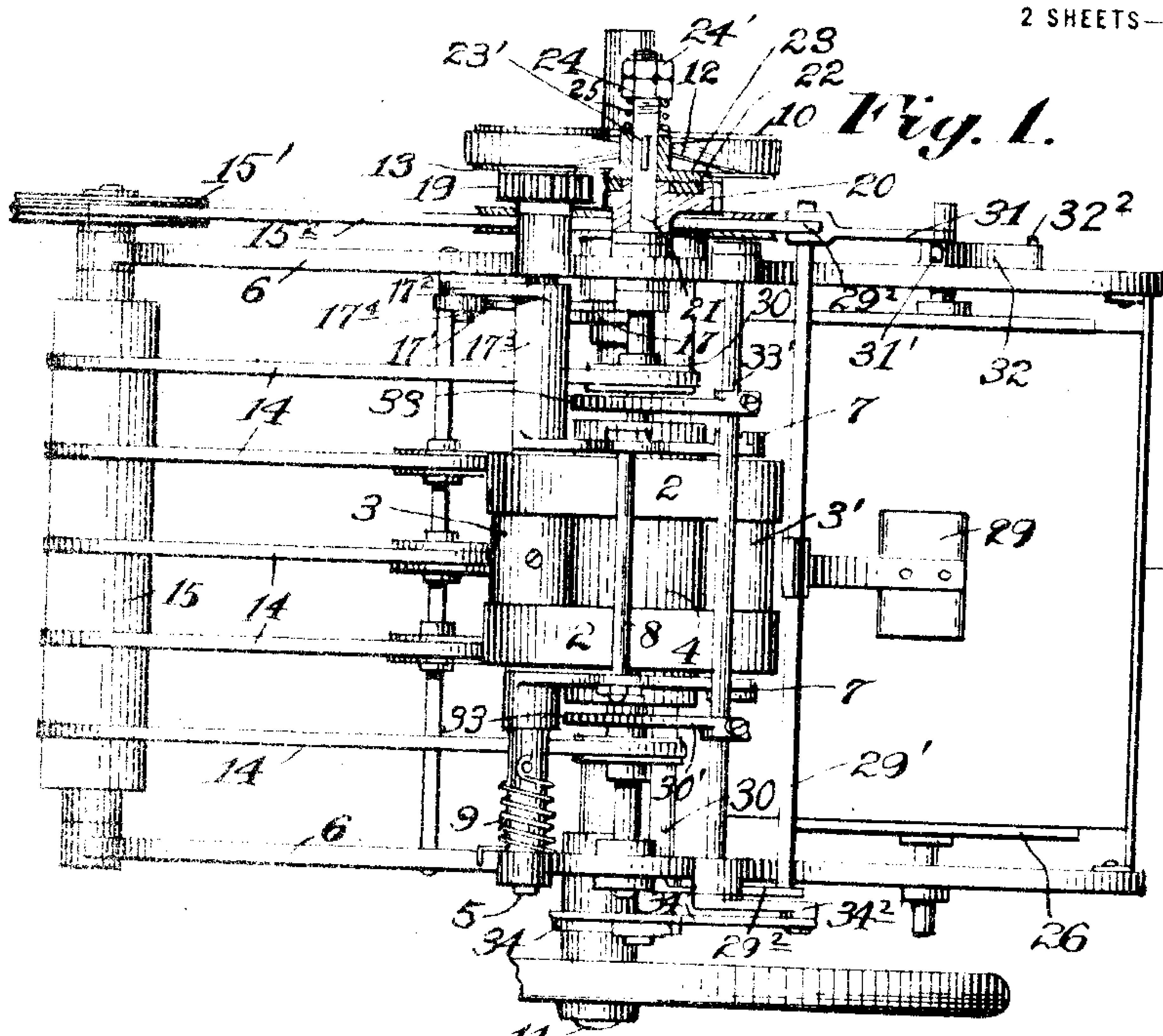
