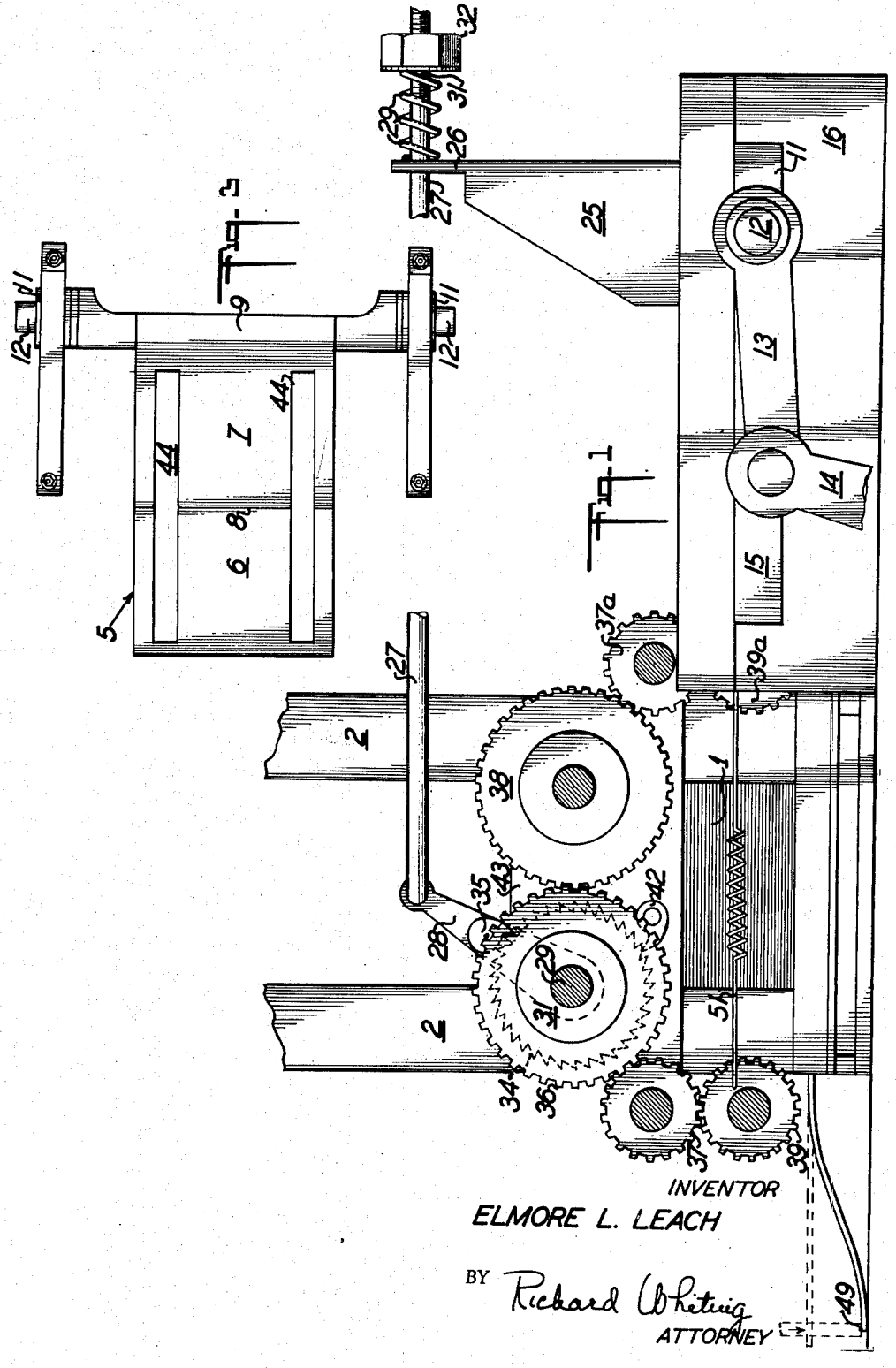
Aug. 17, 1954 E. L. LEACH 2,686,672

AUTOMATIC SHEET FEEDING DEVICE

Filed March 30, 1951 3 Sheets-Sheet 1



Aug. 17, 1954 E. L. LEACH 2,686,672

