

Aug. 9, 1932.

E. S. LINCOLN

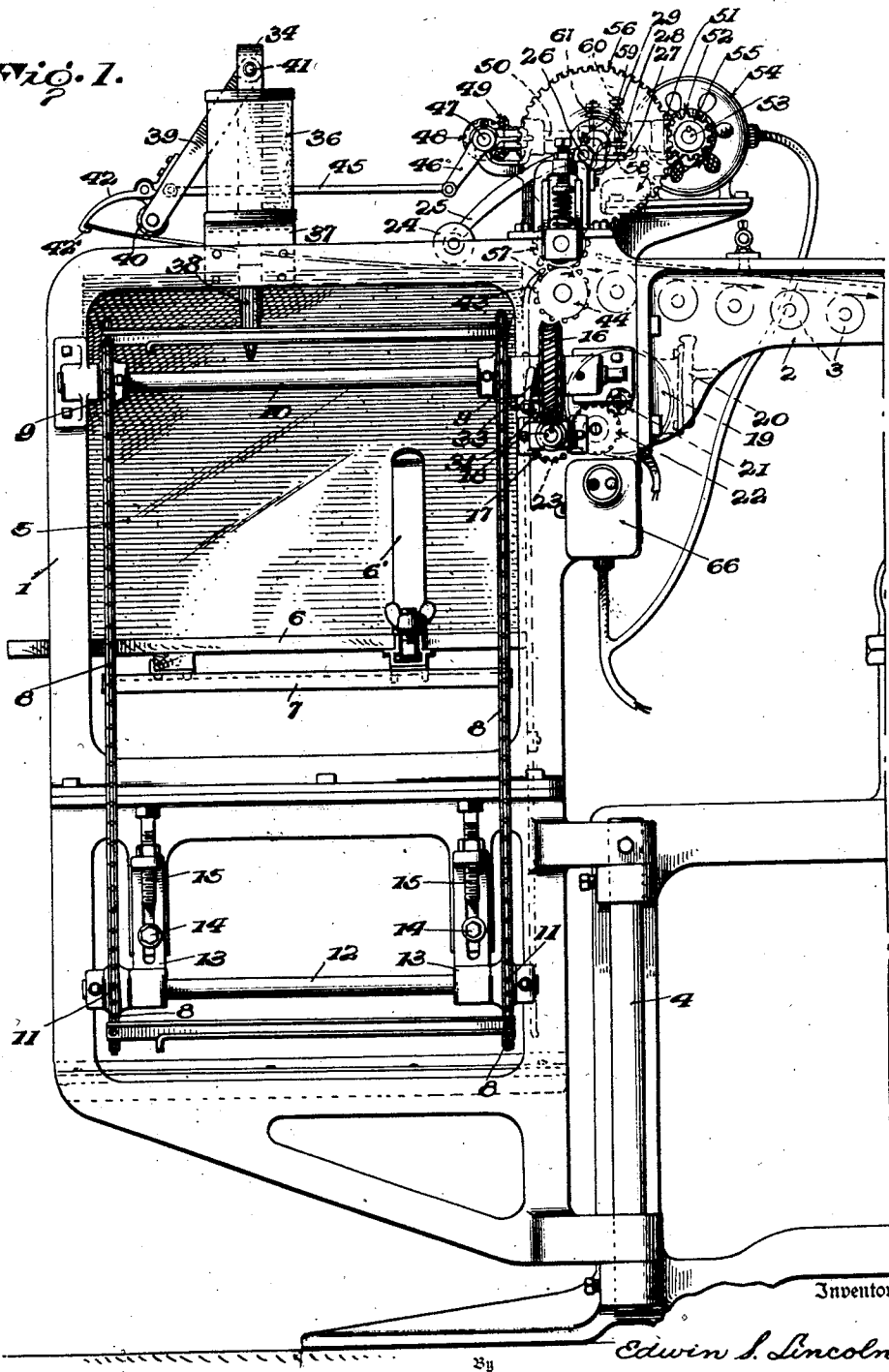
1,870,314

METHOD AND APPARATUS FOR FEEDING SHEETS

Filed June 11, 1930

5 Sheets-Sheet 1

Fig. 1.



