

Feb. 12, 1952

P. A. STEPHENSON

2,585,873

ROLL FEED FOR STENCIL DUPLICATING MACHINES

Filed May 20, 1949

5 Sheets-Sheet 1

Fig. 1

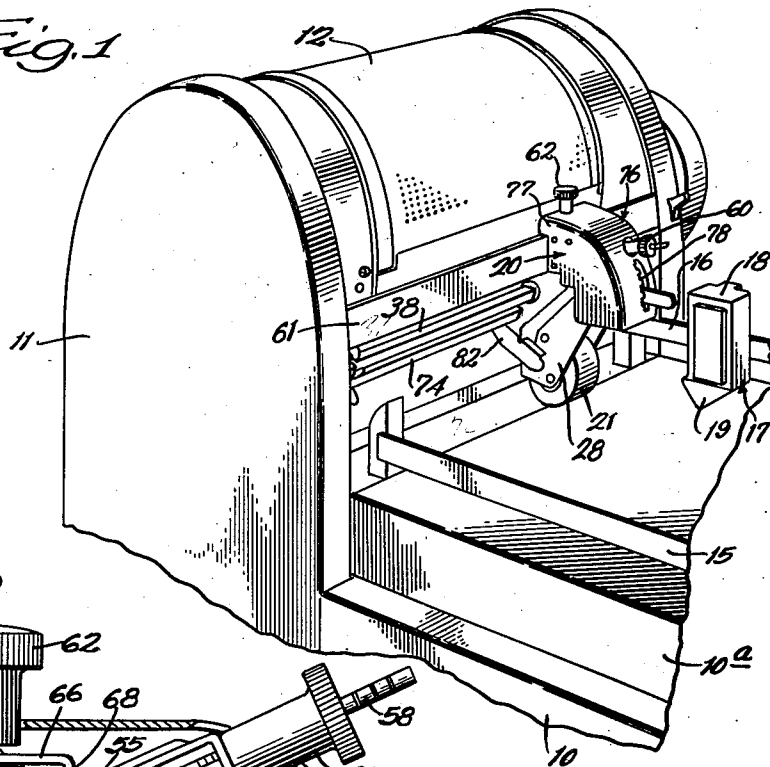
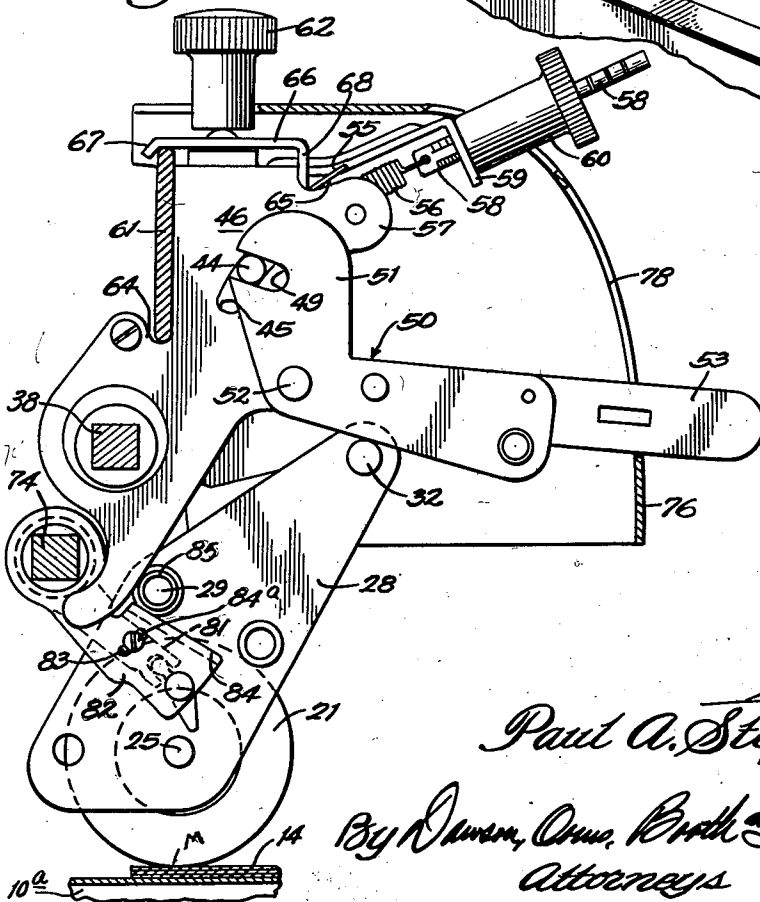