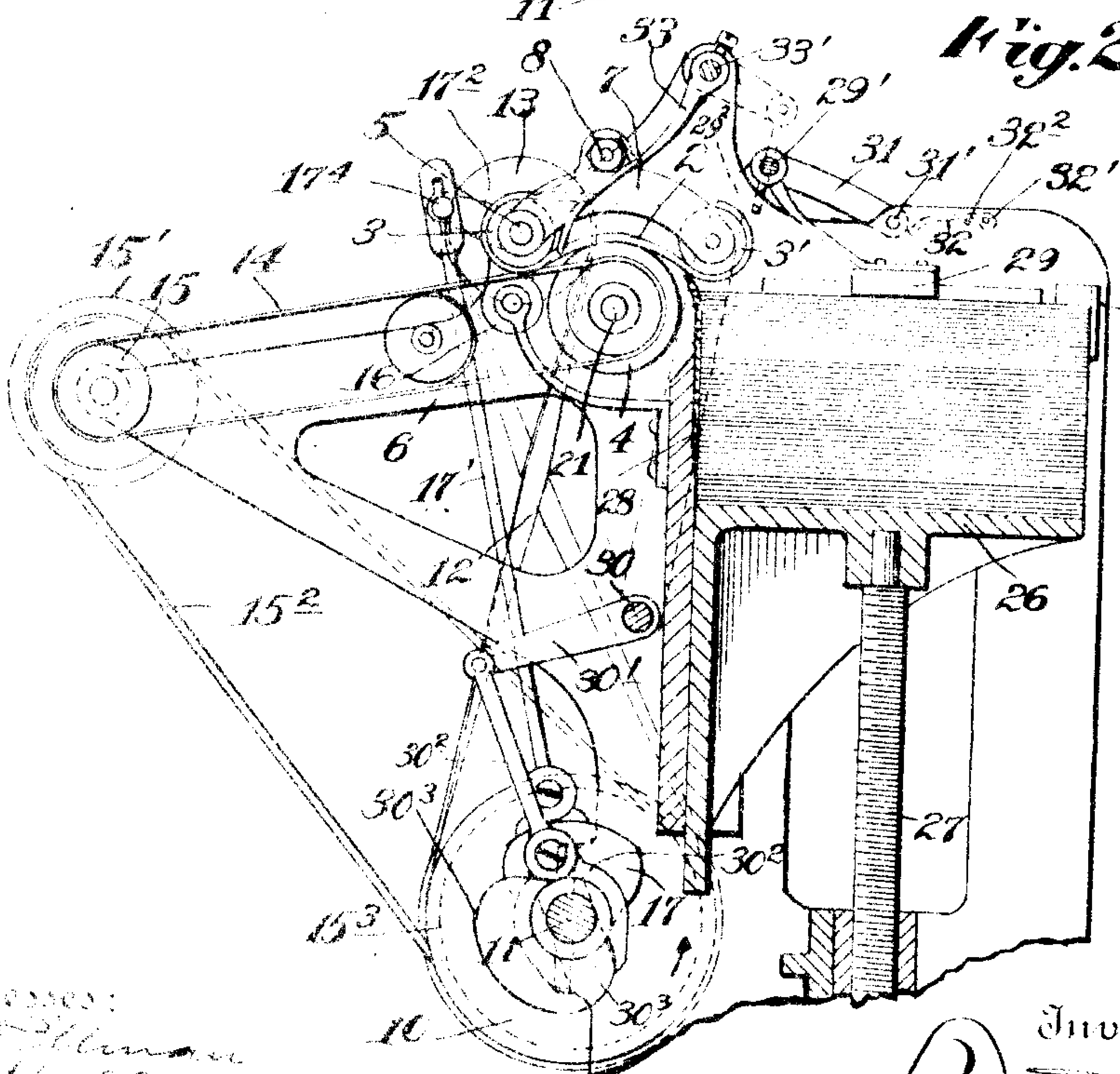