AUTOMATIC SHEET FEEDING DEVICE

Filed March 30, 1951 3 Sheets-Sheet 2

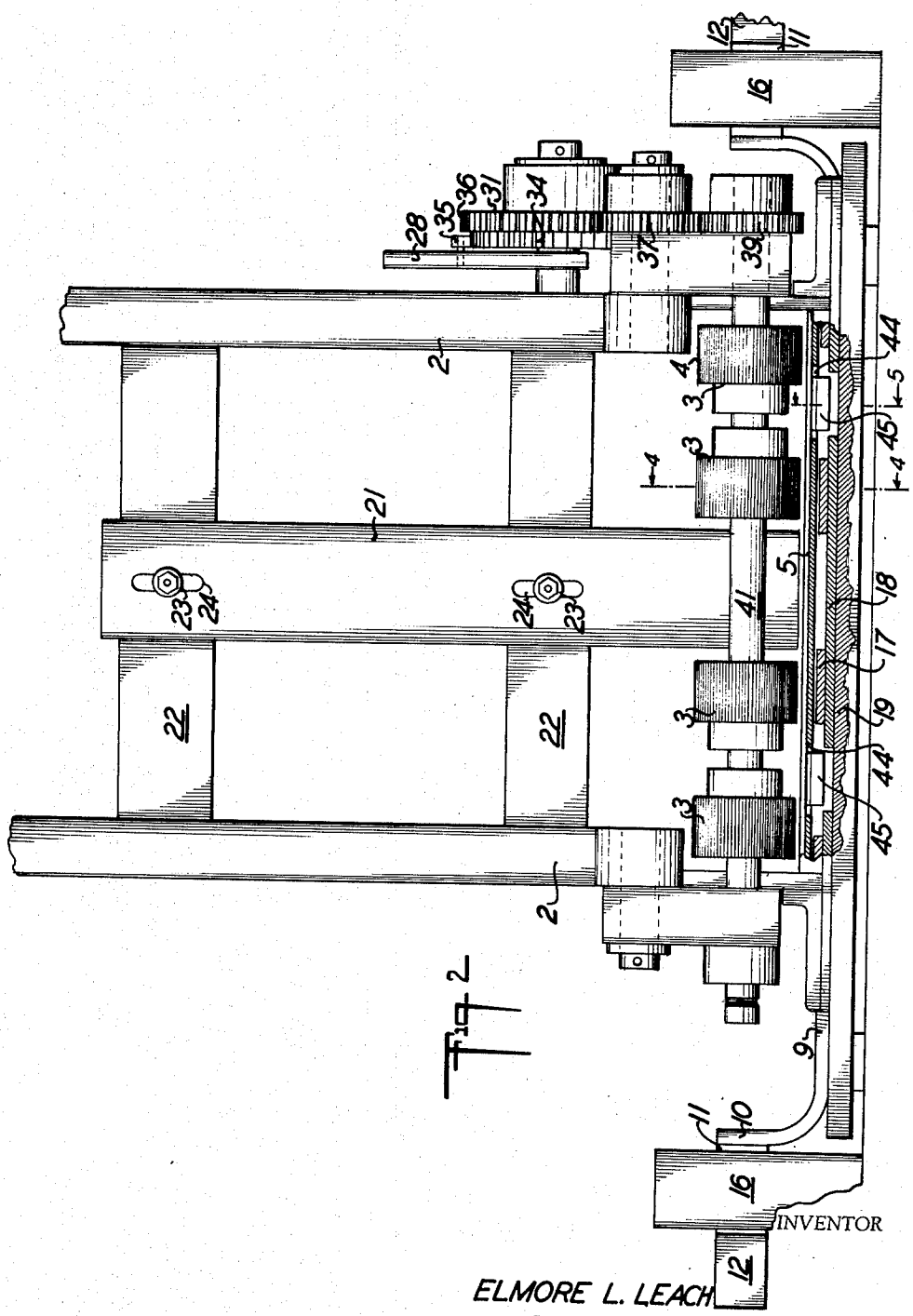


Fig. 2

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AUTOMATIC SHEET FEEDING DEVICE