Aug. 9, 1932.

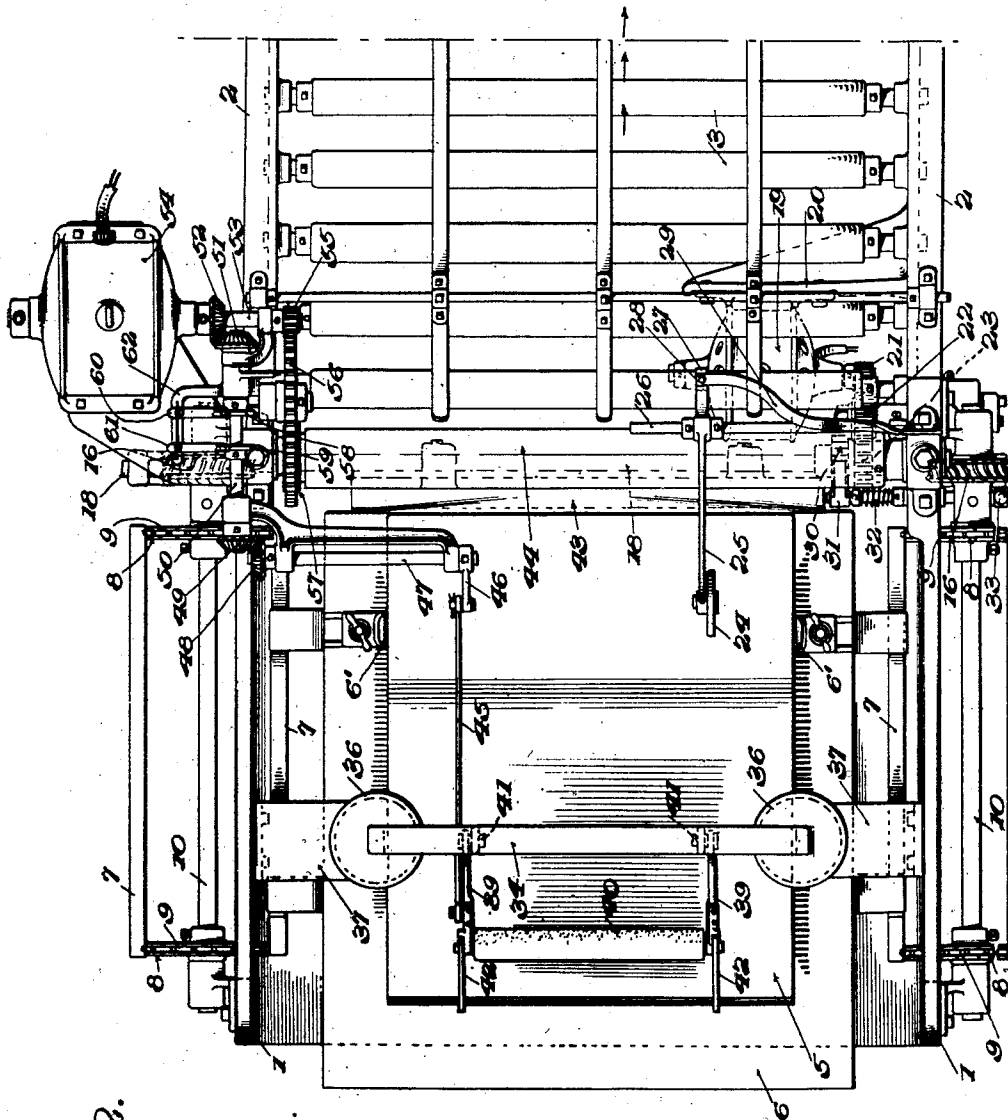
E. S. LINCOLN

**1,870,314**

## METHOD AND APPARATUS FOR FEEDING SHEETS

Filed June 11, 1930

5 Sheets-Sheet 2



Inventor

Edwin S. Lincoln.

23y

Cameron, Kerkam & Sutton.