Fig. 2



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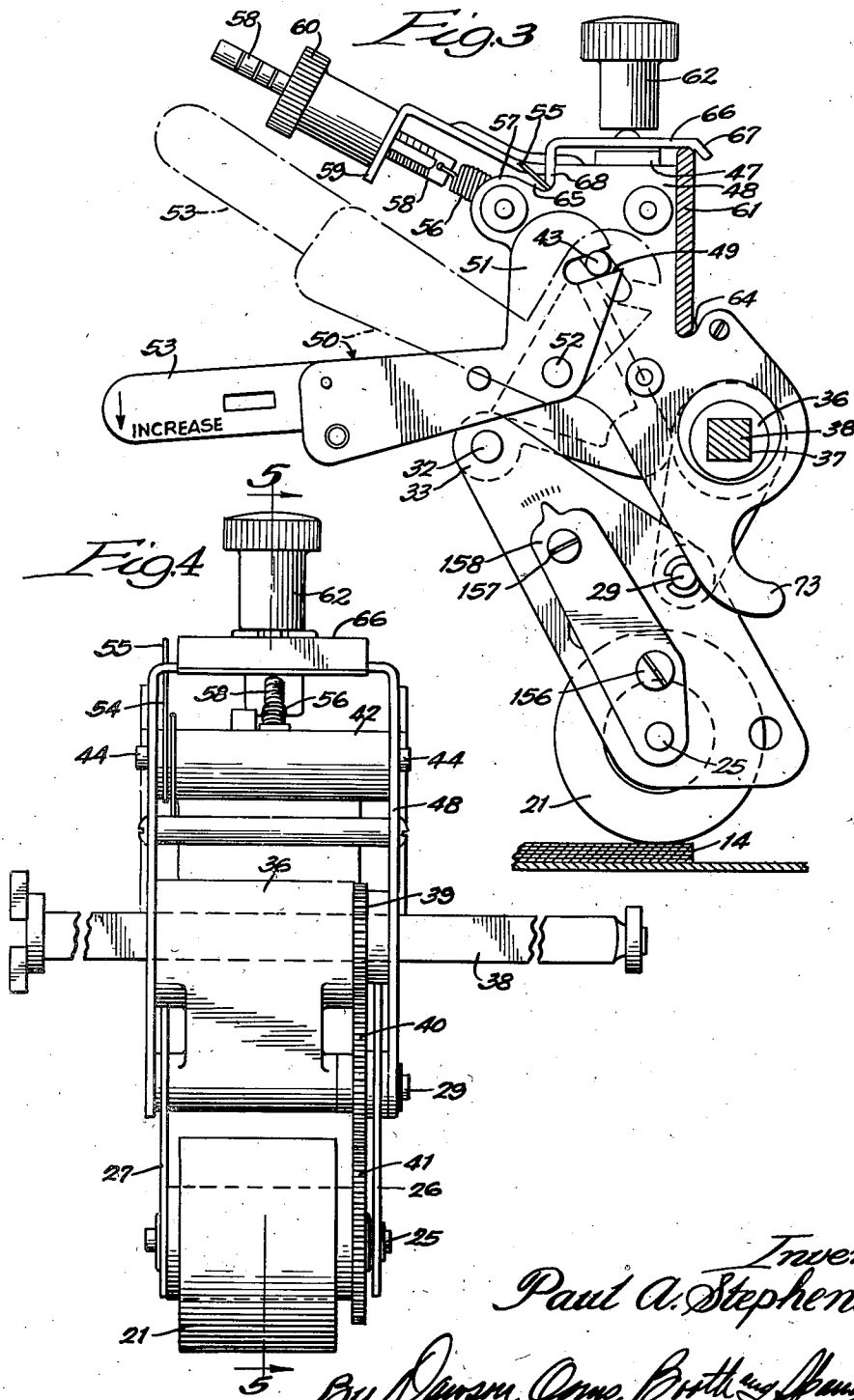
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ROLL FEED FOR STENCIL DUPLICATING MACHINES

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5 Sheets-Sheet 2



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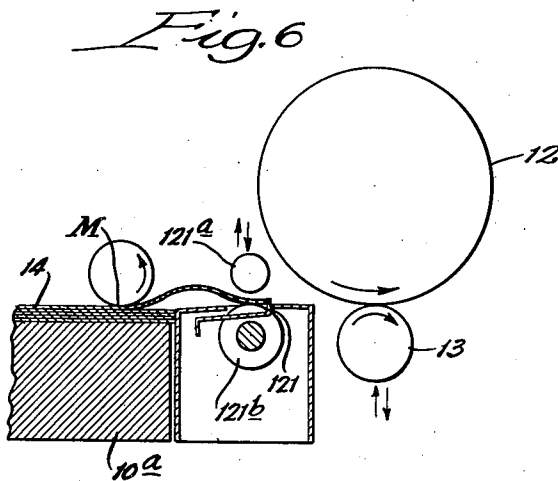
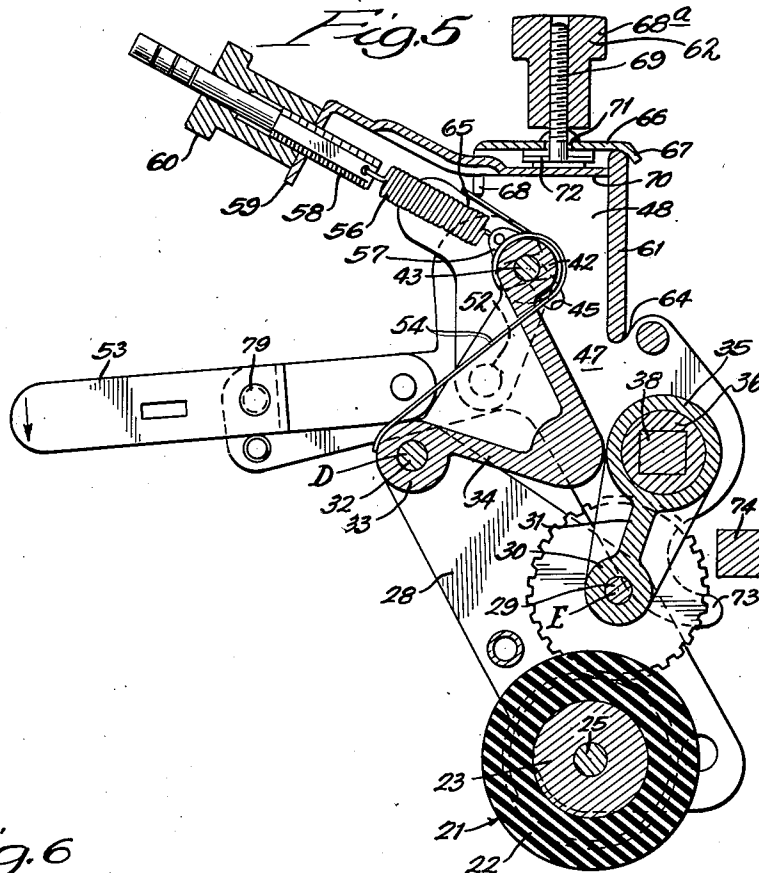
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ROLL FEED FOR STENCIL DUPLICATING MACHINES