Fig. 2.



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2 SHEETS—SHEET 2.

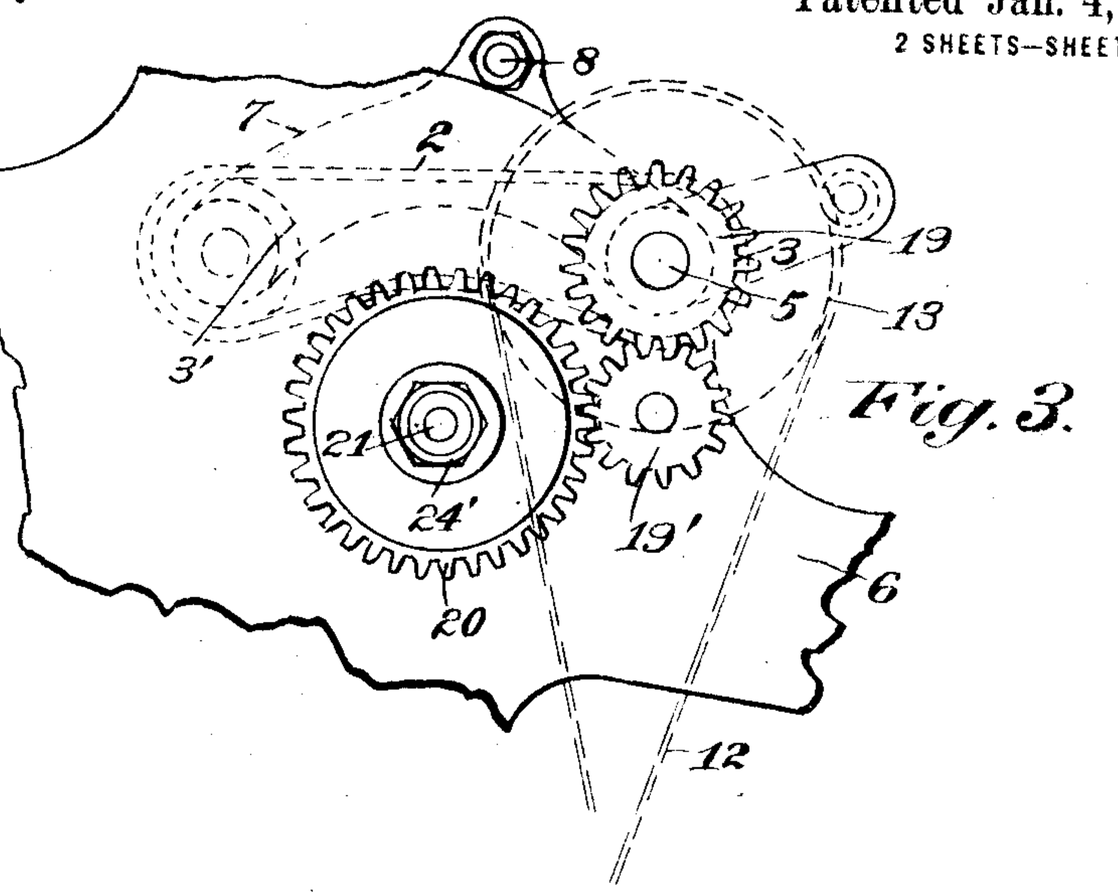


Fig. 3.

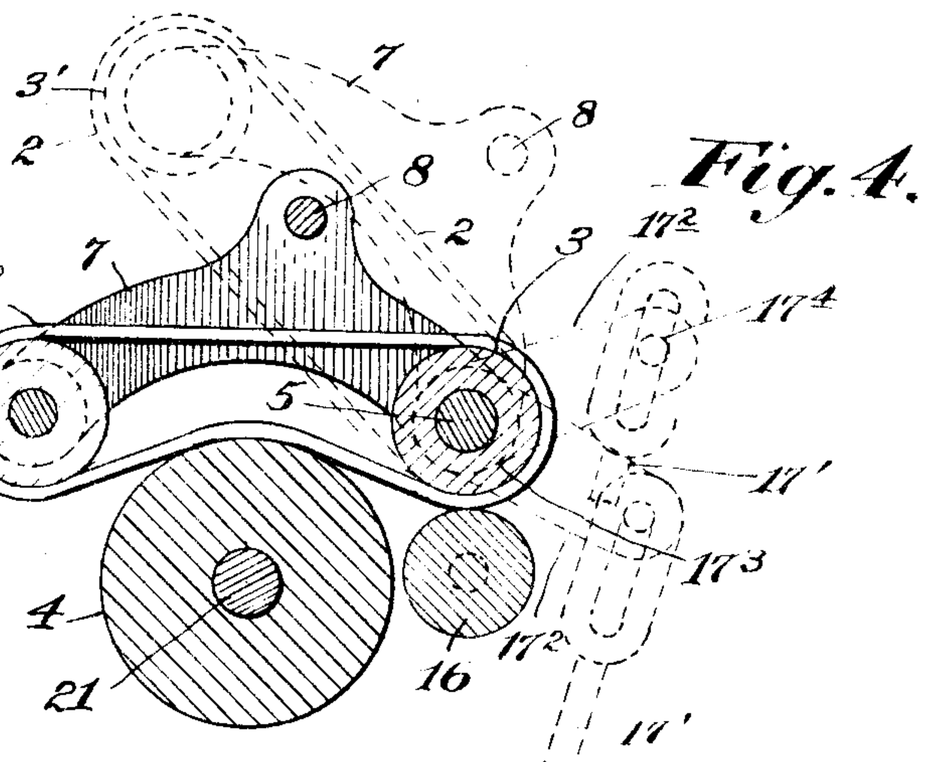


Fig. 4.