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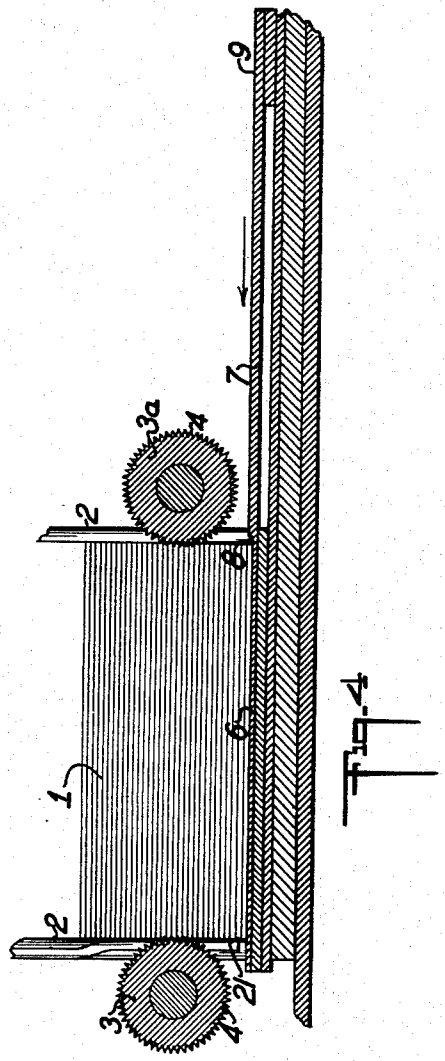


Fig. 4

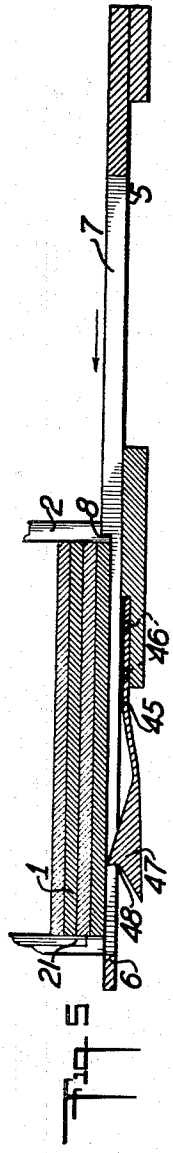


Fig. 5

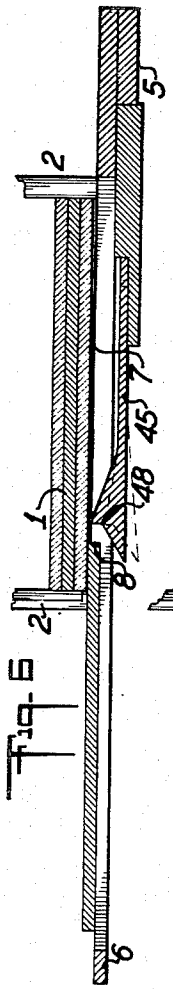


Fig. 6

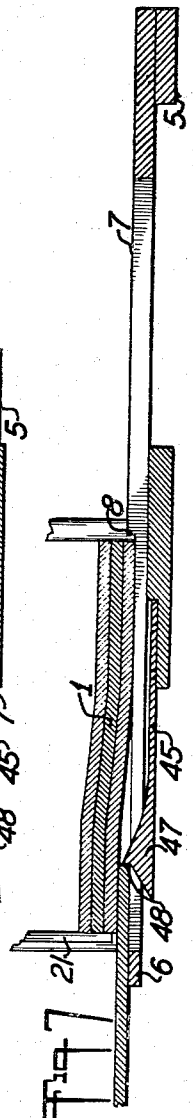


Fig. 7

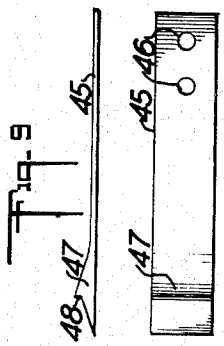


Fig. 9

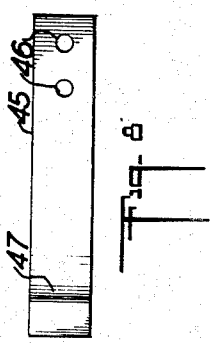


Fig. 8

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UNITED STATES PATENT OFFICE

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AUTOMATIC SHEET FEEDING DEVICE

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Application March 30, 1951, Serial No. 218,338

6 Claims. (Cl. 271—44)

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The present invention relates to devices for automatically feeding sheets of material from one end of a pile of sheets, and more particularly to devices adapted to provide a uniform positive feed for relatively thin sheets of stacked material such as paper, plastic, metal, etc.

Heretofore it has been proposed to feed sheets from the bottom of a pile of sheets in order to utilize the weight of the pile to flatten the lowermost sheets and allow them to be moved either singly or in multiple from the bottom of the pile. Pusher plates or other displacing members have been employed to contact one edge of the bottom sheet or sheets and push the sheet transversely of the pile. If the sheets are not pressed flat they will tend to buckle when pushed and jam the machine, and the continual removal of sheets will vibrate the pile, to also cause buckling and jamming.