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5 Sheets-Sheet 3



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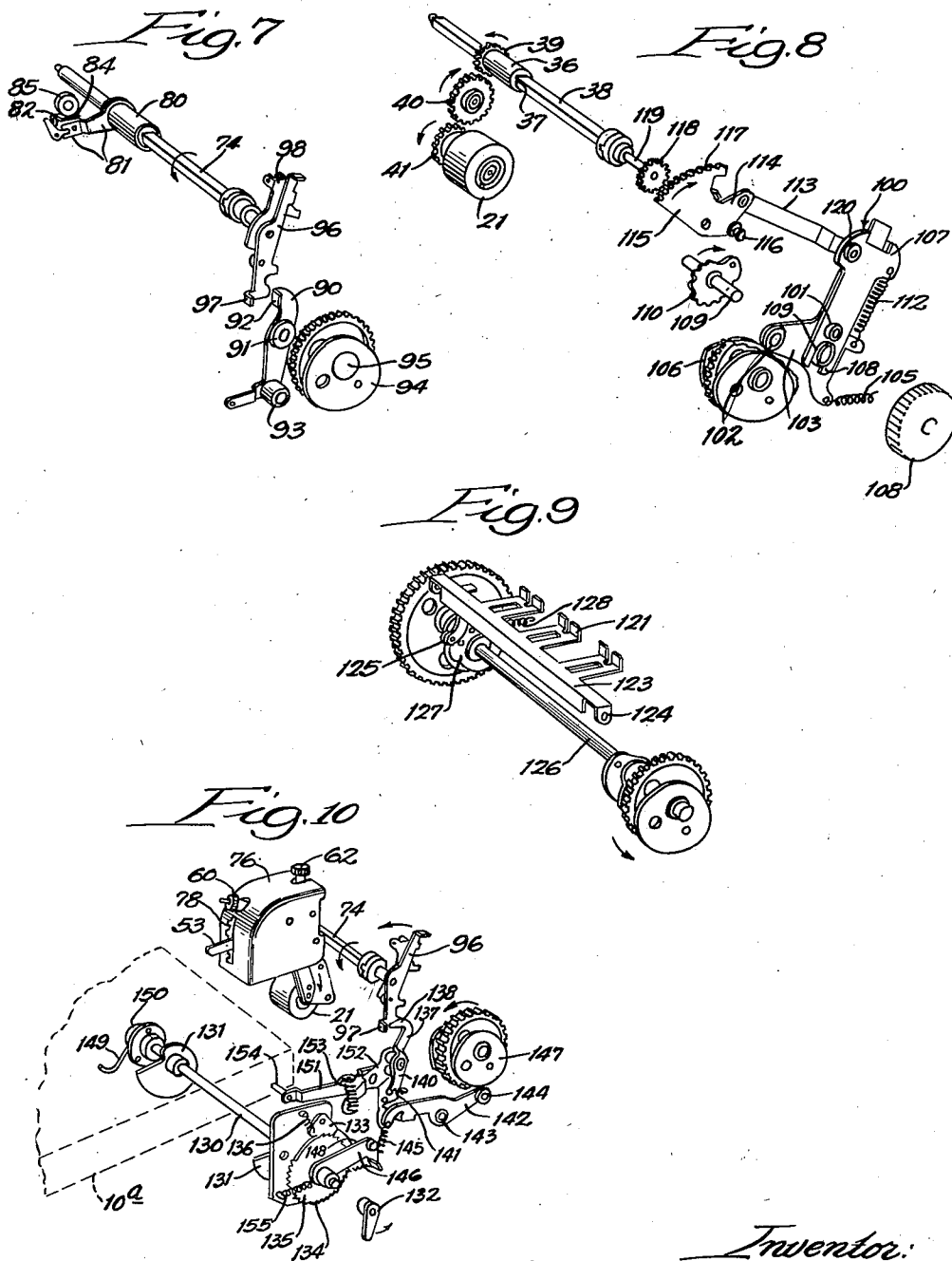
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ROLL FEED FOR STENCIL DUPLICATING MACHINES

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5 Sheets-Sheet 4



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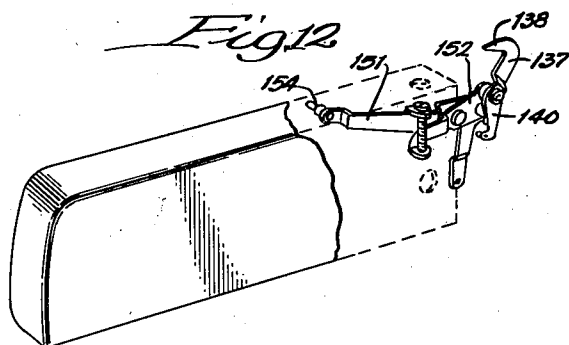
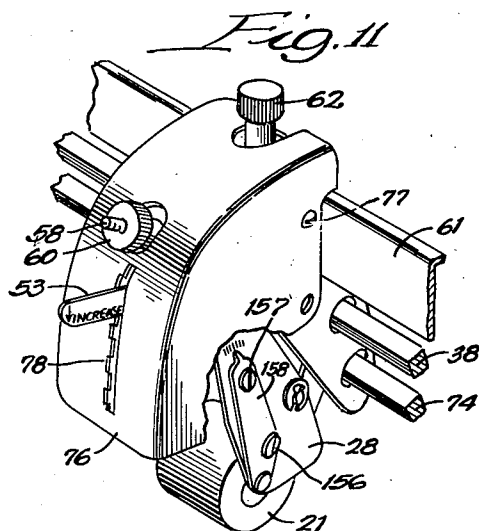
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ROLL FEED FOR STENCIL DUPLICATING MACHINES

Filed May 20, 1949

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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ROLL FEED FOR STENCIL DUPLICATING MACHINES

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Application May 20, 1949, Serial No. 94,445

17 Claims. (Cl. 271—36)

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This invention relates to sheet feeding apparatus and particularly to apparatus of this character for use in connection with a stencil duplicating machine.

Many different kinds of paper are often used interchangeably for duplication work, depending somewhat on the character of the work, personal preference and cost. For example, advertising hand bills are often printed on low cost, soft paper, while letters of a particular nature are often printed on expensive bond or finished letter paper. Accordingly, the sheet feeding mechanism, to be practical, must be capable of developing horizontal and vertical forces, as required, for feeding efficiently, positively and quickly, paper of different quality characteristics and sizes. It should be anticipated that the apparatus may be called upon to feed sheet stock or paper varying in thickness, hardness, roughness, stiffness, width, length, and the like.