Fig. 5

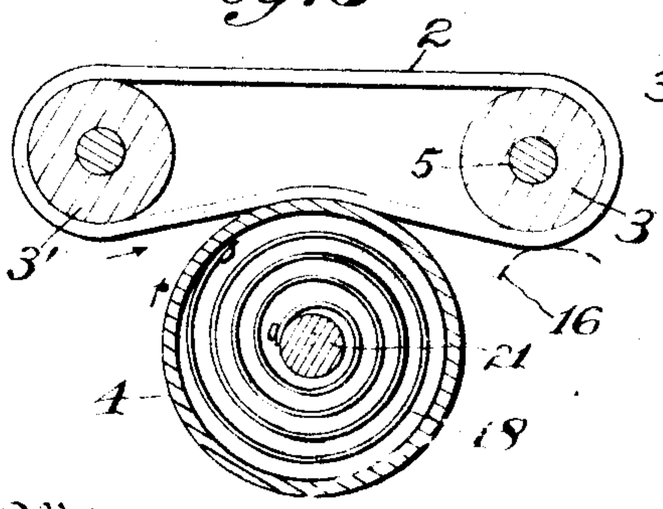
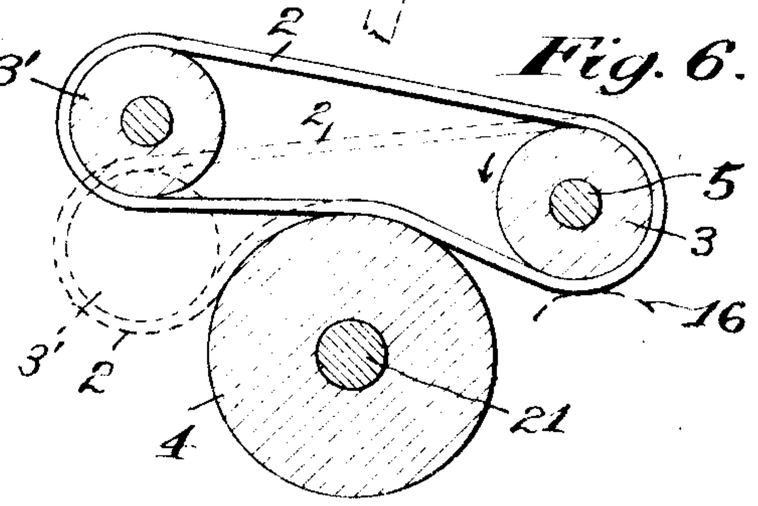


Fig. 6.



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SHEET SEPARATOR AND FEEDER.

1,167,367. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed July 11, 1908, Serial No. 443,132. Renewed May 6, 1913. Serial No. 765,965.

To all whom it may concern:

Be it known that I, PIERSON L. WELLS, of the borough of Brooklyn, city and State of New York, have invented a certain new and useful Improvement in Sheet Separators and Feeders, of which the following is a specification.

This invention pertains to a type of sheet separating and feeding mechanism in which one or more laminæ, as sheets of paper, are caused to pass between opposed friction faces, one of which has a positive sheet-forwarding motion while the motion of the other is a controlled one designed to preclude the ultimate passage of more than one sheet at a time.

The invention contemplates the provision of a simple efficient mechanism of this type, automatic and positive in its action to prevent the passage of but a single sheet at a time, and one that is capable, moreover, of performing its functions with practically no necessity of adjustment or regulation whether thick or thin, rough or smooth sheets be delivered to it.

In the accompanying drawings, Figure 1 is mainly a plan of an elemental mechanism whose principle of operation embodies my invention. Fig. 2 is partly an elevation, partly a section thereof. Fig. 3 is an enlarged elevational detail of a certain gear train, etc., of the mechanism of Figs. 1 and 2. Fig. 4 is an enlarged cross sectional detail of a forwarding friction belt, the cooperative reversely rotative sheet arresting roll and certain associated parts. Fig. 5 is a sectional detail, illustrating a device equivalent to that indicated in Fig. 1 for urging the sheet arresting roller in the specified direction. Fig. 6 is a section illustrating in an exaggerated way the relative change in the position of the belt due to its working.

Similar characters of reference designate corresponding parts in all figures.

The invention embraces one or more positively driven frictionally operative sheet forwarders, in this particular instance shown as bands or belts and designated by 2 in the drawings; these bands run over parallel rollers 3, 3′ and assume substantially the position indicated in Fig. 4 with reference to a lower or bottom roll 4. That is to say, as here exemplified, roller 3 is secured to a shaft 5, rotatably mounted in suitable frames 6, 6. Roller 3′ is journaled in arms 7, 7 loosely mounted upon shaft 5 and compelled to move as a unit or frame about the axis of shaft 5, the means for securing the arms together embodying a tie bar 8. With the parts positioned as described, the lower stretch of each belt 2 laps over a small arc of roll 4. A spring 9 may be used to adjust the initial pressure of the belts on the roll. Motion may be imparted to roller 3 by any suitable means, a pulley 10 in the elemental machine on a driving shaft 11 rotating in the direction of the arrow in Fig. 2 driving through a crossed belt 12 a pulley 13 on shaft 5.