Difficulty has been experienced when the weight of the pile alone is used for pressing the sheets down, as the pressure applied varies with the number of sheets in the pile and decrease as these sheets are fed from the machine. Thus in order for such a machine to work properly, the hopper containing the pile or stack must be kept nearly full at all times.

In order to improve slightly upon this situation it has been proposed to use a weighted plate on top of the pile. While this plate does provide a more uniform pressure it does not solve the problem, as again the weight of the pile is appreciable and the pressure on the bottom sheets decreases as feeding continues. Thus if the weight is heavy enough to provide sufficient pressure when the pile is small, it will cause a much greater pressure when the pile is large and tend to cause jamming and undue stresses in the moving parts of the machine. Also there has been no way suggested for adjusting the amount of pressure applied to the pile to suit different materials and different thicknesses of sheet.

The present invention contemplates a device or machine for feeding sheets from one end of a pile wherein substantially equal positive pressures are applied to the sheets at said end of the pile during each feeding stroke of the displacing means and a lesser pressure is applied during the return stroke of said displacing means. This is preferably accomplished by toothed rotatable wheels which grip the sides of the pile adjacent one end and press the sheets between the wheels and said end toward the displacing means. Pressure is applied to these end sheets by a slight rotation of the wheels toward the end of the pile.

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The pressure is applied intermittently and is substantially the same for each feeding stroke of the displacing means. This pressure is independent of the number of sheets in the pile above, or on the other side of, said wheels. During the feeding stroke the gripping wheels remain in a more or less fixed position preventing the bulk of the pile from exerting any pressure on the lower sheets and allowing the pressure applied to the lower sheets to be relieved somewhat by the removal of the end sheet or sheets. Then on each return stroke the gripping wheels are again rotated slightly to compensate for the removed sheet or sheets and apply substantially the same pressure to the new end sheets.

Adjusting means are provided for controlling the amount of pressure which the gripping wheels exert on the pile to suit different kinds of material and thicknesses of sheet.

This invention further contemplates means for holding a partially fed sheet in an extended position but not fully removed from the pile in order to perform some operation on the sheet. In order to properly register the sheet a resilient member is mounted to spring up behind the trailing edge of a bottom sheet as it is moved away from the pile and hold the sheet against being dragged back into the pile on the return motion of the displacing means.

It is therefore an object of the present invention to provide an improved means for feeding sheets from one end of a pile or stack of sheets.

Another object of the invention is to provide a machine for the above purpose which includes means for applying substantially equal pressures to the sheets at said end of the pile during each feeding stroke of the machine.

Another object of the invention is the provision of a machine of the above type, the feeding pressure of which is independent of gravity.

Still another object of the invention is to provide a machine of the above type wherein the substantially equal feeding pressures can be adjusted to the desired amount, and to suit different types and thickness of sheets.

Still another object of the invention is the provision of means for gripping the sides or edges of the pile adjacent the feeding end of said pile for placing the sheets at that end of the pile under pressure independently of the weight of the sheets above or on the other side of said gripping means.

A further object of the invention is the provision of means for correlating the action of the pressure applying or gripping means with the motion of the displacing means so that the grip-

ping means remains relatively fixed while the displacing means moves a sheet transversely of the pile and said gripping means moves slightly to compensate for the removal of said sheet and provide substantially the same pressure on the next end sheet on the return motion of said displacing means.

A further object of the invention is the provision of means for holding a partially fed sheet or sheets in an extended position but not fully removed from the pile in order to perform some operation on the sheet or sheets.

Other and further objects inherent in the invention will be apparent from the following description and claims taken together with the drawings wherein:

Figure 1 is a side view of a machine of this invention.

Figure 2 is a front view of this machine partly in section and partly in elevation.

Figure 3 is a reduced plan view of the displacing plate used in this machine showing its connection to the driving mechanism.

Figure 4 is a schematic sectional view taken along the line 4—4 of Figure 2.

Figure 5 is a schematic sectional view, enlarged in a vertical direction only, taken along the line 5—5 of Figure 2 and showing the displacing plate in its retracted position just prior to feeding the end sheet from the pile.

Figure 6 is a similar view along the line 5—5 showing the members of Figure 5 with the displacing plate carrying the end sheet to its register position.