These differences in characteristics and grain structure of the sheet stock influence the surface coefficient of friction which must be overcome in effecting the relative movement of one sheet over the other without unnecessary disturbance of the rest of the sheet pile. Not infrequently, it is only the minute difference in surface coefficient of friction between the first and second sheet and the second and third sheet, occasioned by the added weight of one more sheet that determines the ability to slide the top sheet over the second sheet without also conjointly advancing sheets lying beneath. This indicates the need for adjustments to give the proper balance between horizontal and vertical forces developed by the sheet feeding apparatus in accordance with the types of material to be advanced to the printing coupling. It is to the production of a simple and efficient sheet feeding apparatus capable of adjustment while the machine is running to meet these varying conditions which constitutes one of the principal objects of this invention.

Another object of this invention is to produce a sheet feeding device having an adjustable oscillating feeding element adapted intermittently to engage the top sheet of a sheet pile for feeding successive sheets in a desired manner, notwithstanding differences in texture, weight and size of the sheets.

A further object is to provide an improved sheet feeding apparatus which controls means for adjusting the height of the table supporting the pile to maintain the top of the sheet pile at proper feeding level.

A still further object is to provide an improved sheet feeding apparatus including means for automatically buckling the sheet during advancement to the duplicating crotch of a duplicating machine and means for adjusting the advancement of the sheet to satisfy requirements occasioned

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by slippage of the feeding element, size of the sheets, and the position of the sheet pile, to provide for a proper feeding relation.

A further object is to produce a rotary feed for a duplicating machine having manual adjustments for controlling the relative horizontal and vertical forces developed upon operative engagement of the feed roller with the top of the sheet pile.

A still further object is to provide the sheet feeding apparatus adapted for use in connection with duplicating machines, which is simple and sturdy in construction, positive and rapid in operation, and easily adjusted to meet practically all existing conditions.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, an embodiment is shown in the accompanying drawings in which:

Figure 1 is a perspective fragmentary view of a sheet feeding apparatus embodying features of my invention in connection with a rotary stencil duplicating machine;

Figure 2 is a sectional elevational view showing the arrangement of parts from one side of the roll feed while in feeding relation with a sheet pile;

Figure 3 is a sectional elevational view taken from the opposite side of the feeding apparatus shown in Figure 2;

Figure 4 is a front elevational view showing the arrangement of parts in the roll feed of Figures 2 and 3;

Figure 5 is a sectional view taken along the line 5—5 of Figure 4;

Figure 6 is a schematic illustration showing the travel of the fed paper;

Figure 7 is a perspective diagrammatic view showing the arrangement of parts for operating the feed lowering and raising mechanism;

Figure 8 is a perspective diagrammatic view showing the arrangement of parts for operating the feed roller and for adjusting the oscillations of the roller;

Figure 9 is a perspective diagrammatic view of the buckling means operating in the feed system;

Figure 10 is a perspective diagrammatic view, showing the means for raising the feed table as controlled by the elements in the sheet feeding apparatus.

Figure 11 is a perspective view of the roll feed assembly showing in detail the means for adjusting the alignment of the feed roller; and

Figure 12 is a perspective view of the means for manually adjusting the level of the feed table.

In accordance with this invention, a feeding device of the roller type, having the dual function of an oscillating feed roller and means for raising and lowering the feed roller in timed

relation, is carried rearwardly of the processing unit for movements into and out of engagement with a top sheet of a sheet pile disposed upon an adjustable feed table. Table adjustment is automatically controlled by the elevating roller to keep the sheet pile at proper level for the desired feeding relation.

A roller feed of the type embodied in this invention has many important advantages over other feeding systems, such as the shoe feed. The roller feed, for example, is adapted to be mounted for operative engagement with the leading edge of the paper to permit a feeding relationship to be established entirely independently of the size, width or length of the sheet stock. The shoe feed, on the other hand, engages a portion usually spaced from the leading edge at least by an amount designed to give the proper buckle. Thus the shoe feed is limited in length of paper which can be fed satisfactorily.

The self serving effect, hereinafter referred to as the servo effect, of the type which has been developed in the shoe feed is also provided in my sheet feeding apparatus embodying a roller feed to generate the desired breakdown of operating forces into vertical and horizontal components when the feed roller is in feeding relation. Important in the apparatus is a manual adjustment for varying the balance, while the machine is running, between horizontal and vertical forces generated to overcome the surface coefficient of friction required to advance one sheet over another in the desired manner. As used herein the term, servo, may be described as relating to the internal automatic increase or decrease of forces at the point of contact into horizontal or vertical components.

The drawings illustrate the use of sheet feeding apparatus embodying features of my invention, for feeding sheet stock to the duplicating crotch of a rotary stencil duplicating machine. The duplicating machine will not be described in detail because its construction is well known to those skilled in the art. It does not constitute a part of this invention, but is merely illustrative of one of the many machines with which my feeding apparatus may be used.

As shown in Figures 1 and 6, the rotary stencil duplicating machine has a base 10 which supports two side frames concealed within the housing 11. A stencil duplicating drum 12 is mounted for rotation in suitable bearings provided in the side frames and an impression roller 13 is carried below the drum for reciprocatory movement into and out of engagement with the drum to effect stencil duplication as the sheet stock is carried between the rotating drum and impression roller.

A feed table 10^a supports the sheet pile 14 for feeding the top sheet smoothly to the buckling stops 121 which hold the paper until it is positively gripped by the segment rollers 121^a and the oscillating rollers 121^b for advancement to the duplicating crotch formed by the impression roller 13 and the drum 12. The feed table is provided with lateral adjustable retainer rails 15 and 16 which carry retainer pad housings 17. Housings 17, longitudinally slideable along the rails 15 and 16, are provided with resilient pressure pads 18, urged into frictional engagement with the side walls of the sheet pile. The sheet pile also rests upon shoes 19 extending from the lower end of the housings 17.

The roller feed device 20 is supported on tie bar 61 to locate the oscillating feed roller 21 over the forward edge portion of the top sheet of the

pile 14. Mechanism, shown in Figure 8, is adapted to oscillate the feed roller in a turning movement to feed the sheet stock and return. To permit return of the roller while free of the sheet pile, other mechanism, shown in Figure 7, operates in timed relation with the roller to effect a vertical movement of the roller 21 away from the sheet pile.