It should be here stated that in using the term belt or the term belts in this specification and the claims, the use of one or more than one of such elements is implied, as may be found most advisable.

One of the principal features of the invention relates to the sheet retarder, here in the nature of a friction roll 4, this roll being constantly urged during the running of the machine in a direction such that its upper peripheral portion, that is that portion which in Fig. 4 is in contact with the lower stretch of belt 2, tends to move in the opposite direction to such stretch, or in other words this roll tends to turn in the same direction as roller 3 is driven. In using the term opposite, hereafter, in the claims, it will be understood, therefore, to mean in the relative direction just defined. The constantly acting torque to so turn roll 4 is, however, less than that resulting from the friction of belt 2 to turn it in the opposite direction when the belt is in direct engagement with the roll throughout the full possible arc of contact. Under such circumstances the roll-contacting stretch of the belt and the roll periphery run together in the same direction with substantially if not exactly the same linear velocity. When a single sheet is introduced into the bite between the friction surfaces on that side of roll 4 on which roller 3′ is located, conditions are still favorable to the overcoming of the aforesaid constantly exerted torque and the sheet is readily advanced from one side of rotating roll 4 to the other at substantially the velocity of belt travel. When,

however, two or more sheets are introduced, as aforesaid, the more the friction surfaces are wedged apart and covered by the sheets as they are drawn in, the less becomes the effort to overcome the aforesaid constantly exerted torque on roll 4. The result is that the greater the tenacity with which two or more sheets cling together the greater the relative force automatically developed to dislodge them from each other and slide backward all of them except the sheet in contact with the belt. It is evident in this connection that the farther two or more sheets are advanced between the belt and the roll the more the force resisting the opposing torque approximates to the fractional resistance to the sliding of one sheet over another. I deem it essential to positively though yieldingly urge the sheet retarder in the opposite direction, as aforesaid, as distinguished from frictionally retarding or braking the same against the positive drive of the sheet forwarder (either directly or indirectly through an interposed single sheet) in order to prevent the retarder from being entirely covered with a displaced sheet or sheets other than the single top sheet and thereby rendered ineffective in holding back all but the latter. That is to say, if a brake only is applied to the retarder and a number of sheets are introduced between the retarder and the forwarder the latter tends to "fan out" the sheets over the surface of the retarder until the effective portion of the periphery of the latter is entirely covered over, the brake on the retarder under these conditions simply holding the latter stationary. The retarder being then ineffective to stop any overlying sheet or sheets not in contact with its periphery, these latter are carried forward by the forwarder in more or less quantity and a number of sheets instead of the single top sheet passes onward. The present backwardly urged retarder on the other hand nullifies this "fanning out" tendency since there is always existing a force that serves to push backwardly all sheets except the top one no matter what their number thereby maintaining the retarder effective through its constant tendency to bring about a condition, in practically all circumstances, in which some portion of its periphery is in contact with the under surface of the top sheet.

The resilience of the belts and the fact that they are yieldingly held against roll 4 makes the illustrated apparatus adapted without adjustment to the separation and feeding of flexible sheets irrespective of their thickness or condition of surface.

The individual sheets may be delivered onto a series of traveling tapes 14 which here run over a driving roll r 5, a fixed pulley 15′ on which is here dri en by a belt 15^2 from a pulley 15^3 on driving shaft 11. If the linear velocity of these tapes is greater than that of belt or belts 2, the rear edge of each sheet as the latter is forwarded by the tapes will be carried free of the forward edge of the sheet next passing between the belt and the roll. On the other hand if a timed delivery of the sheets is desired the forward edge of each sheet may be caused to pass into the bite of a rotary gripping device before the sheet is free from the forwarding action of belt 2 whereupon the latter may be lifted out of its operative position. That is to say, as illustrated, a suitably journaled gripping roller 16 is frictionally driven by belt 2, the roller being at such a distance from the surface, along which belt 2 and roll 4 coöperate as that the forward edge of the smallest sheet (measured in the plane of movement of the belt) which is to be fed shall be gripped by roller 16 before the rearward portion of the sheet passes out from between the belt and the roll. Belt-carrying frame may then be tilted upward about axis of shaft 5 to a position such as shown in dotted outline in Fig. 4 and in which position it may be retained until the forwarding of another sheet is demanded when it may be returned to operative position. Such results may be obtained by a suitable cam mechanism, see cam 17, spring pressed cam rod 17′, and rock arm 17^2 extending from a sleeve 17^3 rigid with belt frame arm 7.