Figure 7 is a similar view along the line 5—5 showing the members of Figures 5 and 6 with the displacing plate again retracted and the end sheet in register position for the performance of an operation.

Figure 8 is a plan view of spring positioning means of this invention and Figure 9 is an elevation of the same means.

Referring more particularly to the drawings, the numeral 1 designates a pile of sheets held in a hopper in flatwise relation to one another by the guides 2. Disposed adjacent to bottom of pile are gripping means 3 and 3*a* comprising wheels having a number of small teeth 4 which grip the edges of the pile and press the sheets below said gripping means flat against one another for feeding purposes. The gripping means 3 and 3*a* also act to support the pile above said gripping means so that the downward pressure upon the lowermost sheets is independent of gravity and the number of sheets in the pile and is determined only by the force exerted through the teeth 4.

Located directly below the pile for feeding the sheets is an elongated displacing means 5. As shown particularly in Figures 3 and 4, this displacing means is in the form of a plate having a thinner carrying portion 6 on which the pile normally rests and a raised displacing portion 7 on one side of the pile. The juncture of these portions forms a shoulder 8 which acts as a displacing part for moving sheets transversely of the pile.

To impart motion to the displacing plate 5 the cross bar 9 having vertical portions 10 terminating in horizontal extensions 11 is connected to one end of the plate. Integral with each of the horizontal extensions 11 are the driving pins 12, each of which are in turn connected to one end of a connecting rod 13. The other ends of the connecting rods 13 are pivotally connected to

reciprocating driving arms 14. Thus, the reciprocating motion of the driving arms 14 is transmitted to the displacing plate 5 through the connecting arms 13 and the cross bar 9. The horizontal extensions 11 of the cross bar slide in the slots 15 in the fixed base members 16 to impart a smooth reciprocating motion to the displacing plate. As shown in some detail in the Figure 2 of the drawings, the displacing plate moves over the sliding plates 17 which are in turn mounted on the base plates 18 and 19.

As the displacing plate 5 is moved towards the pile, the shoulder 8 moves into contact with the edge of one or more sheets, depending upon their thickness, and the combined pushing action of the shoulder and frictional contact between the lowermost sheet and the relatively thin portion of the plate 6 moves a sheet or sheets transversely of the pile. Mounted on the other side of the pile is a limit means 21 comprising a plate or bar which is adjustably mounted on the transverse members 22 by the bolts 23 which go through the slots 24 in the limit bar. The limit bar 21 can be vertically adjusted above the displacing plate to define a space between the bar and the plate 5 which will determine the number of sheets which can be fed in any one stroke of the displacing plate.

The action of the gripping means 3 and 3*a* is correlated with the reciprocating motion of the displacing plate 5 by connecting means between them. Connected to the displacing plate 5 through the cross bar 9, is a cantilever force transmitting member 25 having a plate-like extension 26. Passing through a hole in the extension 26 is the rod 27, one end of which is connected to the arm 28. Fitting over the other end of the rod is the resilient member or spring 29 which abuts the extension 26. This end of the rod is threaded at 31 to hold the nut 32 so that the spring is held on the rod between the nut 32 and the extension 26. Thus the pressure on the spring 29 may be varied by a single adjustment of the nut 32 on the threads 31.

The arm 28 is mounted for pivotal movement about the shaft 29. Mounted for rotary movement about the shaft 29, is the wheel 34 having an internal portion with ratchet teeth 34 for engaging the pawl 35, which is in turn pivotally mounted on the arm 28, and an external portion having gear teeth 36. The pawl 35 is so arranged, that when the rod 27 is moved to the right in Figure 1, the arm 28 will be moved with it, and through the pawl, will rotate the wheel 34 and its external gear teeth 36 clockwise. The teeth 36 are directly connected to a reversing gear 37 on one side of the wheel 34 and an intermediate gear 38 on the other side of the wheel. The intermediate gear 38 is in turn connected with a reversing gear 37*a*. The reversing gears 37 and 37*a* are in driving engagement with the gears 39 and 39*a* respectively; the gear 39 being mounted on the end of and driving the shaft 41 and gear 39*a* being mounted on the end of and driving the shaft 41*a*, not shown. The gripping wheels 3 are mounted on the shaft 41 and wheels 3*a* on the shaft 41*a*, to rotate with the shaft.