The feed roller 21 consists of a removable outer cylindrical shell of resilient, rubber-like or other friction material 22, held onto a sleeve 23 by a retainer spring. The sleeve rotates upon a shaft 25 fixed between side walls 26 and 27 of a servo sub-assembly link 28. The sleeve is separated from the side walls by suitable bearing members.

The sub-assembly 28 is pivotally mounted at two points D and E. Point E, in the forward edge portion intermediate the ends of the sub-assembly link 28, centers about a fixed pivot pin 29 which extends through openings in the side walls 26 and 27. A bushing 30 on the free end of a link 31 is pivoted on the pin 29 and is separated from the side walls 26 and 27 by suitable bearings. The other point D, is at the upper end of the sub-assembly link and is provided with studs 32 for pivotal engagement with bushings 33 on one end of link 34.

Link 31 has a larger bushing 35 at the other end rotatably mounted on a sleeve 36 having a square shaped bore 37 which slideably fits on a square drive shaft 38. Sleeve 36 mounts a gear 39 at one end which meshes with a spur gear 40 rotatable upon the shaft 29. Spur gear 40 meshes with gear 41 on the shaft 25 for rotational movement with the feed roller 21.

Link 31 is dimensioned to correspond to the distance between centers of the gears 39 and 40, thereby establishing a gear train in constant meshing relation even though the sub-assembly 28 is rocked about the link 31. The link 31, in turn, may be rocked to any position about the drive shaft 38.

As previously pointed out, pins 32 extending laterally from the side walls 26 and 27 of the servo sub-assembly link 28 provide pivotal points upon which the bushings 33 on the end of the link 34 are mounted. A bushing 42 on the other end of the link 34 is pivoted upon a pin 43 having stub ends 44 of smaller diameter which extend through vertically disposed curvilinear slots 45 formed in the side walls 46 and 47 of a main frame assembly 48. Ends 44 are disposed within slotted end portions 49 formed in the end projections 51 of an adjustment bracket 50. The bracket is pivoted intermediate its ends upon pins 52 anchored in the main frame assembly 48. A handle 53 is provided on the end of the adjustment bracket for manually actuating the bracket about the pivot 52 to adjust the pivot pin 43 within the slot 45 responsive to the co-operative reaction of the pins 44 within the slots 49 and 45.

A torsional spring 54 arranged with its center about the bushing 42 with one end 55 bearing against the main frame assembly 48 and the other end bearing against the bushing 33 constantly urges the link to rock about pivot pin 43 toward lowered position adjustment. Thus the torsional spring constantly urges the sub-assembly 28 with its mounted feed roller 21 into feeding relation with the top sheet of the sheet pile 14.

The pivoted portion of the link, that is pin 43 is constantly urged toward the uppermost position of adjustment in the slot 45 by a spring

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56 which tensionally connects an ear 57 on the bushing 42 with the lower end of an adjustable anchor pin 58. The anchor pin 58, which is threaded throughout the major portion of its length, extends through an opening in a downwardly extending flange 59, rigid with the main frame assembly 48, and is threadably engaged by an adjustment knob 60 that rests against the outer wall of the flange 59. Spring 56 functions in addition to urge the link to rock about the pin 43 to increase the pressure of roller 21 on the paper. Increasing the tension of the spring increases proportionally the force by which roller is urged into engagement with the paper, while decreasing the tension will have the reverse effect.

The main frame 48 is carried on a tie bar 61 disposed between the side frames. Proper clamping relation between the tie bar 61 and the main frame 48, in a manner to permit lateral adjustment, is effected by providing the upper side walls of the main frame with notches or grooves 64 and 65 respectively. The forward notches 64 receive the lower edge portion of the tie bar 61 which is held therein in gripping relation by the cooperative action of a clamping member 66, formed with a downturned lip 67 on the forward edge to prevent inadvertent release of the tie bar when in clamping relation and another downturned flange 68 at the rearward portion which seats within the groove 65. The clamping member 66 is actuated into clamping relation by a tensioning knob 62 that engages a threaded post 69 projecting upwardly from the top wall 70 of the main frame 48 to extend through an opening 71 in the clamping member 66. A leaf spring 72, interposed between the top wall 70 and the clamping member 66, establishes a resilient clamping relation that militates against undesirable movements.

As the knob 62 is turned to actuate the clamping member 66 toward the main frame 48, the flange 68 seats within the notch 55 and, upon further actuation, the clamping member 66 is rocked about the seated portion until the tie bar 61 is firmly gripped between the lip 67 and the notch 64. When the knob 62 is turned to relax the gripping relation, the entire main frame with its associated parts, heretofore described, may be shifted laterally to cross the tie bar to any desired positions of adjustment for purposes of disposing the feed roller 21 in proper relation with the sheet pile 14.

Concealing substantially all of the elements of the roller feed assembly is a cover member 76 having openings 77 in the side walls for insertion of screws by which the cover is screwed to the main frame. It also has suitable openings for extension of the post 69 and pin 58, and it has an elongate slot 78 formed with rack teeth on one edge operatively to engage the handle 53 which is constantly urged sidewise in a direction to seat between the rack teeth by a spring member arranged on pin 79.

As will hereinafter be described, the square drive shaft 32 is oscillated for clockwise and counterclockwise rotation in timed relation with the cylinder 12 of the stencil duplicating machine. When the shaft is rotated in the counterclockwise direction, the feed roller 21 is adapted to be turned in a similar direction through gears 39, 40 and 41. During such rotational movements, the feed roller 21 is urged into frictional engagement with the sheet pile by the torsional spring 54 and spring 56 which act to lower the

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servo feed sub-assembly 28. When the drive shaft 32 is turned in the opposite direction, the gear train causes reverse rotational movement of the feed roller and during such movement the raising and lowering mechanism is operative to elevate the feed roller 21 and the sub-assembly 28.

The feed roller lowering and raising mechanism includes the drive shaft 74 mounted for oscillating movement between the side frame. Slidably mounted on the shaft is a hub 80 having a bore into which the shaft 74 fits and a lever 81 extending outwardly from one end. Another height adjusting lever 82 extends in juxtaposed relation with the first lever and is fixed in position by a set screw 84^a that extends through a slot 83 in the lever 82.