The torque or yielding force which tends to turn friction roll 4 in a direction opposite to that in which it is rotated by belt 2 may be obtained in various ways. For instance, in those cases in which the belt is lifted from roll 4 subsequent to the gripping of the sheet by roller 16, the frictional drive of the belt may turn the roll against the tension of spring 18 which turns the roll backward to the same stop position upon the upward tilting of the belt frame, see Fig. 5. On the other hand the roll may be constantly urged or driven in this reverse direction by a suitable friction drive, a form of which is illustrated in Figs. 1, 2 and 3 and in which motion is derived from rotating shaft 5, a gear 19 thereon driving through an intermediate 19′ (to secure the proper directional relation) a gear 20 loose upon shaft 21 of roll 4. Gear 20 carries a friction ring 22 against which bears a friction disk 23 slidable lengthwise of shaft 21 but compelled to rotate therewith by a pin and slot connection 23′. The pressure of the disk against the friction ring, that is the effort upon roll 4 may be regulated by adjusting nut 24 (backed by a locking nut 24′) between which and disk 23 there is interposed a spring 25.

The drawings typify a top feed pile elevator adapted to more or less automatically raise a pile of sheets as the latter are with-

drawn from the top. As this feature forms no part of the present invention, I deem it unnecessary to illustrate or describe with any particularity such a device. Suffice it to say that the illustration shows a guided platform 26, an elevating screw 27 and a front guard plate 28 over which and between the converging periphery of roll 4 and the lower stretch of belt 2 the top sheet or sheets of the pile may be slid by a suitable presser foot typified in the drawings and designated by 29. Whatever the character of this sheet advancer its mode of operation involves its elevation above the pile during the time a sheet is being forwarded by belt 2, thus leaving the underlying but advanced sheet or sheets, if any, free to be shifted backward. That is to say, as here illustrated shaft 29′ of the presser foot is loosely mounted in rock arms 29^2, 29^2 extending from a rock shaft 30 which through the medium of an attached arm 30′, spring returned cam fork 30^2 and cam 30^3 on driving shaft 11 may be rocked in proper timing to and fro and thereby impart a longitudinal motion to the presser foot. While this foot is in contact with the top sheet during the forward or feeding movement of the latter, the foot is lifted clear of the pile during the backward movement for the purpose above referred to, this result being here effected by attaching to shaft 29′ to which the presser foot is affixed, an arm 31, a laterally extending pin 31′ on which is adapted to coöperate with a track lever 32 in such a manner that as the presser foot is carried forward resting upon the top sheet with sufficient pressure to shift it alone or together with underlying sheets into the bite of the forwardly running belt 2 and roll 4, pin 31′ is below lever 32. As the pin passes beyond the end of the lever the latter is swung upward about its pivot pin 32′ thereafter dropping backward against stop pin 32^2 behind pin 31′. When the presser foot is swung rearward by its cam, pin 31′ rides upward on lever 32 and the presser foot is carried to the rear along a path in which it is free of the pile until it reaches a position in which the pin is clear of the lever whereupon the presser foot drops onto the top sheet of the pile beneath, for another feeding movement.

Preferably, and in order to assure the advance of each sheet with its forward edge at right angles to the line of feeding movement and at the designed and predeterminate intervals I will employ in those instances in which belt 2 is lifted from roll 4, as explained, suitable jogger fingers for sliding back into approximate alinement with the pile those underlying sheets which have been shifted forward by the presser foot and prevented by roll 4 from passing onward. In which a jogging device is illustrated and described in the application of Wells and Hunter filed Dec. 16, 1907, Ser. No. 406,803. In the present elemental machine, jogger fingers 33 extend from a suitably mounted rock shaft 33′ which is rocked through a suitable cam 34 on shaft 11 cam fork and rod 34′, and arm 34^2 to shift the displaced upper sheet or sheets of the pile backward against a suitable back stop 35, this jogging action taking place just prior to the rocking downward of the belt frame to feed a new sheet forward and after the advancing top sheet has moved so far forward as to be out of the path of the jogger fingers. An additional important feature of novelty is however embodied in the organization as thus illustrated and described. I have found in practice that if one stretch of a friction belt such as 2 is pressed with sufficient force against the periphery of a friction roll such as 4 to overcome the yielding force or torque which tends to turn the latter in the opposite direction and the axis of the belt roll fixedly held in such position, the device frequently acts sluggishly in arresting the forward movement of and sliding backward all sheets except the advancing top sheet. This is owing apparently, under the aforesaid conditions, to an insufficient disparity between the magnitude of the forwardly acting frictional force of sheet sliding on sheet (created by the pressure of the moving belt) and the magnitude of the reversely acting torque on roll 4, since it is obvious that the greater this torque is made the greater, assuming a given arc of contact, must be the radial pressure of the belt on roll 4 with consequent greater sheet friction.