Thus when the rod 2 moves to the right and rotates the arm 28 and its associated pawl 35, clockwise in Figure 1, this motion will be transmitted through the above mentioned gearing to the shaft 41 and 41*a* so that the gripping wheels 3 and 3*a* will be rotated with the shaft clockwise and counter-clockwise, respectively, to press the sheets below the wheels downward to flatten

the lowermost sheet to hold them closely together for feeding purposes.

However, when the rod 2 moves to the left it will disengage the pawl 35 from the ratchet teeth 34 and its motion will not be transmitted to the wheel 31. To prevent the wheel 31 and its associate gearing from moving backward and releasing the pressure on the lower sheet the pawl 42, mounted on the plate 43, is provided to engage the ratchet teeth 34 and prevent the wheel 31 from moving in a counter-clockwise direction. The plate 43 is mounted on one side of two of the guides 2.

Thus, the reciprocating driving arm 14 is connected to the driving pin 12 through the connecting rod 13, so that the pin 12 and the horizontal extension 11 of the cross bar 9 slide back and forth over a fixed distance or stroke S with any given stroke of the arm 14. Since the cross bar 9 is directly connected to the displacing plate 5, the stroke of the bar is the stroke of the displacing plate. Also, since the cantilever force transmitting member 25 and its extension 26 is connected to the bar 9, the stroke of this extension is the same as the stroke S of the displacing plate 5.

If the member 25 and the rod 27 were joined by a fixed connection, this rod would also move through the full stroke of the displacing plate and on each return motion of the plate 5 would transmit this full stroke through the above described gearing to impart a considerable amount of rotation to the gripping wheels 3 and 3a. However, the rod 27 is slidably connected with the member 25 through a hole in the extension 26 and the return motion of the member 25 is transmitted through the resilient member or spring 29 to the nut 32 which is adjustably mounted on the threads 31 of the rod 27. Thus, the amount of force which the member 25 transmits to the gripping means 3 and 3a through the rod 27 and associated gearing, depends upon the strength of the spring 29 and the setting of the nut 32 on the threads 31.

If there are no sheets in contact with the gripping means 3 and 3a, there will be no load on the gearing, so that the spring 29 will compress very little and almost the full stroke of the displacing plate 5 will be transmitted to the gripping wheels. However, if a pile of sheets is resting on the displacing plate 5 and the wheels 3 and 3a are in contact with and gripping the sides of this pile, as soon as the wheels begin to rotate they will press the lower sheets together and the sheets will exert a back pressure through the gearing to place the rod 27 in tension and cause the spring 29 to compress. To increase the pressure which the gripping means 3 and 3a exert on the sheets, the nut 32 is adjusted to the left on the threads 31, referring to Figure 1, thereby increasing the pressure on the spring 29, and to decrease the pressure on the sheets the nut 32 is adjusted to the right to decrease the pressure on the spring. Thus a major portion of the stroke S of the displacing plate 5 will be absorbed in compression of the spring 29, while the remaining portion will be absorbed in a slight rotation of the gripping means 3 and 3a as they place the lowermost sheets in the pile under pressure.

While the resilient means has been shown as a compression spring 29 having a simple thread and nut adjustment, of course a tension spring or other resilient means such as an adjustable dash pot, for instance, may be used without detracting from the effectiveness or departing from the scope of this invention.

To begin operation, a number of sheets of relatively thin material, such as paper, cardboard, plastic, steel, etc., are placed in the hopper defined by the guides 2. These sheets will drop down between the guides until they contact the teeth 4 on the gripping wheels 3 and 3a on opposite sides of the pile of sheets. The machine is then operated once or twice to bring the lowermost sheets into position for feeding.

During the first few strokes of the machine very little back pressure will be exerted on the spring 29 and the wheels 3 and 3a will rotate through a major portion of their maximum unloaded rotation, as described hereinbefore, to move the lowermost sheets past said wheels to rest on the displacing plate where they are placed under pressure for feeding.

At this point the lowermost sheet will rest upon the thinner portion 6 of the displacing plate 5, when the plate is in its retracted position or to the right of the pile in Figure 1, and this sheet and all the others below the gripping wheels 3 and 3a will be flattened out and under pressure for feeding. The amount of this pressure will be determined by the strength of the spring 29 and the setting of the nut 32 on the threads 31, and will be fixed for any one spring and any one setting of the nut. Then as the displacing plate begins its feeding stroke, moving to the left in Figure 1, the shoulder 8 on the plate moves into contact with an edge of one or more of the bottom sheets, depending upon the thickness of the sheets and the size of the plate used, to begin to move the sheet or sheets contacted transversely of the pile. Of course, to feed only one sheet, the shoulder 8 can be no higher than the thickness of a single sheet. Since the lowermost sheets are pressed tightly together, the frictional forces between their surfaces are relatively high and the feeding motion of the displacing plate 5 will tend to move more sheets than those which the shoulder 8 contacts directly. Therefore, in order to limit the number of sheets fed to an exact amount, the limit bar 21 is adjusted up or down, as described hereinbefore, to define a fixed feeding space between the end of the bar and the displacing plate.