The adjustable lever 82 has a horizontally disposed platform 84 upon which a roller 85 mounted upon an extending portion of shaft 29 rides. Thus, responsive to the rocking movement of the shaft 74, the servo link sub-assembly 28 is raised to the inoperative position and is permitted to return to the lowered position responsive to the force of the torsional spring 54 and spring 56.

The development of the desired balance between vertical and horizontal forces at the point of contact between the feed roller 21 and the top sheet of the sheet pile 14 might be explained exactly by diagrams of forces existing at each reaction position, but for purposes of clarity suffice it to say that as the handle 53 is rocked in the downward direction to raise the pivot pin 43 with respect to the pivotal point D, the ratio of vertical force to horizontal force developed at M will be increased. Likewise, as the handle is raised, the balance of forces at M will tend toward the development of greater horizontal force and less vertical force.

Thus simply by selectively positioning the pin 43 responsive to movements of the handles 53, the ratio of force components developed while the feed roll 21 is in feeding relation can be varied to give proper balance of force for overcoming the surface frictional force of the particular type of paper.

As shown in Figure 7, the feed raising and lowering mechanism for operating the drive shaft 74 in timed relation with the shaft 32 and the printing coupling, includes a roll operating lever 90 pivoted, as at 91, to the frame of the stencil duplicating machine. The lever has an abutment 92 at the upper end. A truck 93, mounted on the lower end of the roll operating lever 90, travels on the periphery of a cam 94 mounted on a shaft 95 that rotates with the stencil duplicating cylinder.

A roll raising lever 96, is fixed intermediate its end to the shaft 74. The lower end of the lever 96 is provided with an abutment 97 adapted to engage the part 92 on the upper end of the lever 90, while the other end of the lever 96 cooperates with an adjustment arm 98 for prepositioning the lever with respect to the shaft to provide a preliminary adjustment for the raising and lowering mechanism.

Thus, as the truck 93 travels to the high of the cam 94, the roll operating lever 90 rotates in the clockwise direction, permitting the roll raising lever 96 and the drive shaft 74 to turn in the counterclockwise direction, as indicated by the arrow. The lever arm assembly 81 and 82 is rocked downwardly responsive to the function of the torsional spring 54 and spring 56 urging the feed roller 21 into contact with the top sheet of the sheet pile 14. When the truck rides to

the low of the cam 94, the direction of rotational movements of the lever arms and the shaft 74 are in the opposite direction, thereby to raise the feed roll 21 and the servo link sub-assembly 28 to a position of adjustment out of contact with the sheet pile.

The feed roll drive shaft 38 is operated in timed relation with the stencil duplicating cylinder and the raising and lowering mechanism just described by the arrangement of parts shown in Figure 8. As shown, a vertically disposed arm 100 is pivoted intermediate its ends to the frame by a pin 101. A truck 102 rotatably mounted on an extension 103 from the lower end of the arm 100 is constantly urged by a spring 105 into engagement with a cam 106 fixed to shaft 95. A slide 107 is slotted along its rear wall for longitudinal adjustment along arm 100 in engagement therewith. Adjustment is effected by a knob 108 which operates a shaft 109 having a locking cam 110 on the other end. The pin 101 is constantly urged into operating engagement with the cam surface by a coil spring 112 anchored at one end to the slide 107 and at the other end to the arm 100. As the cam 110 is turned in one direction or the other by knob 108, the slide 107 is caused to move longitudinally relative to the arm 100.

A link 113 is pivoted at one end to an upper portion of the slide 107, while the other end of the link is pivoted to an extension 114 on a gear segment 115 pivoted, as at 116, to the frame. Gear teeth 117 in the periphery of the segment mesh with a stub gear 118 fixed on the stub shaft 119 rotatable with the shaft 38.

Thus, as the truck 102 travels toward the high portion of the cam 106, the lever arm assembly 100 is rocked about its pivot in the clockwise direction to displace the link 113 in the direction to the right. Such displacement causes the segment 115 to rock in the clockwise direction, thereby to actuate the drive shaft in the counter clockwise direction. By reaction through the meshing gears 38, 40 and 41, the feed roller 21 is caused to turn in the counter clockwise direction to actuate the top sheet a greater or less distance controlled by the relative position of the slide 107. The complete cycle is reversed when the truck 102 leaves the high point of the cam 106. Outward adjustment of the slide causes the pivot 120 to rock about a greater radius thereby to increase the lateral displacement of the link 113. This causes a proportionate increase in relation of the sector and the shaft 38. The reverse effect is had by shortening the distance from the pivot 120 to the pivot 101.

As previously pointed out, it is desirable to cause the paper to be fed from the sheet pile by an amount sufficient to buckle the leading edge of the paper as it strikes stops 121, which momentarily hold the paper in aligned relation until it is firmly gripped by an oscillating roller and rubber segment by which the paper is positively advanced to the printing coupling.

Stops 121 creates a buckle in the leading edge of the advanced paper by momentarily obstructing the progress of the paper until it is properly gripped by the oscillating roller and the segment roller 121^a, then the stops recede from the path of the paper to permit positive advancement to the duplicating crotch. To effect this desired relationship, the stops 121 are arranged on the forward end of the pivotally mounted bracket 123. The bracket is rocked in the direction to lower the stops 121 responsive to movement of a truck 125 rigid with the bracket to a high point on a

cam 127 fixed to a shaft 126 that rotates in timed relation with the cylinder 12. A spring 128 constantly urges the bracket in the opposite direction to dispose the stops in the path of the paper sheet.

The feeding mechanism also includes controls for regulating adjustment of the level of the feed table 11 to bring the top of the sheet pile 14 in proper alignment for feeding to the printing coupling. Figure 10 illustrates one such adjustment system which is controlled by the raising and lowering mechanism.

Briefly described, the adjustment means includes a shaft 130 rotatably mounted between side frame members and operatively mounting intermediate its ends, two or more spaced raising cams 131 that engage the underside of the table. The shaft 130 is adapted to be turned manually by a crank 132 and to be held in the adjusted position by the pawl 133, that is constantly urged into engagement with the rack teeth 134 of a ratchet wheel 135 by spring 136. By turning the handle in the counterclockwise direction, indicated by the arrow, the feed table may be raised and it may be lowered by continued turning movement of the handle in the same direction.