In order to overcome the aforesaid objection and to avoid the necessity for impracticable adjustment requirements as regards belt tension, radial pressure, etc., I have devised a method of operation and an organization in accordance with which the forwarding force transmitted by the moving belt automatically adjusts itself to the resistance to movement exerted by the surface or part with which the belt is in contact. That is to say, if the belt is in contact with roll 4 the force exerted by the former is sufficient to cause the roll to travel with the belt; similarly, if a single sheet is introduced between the belt and the roll the driving conditions remain as before, all three elements move together, and the sheet is advanced at the linear belt velocity; when, however, two or more sheets have passed some distance in between belt and roll the force necessary to advance the top sheet manifestly embracing in part at least a force equal and opposite to the frictional resistance to the sliding of the top sheet over the one underneath, is less than before. According to this invention this driving force

under these conditions automatically decreases, thus leaving roll 4 free to turn reversely and slide backward the superfluous sheets which have adhered sufficiently together and to the top sheet to cause their initial advancement therewith. In further explanation it should be stated that the farther a plurality of sheets is advanced between the belt and the roller, the greater relatively becomes the reversing torque on roll 4 to turn the latter backward since the force opposing such torque becomes less. In other words there always exists a tendency to maintain a portion of the contact arc of roll 4 free from all sheets except the top one.

The force tending to drive roll 4 forwardly is manifestly a function of the arc of contact of the belt therewith and the belt pressure thereagainst. A change in either one of these features will effect a change in the aforesaid driving force. The particular embodiment herein set forth effects a change in the driving force by a simultaneous change in both these features. That is to say, the means illustrated in the present embodiment for effecting the aforesaid result embraces a device in which the driving torque on the driving roller of the belt is resisted by the moment of the frictional force between the belt and the surface with which it is in contact, the parts being so related that the greater this moment the greater will be the effect of the belt driving torque in increasing the arc of contact between the belt and the roll and the pressure of the two against each other. Conversely the less the friction opposing the movement of the part in contact with the belt with the latter the less automatically becomes said pressure and contact arc and the greater in consequence becomes the relative effect of the constantly exerted reversing torque on roll 4. The result in practice therefore is that during the rapid feeding off of sheets from a top of a pile thereof roll 4 is in almost constant oscillation backwardly and forwardly in response to the varying conditions as to the number of sheets fed into the bite of belt and roll the distance they are advanced therebetween, etc., as above explained; these results moreover, are practically independent of the character of the sheets as to texture or thickness.

Referring to the drawings, it has already been stated that the frame composed of arms 7, 7 and their tie bar and carrying belt roller 3′ can freely swing about axis of shaft 5. The driving force exerted on shaft 5 to rotate it and roller 3′ in the direction of the arrow Fig. 6, causes, from the manner of its application and the frictional resistance to motion of the parts a tendency on the part of the aforesaid frame to move downward and press the lower stretch of belt against the friction roll. The greater the frictional resistance opposing the motion of the part in contact with the lower stretch of the belt therewith (assuming an initial adjustment of contact area, pressure, etc., sufficient to preclude slipping of the belt on the part) the greater is this downward tendency and in consequence the greater becomes the contact area and pressure or in other words the greater becomes the driving force exerted by the belt. As the tension of the latter increases to a point at which it suffices to overcome the resistance, the belt and the part move forwardly.

Referring in further explanation to Fig. 6, the full lines represent in a general way the relation of the moving parts, assuming that there is no reversely acting torque applied to lower roll 4. When however such torque is applied the resistance exerted thereby added to the consequent instantaneous change in tension throughout the belt causes the belt, etc., for the reason above explained to take approximately the lower of the dotted positions, the belt and roll then traveling at a uniform speed.

If a single sheet is introduced and forwarded, the parts retain substantially the same, or lowermost relative position. When however two or more sheets are introduced the resistance opposing the movement of the lower stretch of the belt instead of remaining the frictional resistance between belt and roll or roll and sheet approximates to the less resistance of the friction of sheet on sheet. The aforesaid frame rises slightly as the result of spring tension, in this particular instance, constituted by the resilient resistance to deflection of the lower stretch of the belt, the force opposing the reversing torque of the friction roll becomes less and the latter is free to reverse and hold back all sheets except the top one, the edges of these arrested sheets being forced into engagement with the friction roll by the pressure of belt 4.