Since the pawl 35 will pivot and disengage from the ratchet teeth 34 when the rod 27 moves in a feeding direction or to the left in Figure 1, the gripping wheels 3 and 3a will not be rotated backwards by the driving mechanism, and further will be held against backward rotation by the pawl 42 mounted on the plate 43. Also tending to hold the feeding wheels 3 and 3a against backward rotation is the spring snubber 51 secured between the gears 39 and 39a slightly off their centers in such a way as to tend to rotate them in a feeding direction.

However, the removal of a sheet or sheets from the bottom of the pile will reduce the pressure on the sheets under the gripping means below the desired feeding pressure. Then on the return stroke of the displacing plate the pawl 42 will disengage and the pawl 35 will reengage the ratchet teeth 34, and the gripping wheels 3 and 3a will be rotated slightly to move more sheets downward to replace the sheets removed and again place the lowermost sheets under the desired pressure. This pressure is maintained substantially the same for each stroke of the displacing means by the fixed setting of the resilient means or spring 29 and is independent of gravity and the weight of the pile above the gripping means 3 and 3a.

Thus, the machine of this invention will feed perfectly well as long as there are sufficient sheets in the hopper to fill up the space between the gripping wheels 3 and 3a and the displacing means.

While the displacing means of this invention is preferably in the form of a plate having a thin portion and a thick portion with a feeding shoulder formed by the juncture of these two portions, other displacing means may be used without departing from the scope of the invention. For instance, the thin portion 6 could be cut off the displacing plate 5 at the shoulder 8, the sheets could rest on a sliding plate or table, and the shoulder 8 could be moved in to displace the lowermost sheets as it does at present. Of course appropriate adjustments would be made in the dimensions of the parts to suit such a change.

The above described mechanism may be used solely as a feeding device which intermittently delivers sheets singly or in multiple to a designated point. However, if it is desired to perform an operation on the sheet or sheets being fed, I have found that the device of this invention will hold the sheets in an extended position and register them so that the operation may be performed with accuracy.

I have shown in some detail in Figures 4, 5, 6, 7 and 8 the structure which holds the sheets in a registered position for this purpose.

The displacing plate 5 is provided with two longitudinal slots 44, into each of which extends a spring positioning means 45 shown in detail in Figures 8 and 9. The spring 45 is a leaf spring type, having securing means 46 at one end fastening said spring to the base plate 18. The other end of the spring has a raised sheet engaging portion 47 for positioning a sheet in an extended position. Both upper surfaces of the raised portion 47 are sloped toward the apex of the raised portion to allow sheets to pass over the surfaces. However the outermost slope does not reach the apex of the raised portion but terminates in a substantially vertical shoulder 48, which shoulder is the part which actually engages and positions the sheets being fed.

With the displacing plate 5 in retracted position as shown in Figure 5, the lowermost sheets press down upon the top of the vertical shoulder 48 on the spring positioning means 45 to bend that end of the spring downwards below the top surface of the thinner portion 6 of the displacing plate. The spring 45 remains in this depressed position until the trailing edge of the bottom sheet moves over the shoulder 48, at which point, it springs up behind this sheet to the position shown in full lines in Figure 6. For use with the positioning spring, the stroke of the displacing plate is limited so that the shoulder 8 of the plate reaches its fully extended position before it pushes the bottom sheet fully out from under the pile, as shown at 8 in Figure 6. Now, when the displacing plate 5 is retracted from this position to return to its first position, through frictional contact with the bottom sheet, it drags the sheet slightly to bring the trailing edge of the sheet in contact with the shoulder 48. Thus the sheet is firmly held by the pressure on the pile 1, the portion 6 of the displacing plate 5 and the shoulder 48 of the spring positioning means, as shown in Figure 7. An operation may then be performed on the extended end of the sheet as shown at 49 in Figure 1.