After the table 11 has once been adjusted by this means or other means to the proper operating level, further adjustment is effected automatically, responsive to the elevation of the feed roller. To accomplish this, a rocking lever 127 pivoted to the frame intermediate its ends, is disposed with its upper turned end 138 in position to be engaged by an ear 139 on the lower end of the roll raising lever 96. Rocking movement of the lever 96 will increase in extent, responsive to the drop of the feed roll 21, as sheets are peeled off the sheet pile.

Mounted on the same pivot with the upper rocking lever 137 is a lower locking lever 140 coupled to the upper locking lever by a spring 141. With the removal of successive sheets from the sheet pile, the upper rocking lever 137 and the lower locking lever 140 will be rocked together in the counterclockwise direction until the locking elements on the lower end of the lower locking lever 140 releases the raising lever pivoted at 143 intermediate its ends. A truck 144 on the outer end of the raising lever 142 is constantly urged to follow cam 147 by a spring 145 which tensionally joins the outer end of lever 142 to a lever 146 fixed to shaft 130.

As the truck 144 travels to a low point on the cam 147, the released tension of the spring 145 allows a pawl 148 carried by the lever 146 to reach for new teeth 134 on the ratchet wheel 135. Then as the truck 144 rides to a high point on the cam 147, the increased tension in the coil spring 145 causes the lever 146 to advance the ratchet wheel 135 slightly more than the equivalent of one tooth, thereby to permit the retaining pawl 133 to engage the ratchet wheel to support the advance. Such movement of the ratchet wheel causes corresponding raising of the feed table 11.

The shaft 130 is constantly urged in the direction to lower the feed table by a torsion spring 149, operative on the spring drum 150 on shaft 130.

In order to maintain proper feed level of paper, a lever 151 and adjustment arm 152 are resiliently connected by a spring 153 and pivoted at the forward end for rocking movement with the lever 137. The purpose of the lever 151 and the adjustment arm 152 is to allow the feed roller 21 to drop lower and lower with each successive call for sheet stock. The rearward end of the

adjusting lever 151 has a laterally extending pin 154 that is adapted firmly to engage the under-side of the feed table through the action of the spring 155. Successive adjustment of the feed table causes the lever 151 and adjustment arm 152 to pivot in a clockwise direction, moving the upper locking lever 137 in a clockwise direction which compels the feed roll 21 to move lower and lower before the assembly can engage the upper end 138 of the member 137 to cause unlatching of the table raising mechanism. Without this positioning device, the feed roll would call for paper at the same point and when the table had reached its maximum height, the level of the sheet pile would be too far above the front edge of the machine for proper feeding relation.

In the event that the paper fed by the feed roller 21 is shifted to the right or left during feeding movement, proper alignment can be re-established by realignment of the feed roller. This adjustment may be effected by loosening the screws 156 and 157 to permit adjustment of shaft by shifting the pointer 158 forwardly to compensate for movement of the paper to right, or to the rear in the event that paper is moved to the left.

It will be understood that my sheet feeding apparatus is not to be limited to use in connection with stencil duplicating machines, but may be used for feeding sheet stock to many other processing units. It will be further understood that numerous changes may be made in the details of construction, operation and arrangement without departing from the spirit of the invention.

What is claimed is:

1. Sheet feeding apparatus, including the combination, a table providing an adjustable support for a sheet pile, a friction feed roller, an adjustable servo link assembly mounting the feed roller, means for rocking the servo link assembly to bring the friction roller into and out of engagement with the top sheet of the sheet pile, separate means synchronized with the first for rotating the roller in feeding relation when in engagement with the sheet pile.

2. Sheet feeding apparatus, including in combination, a table providing an adjustable support for a sheet pile, a friction feed roller, a servo link assembly mounting the feed roller, means forming a part of said servo link assembly to adjust the force reaction at the point of contact between the feed roller with the sheet pile into a desired ratio of vertical and horizontal components, means for moving the servo link assembly to bring the friction roller into and out of engagement with the top sheet of the sheet pile, said means including a drive shaft oscillable in timed relation with the unit to which the sheet is being fed, a lever arm assembly rockable with the shaft, and an operative connection between the lever arm assembly and the feed roller for moving the roller responsive to oscillations of the drive shaft.

3. A sheet feeding device as claimed in claim 2 in which the drive shaft is oscillated by means including a cam rotatable in timed relation with the unit to which the sheet is being fed, a pivoted lever having a truck which follows the cam, another lever operatively connected to the end of the drive shaft and adapted to be rocked by the first lever during a portion of its pivotal movement.

4. Sheet feeding apparatus, including in combination, a table providing an adjustable support for a sheet pile, a friction feed roller, adjustable servo means operative on the feed roller when in

feeding relation, means for moving the friction roller into and out of engagement with the top sheet of the sheet pile, separate means synchronized with the first for rotating the roller in feeding relation when in engagement with the sheet pile and to return the roller when out of engagement with the sheet pile, said latter means including a drive shaft oscillatable in timed relation with the unit to which the sheet is being fed, gears rotatable with the shaft and with the roller, and an operative connection between gears to effect their conjoint rotational movement.

5. A sheet feeding device as claimed in claim 4 in which the drive shaft is oscillated by means which include a cam rotatable in timed relation with the unit to which the sheet is being fed, a pivoted lever assembly having a truck which follows the cam, a gear rotatable with the shaft, a pivoted gear sector having gear teeth in meshing relation with the gear, and a link connecting the gear sector to the pivoted lever to transmit rocking movement of the lever to the gear sector.

6. A sheet feeding device as claimed in claim 5 wherein the pivoted lever assembly is formed of extensible parts to adjust the extent of rotational movement of the drive shaft responsive to rocking movement of the lever assembly.

7. Sheet feeding apparatus, including in combination, a table providing an adjustable support for a sheet pile, a friction feed roller, a servo link assembly mounting the feed roller, means forming a part of said servo link assembly to convert the force reaction developed at the point of contact between the feed roller and the top of the sheet pile into vertical and horizontal components, the ratio of which depends upon the adjusted angular relation of the servo link members, means for rocking the friction roller into and out of engagement with the top sheet of the sheet pile, separate means synchronized with the first for rotating the roller in feeding relation when in engagement with the sheet pile to feed the top sheet of the sheet pile and to return the roller when out of engagement with the sheet pile, and releasable stops for engaging the leading edge of the fed sheet while it is being fed to buckle the sheet and means for positively gripping the buckled sheet in advance of release thereof by the stops and for further advancement of the sheet thereafter.