It will be noticed that cam rod 17′ engages with rock arm 17^2 by a pin and slot connection 17^4, the purpose of this being to leave the belt frame free to adjust itself angularly in response to the varying conditions established by the sheet or sheets introduced between the belt and the friction roll and above referred to in detail. That is to say the designed extent of ascending motion of cam rod 17′ is sufficient not only to drop the belt of belt frame onto the friction roll but to carry the upper end wall of the slot in the rod away from the pin thus leaving the latter free to play in the slot during the sheet feeding and separating operation.

Having described my invention, I claim:

1. In a sheet feeder and separator, the combination of a positively driven sheet forwarder, and a coöperative sheet retarder adapted to travel with the forwarder when

the two are in contact, said retarder being frictionally driven in a direction such that its coöperative surface tends to move in the opposite direction to the corresponding surface of the forwarder, whereby the retarder and the forwarder tend to maintain contact with the same single sheet.

2. In a sheet feeder and separator, the combination of a positively driven sheet forwarding belt, and a retarding roll driven thereby when the two are in contact and means for frictionally driving said roll in the opposite direction, whereby the roll and the belt tend to maintain contact with the same single sheet.

3. In a sheet feeder and separator, the combination of a positively driven sheet forwarder, a coöperative sheet retarder driven thereby when the two are in contact, means for yieldingly urging said retarder in the opposite direction, and means adapted to introduce the material between the forwarder and the retarder.

4. In a sheet feeder and separator, the combination of a positively driven sheet forwarder, a coöperating sheet retarder driven thereby when the two are in contact, means for yieldingly urging said retarder in the opposite direction, and a jogging device.

5. In a sheet feeder and separator, the combination with a pair of oppositely disposed coöperative friction elements for feeding and separating sheets and between which the latter pass, of driven means for seizing the advanced sheet and forwarding the same, and means, for shifting and holding said friction elements out of coöperative relation after each sheet has been thus seized.

6. In a sheet feeder and separator, the combination with a pair of coöperative friction elements for feeding and separating sheets, of driven means, for seizing the advanced sheet and forwarding the same, means for shifting and holding said friction elements out of coöperative relation after each sheet has been thus seized, a jogging device, and means adapted to advance the material to a point where it may be acted upon by said friction elements.

7. In a sheet feeder and separator, the combination of a pair of coöperative friction elements consisting of a roll and belt, one of said elements being yieldingly driven in a direction opposite to that in which the sheet is advanced, and positive driving means adapted to rotate the other element and press the coöperative surfaces together.

8. In a sheet feeder and separator, the combination of a sheet forwarding friction belt, a swinging frame carrying said belt, a supporting shaft about which said frame may swing, a sheet retarding friction roll yieldingly urged in the opposite direction, and a driving connection for said belt adapted to press the belt against the roll and thereby drive the roll with the belt when the two are in contact.

9. In a sheet feeder and separator, the combination of a sheet forwarding friction belt, a swinging frame embodying a pair of rollers over which said belt runs, a supporting shaft co-axial with one of said rollers and about which said frame may swing, a sheet retarding friction roll yieldingly urged in the opposite direction, a driving connection for said belt adapted to press the belt against said friction roll and thereby drive the roll with the belt when the two are in contact, a forwarding device for grasping the advanced sheet and continuing the motion thereof, means for suppressing the cooperation of said belt and friction roll at predetermined times, and a jogging device.

10. In a sheet feeder and separator, the combination of a sheet forwarding friction element, a swinging frame carrying said element, a sheet retarding friction element, means to yieldingly urge said latter element in a direction opposite to the motion of the forwarding element, a driving connection for the forwarding element adapted to press it against the retarding element and thereby drive the latter with the forwarding element when the two are in contact.

11. In a sheet feeder and separator, the combination with a sheet forwarding belt; a swinging frame carrying said belt; a sheet retarding friction roll; means to yieldingly urge said roll in a direction opposite to that of the forwarding belt; a driving connection for the forwarding belt adapted to press the belt against the retarding roll and thereby drive the latter with the forwarding belt when the two are in contact, and a roll cooperating with and driven by the belt to grasp the advancing sheet and continue the motion thereof.

12. In a sheet feeder and separator, the combination of a sheet forwarding friction belt; a coöperating sheet retarding roll adapted to contact with the forwarding belt and be driven thereby; means to urge the retarding roll yieldingly in the opposite direction to that of the motion of the friction belt; a roll coöperating with and driven by the belt to grasp the advancing sheet and continue the motion thereof; and a jogging device comprising fingers fixed on a cam actuated rocker shaft.

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

PIERSON L. WELLS.

Witnesses:
[illegible]. Frith,
A. L. Allison.