While I have shown and described certain specific embodiments, it is to be understood that I do not wish to be limited thereto, as modifications may be made without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, gripping means for placing the sheets at one end of said pile under pressure thereby holding said sheets flat against one another for feeding purposes, displacing means at said one end of the pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, and connecting means between said displacing means and said gripping means, said connecting means being inoperative to connect said displacing means and said gripping means when said displacing means moves in a feeding direction and operative to connect said displacing means and said gripping means when said displacing means moves in a return direction, a portion of the return motion of said displacing means being transmitted to said gripping means for placing said end sheets under pressure, whereby the feeding motion of said displacing means removes said end sheet, thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said gripping means to compensate for said reduction in pressure.

2. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, means for placing the sheets at one end of said pile under pressure thereby holding said sheets flat against one another for feeding purposes, displacing means at said one end of the pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, connecting means between said displacing means and said pressure means, said connecting means being inoperative to connect said displacing means and said pressure means when said displacing means moves in a feeding direction and operative to connect said displacing means and said pressure means when said displacing means moves in a return direction, a portion of the return motion of said displacing means being transmitted to said pressure means for placing said end sheets under pressure, and holding means for preventing said pressure means from moving in a direction to relieve said pressure during the feeding motion of said displacing means, whereby the feeding motion of said displacing means removes said end sheet thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said pressure means to compensate for said reduction in pressure.

3. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, means for placing the sheets at one end of said pile under pressure thereby holding said sheets flat against one another for feeding purposes, displacing means at said one end of pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, and connecting means between said displacing means and said pressure means, said connecting means having a resilient portion and being inoperative to connect said displacing means and said pressure means when said displacing means moves in a feeding direction and operative to connect said displacing means and

said pressure means when said displacing means moves in a return direction, said resilient portion absorbing some of the return motion of said displacing means so that only a portion of this motion is transmitted to said pressure means for placing said end sheets under pressure, whereby the feeding motion of said displacing means removes said end sheet thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said pressure means to compensate for said reduction in pressure.

4. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, means for placing the sheets at one end of said pile under pressure thereby holding said sheets flat against one another for feeding purposes, displacing means at said one end of the pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, connecting means between said displacing means and said pressure means, said connecting means having a resilient portion and being inoperative to connect said displacing means and said pressure means when said displacing means moves in a feeding direction and operative to connect said displacing means and said pressure means when said displacing means moves in a return direction, said resilient portion absorbing some of the return motion of said displacing means so that only a portion of said motion is transmitted to said pressure means for placing said end sheets under pressure, and adjustable means for controlling the extent which said resilient portion absorbs said return motion thereby determining the amount of pressure transmitted to the sheets, whereby the feeding motion of said displacing means removes said end sheet thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said pressure means to compensate for said reduction in pressure.

5. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, means for placing the sheets at one end of said pile under pressure thereby holding said sheets flat against one another for feeding purposes, displacing means at said one end of the pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, connecting means between said displacing means and said pressure means, said connecting means having a spring portion and being inoperative to connect said displacing means and said pressure means when said displacing means moves in a feeding direction and

operative to connect said displacing means and said pressure means when said displacing means moves in a return direction, said placing means moves in a return direction, said spring portion absorbing some of the return motion of said displacing means so that only a portion of said motion is transmitted to said pressure means for placing said end sheets under pressure, and adjustable means for controlling the extent which said spring absorbs said return motion thereby determining the amount of pressure transmitted to the sheets, whereby the feeding motion of said displacing means removes said end sheet thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said pressure means to compensate for said reduction in pressure.

6. In a mechanism for feeding a pile of sheets held in flat-wise relationship to one another by guides at the edges of the pile, displacing means at one end of the pile movable from a first position in a direction to move the end sheet transversely of the pile to feed said sheet and in the other direction away from said sheet to return to its first position, gripping means for clutching a portion of said pile edge-wise and pressing it towards said one end to put that part of the pile between said gripping means and said displacing means under pressure and thereby hold the sheets in said part of the pile flat against one another for feeding purposes, and connecting means between said displacing means and said gripping means, said connecting means being inoperative to connect said displacing means and said gripping means when said displacing means moves in a feeding direction, a portion of the return motion of said displacing means being transmitted to said gripping means for placing said end sheets under pressure, whereby the feeding motion of said displacing means removes said end sheet thereby causing a reduction of the pressure on said end sheets and the return motion of said displacing means moves said gripping means to compensate for said reduction in pressure.

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