8. A sheet feeding device as claimed in claim 7 wherein the releasable stops comprise a pivoted assembly having flanges which project in the path of the fed sheet when in operative position, spring means constantly urging the flanges toward operative position, and cooperating cam and lever means responsive to the operation of the unit to which the sheet is being fed for actuating the rack and flanges to release position.

9. Sheet feeding apparatus, including in combination, a table providing an adjustable support for a sheet pile, a friction feed roller, a servo link assembly mounting the feed roller for rocking movement into and out of engagement with the sheet pile, means for adjusting the angular relationship of the links of the servo feed assembly to vary the ratio of vertical and horizontal force developed by the force reaction upon contact of the feed roller with the top of the sheet pile, means for rocking the friction roller into and out of engagement with the top sheet of the sheet pile, separate means synchronized with the first for rotating the roller in feeding relation when in engagement with the sheet pile and to return the roller when out of engagement with the sheet pile, and means for automatically raising the

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table responsive to the level of the sheet pile to establish proper alignment of the top sheet of the sheet pile for feeding relation.

10. Sheet feeding apparatus, including in combination, a table providing an adjustable support for a sheet pile, a friction feed roller, a servo link assembly mounting the feed roller means forming a part of said servo link assembly to convert the force reaction developed at the point of contact between the feed roller and the top of the sheet pile into vertical and horizontal components, the ratio of which depends upon the adjusted angular relation of the servo link members, means for rocking the friction roller into and out of engagement with the top sheet of the sheet pile, separate means synchronized with the first for rotating the roller in feeding relation when in engagement with the sheet pile and to return the roller when out of engagement with the sheet pile, and means for automatically raising the feed table as the sheets are fed off of the sheet pile to maintain proper level of the sheet pile, including cam means operative to raise and lower the feed table, a ratchet wheel turnable with the cam means, and an operative connection between the ratchet wheel and the means for rocking the feed roller into and out of engagement with the sheet pile for actuating the ratchet wheel in the direction to raise the feed table responsive to the extent of rocking movement.

11. A sheet feeding apparatus as claimed in claim 10 wherein the operative connection includes a shaft which rocks the feed roller into and out of sheet engagement, a lever arm secured to the shaft, another lever arm pivoted intermediate its ends with one end adapted to be engaged by the first lever arm as the roller engages the sheet pile, a rotating cam, a third lever arm pivoted intermediate its ends with one end adapted to follow the cam when in operative position while the other end is resiliently connected to the ratchet wheel to effect advancement thereof responsive to cam actuation, and an operative connection between the free ends of the second and third lever arms to permit cam actuation when the second lever arm is rocked to a predetermined position of adjustment.

12. In a sheet feeding apparatus, a servo sub-assembly pivoted at two points to permit rocking movement toward and away from the top sheet of a sheet pile, a friction feed roll rotatably carried by the sub-assembly, a link arranged angularly with respect to the sub-assembly one end of which provides one of the pivots for the sub-assembly, a pin adjustable relative to the sub-assembly and upon which the other end of the link is pivoted, and means for adjusting the position of the pivot pin to change the ratio of vertical and horizontal forces developed upon frictional engagement of the roll with the sheet pile, and means for actuating the roll for rotational movement when in engagement with the sheet pile.

13. In a sheet feeding apparatus, a servo sub-assembly pivoted at two points to permit rocking movement toward and away from the top sheet of a sheet pile, a friction feed roll rotatably carried by the sub-assembly, a link arranged angularly with respect to the sub-assembly one end of which provides one of the pivots for the sub-assembly, a pin adjustable relative to the sub-assembly and upon which the other end of the link is pivoted, and means for adjusting the

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position of the pivot pin to change the ratio of vertical and horizontal forces developed upon frictional engagement of the roll with the sheet pile, and spring means constantly urging the servo sub-assembly in the direction toward engagement with the sheet pile.

14. Sheet feeding apparatus as claimed in claim 12 wherein the means for adjusting the pivot pin includes a stationary housing having slots in which the pin is slidable, an adjusting bracket pivoted intermediate its ends with an actuating handle at one end and a slotted portion at the other end for actuating the pin within the first slots responsive to rocking movement of the bracket.

15. In a sheet feeding apparatus, a sub-assembly pivoted at two points to permit rocking movement toward and away from the top sheet of a sheet pile, a friction feed roll rotatably carried by the sub-assembly, a link arranged angularly with respect to the sub-assembly one end of which provides one of the pivots for the sub-assembly, a pin adjustable relative to the sub-assembly and upon which the other end of the link is pivoted, and means for adjusting the position of the pivot pin to change the ratio of vertical and horizontal forces developed upon frictional engagement of the roll with the sheet pile, spring means constantly urging the sub-assembly to rock about its pivots in the direction of the sheet pile, and means for adjustment of the pivot pin while the feed is operating.

16. In a sheet feeding apparatus, a sub-assembly pivoted at two spaced apart points to permit rocking movement toward and away from the top sheet of a sheet pile, a friction feed roll rotatably carried on one end of the sub-assembly, a link arranged angularly with respect to the sub-assembly one end of which provides one of the pivots for the sub-assembly, a pin adjustable relative to the sub-assembly and upon which the other end of the link is pivoted, and means for adjusting the position of the pivot pin to change the ratio of vertical and horizontal forces developed upon frictional engagement of the roll with the sheet pile, a drive shaft oscillatable in timed relation with the unit to which the sheet is being fed, and constantly meshing gears for transmitting oscillations of the shaft to corresponding movements of the feed roll independent of the position of the sub-assembly.

17. Sheet feeding apparatus as claimed in claim 16 wherein one gear is rotatable with the drive shaft, another gear is freely rotatable about the second pivot of the sub-assembly, and a connecting link pivoted at one end about said second pivot and at the other end about said drive shaft connects the sub-assembly to the drive shaft to permit rocking movement thereabout without disturbing the driving relation between gears.

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