Attorneys

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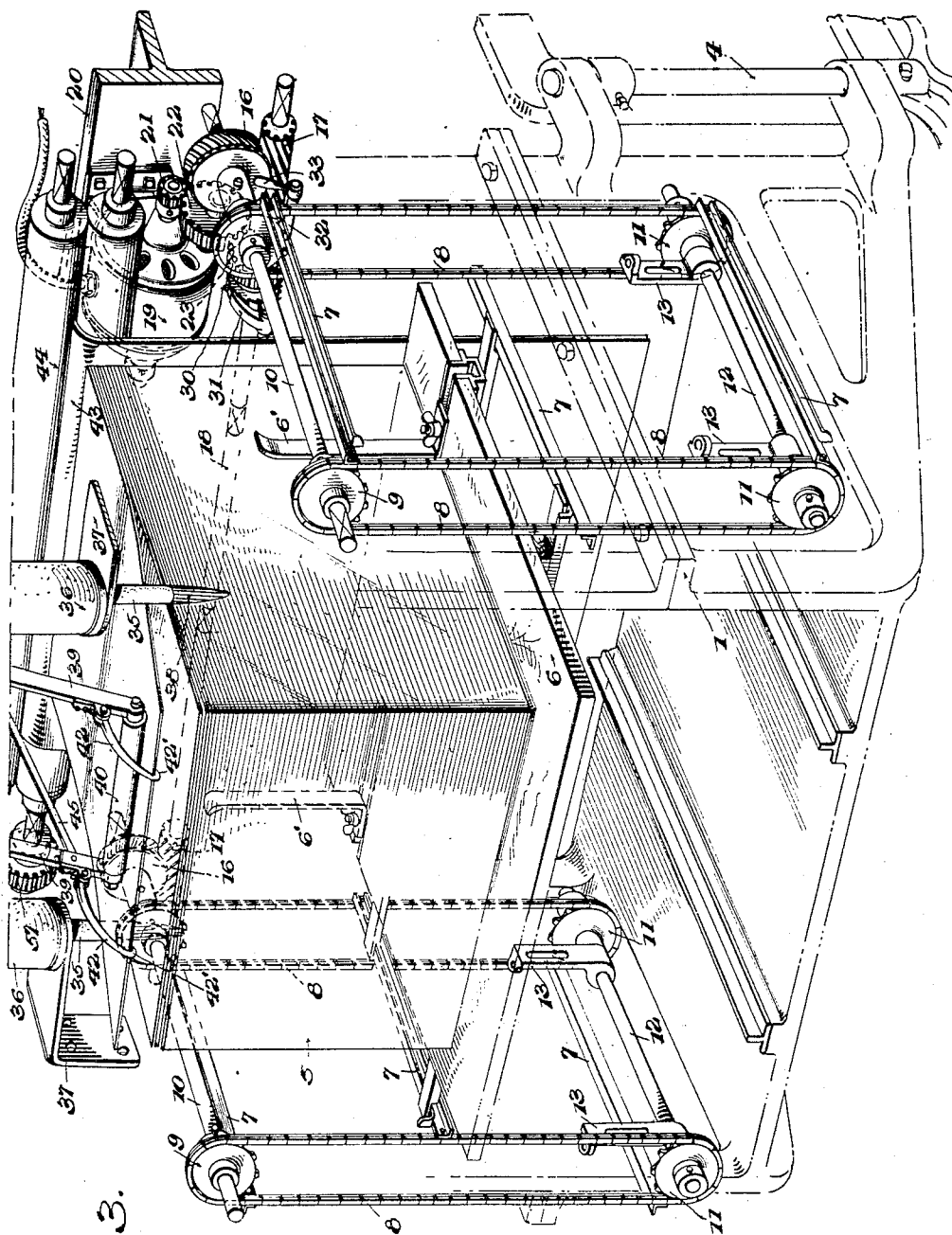
E. S. LINCOLN

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## METHOD AND APPARATUS FOR FEEDING SHEETS

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5 Sheets-Sheet 3



Inventor  
Edwin S. Lincoln.

23g  
Cameron, Kerkam & Sutton.  
Attorneys

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E. S. LINCOLN

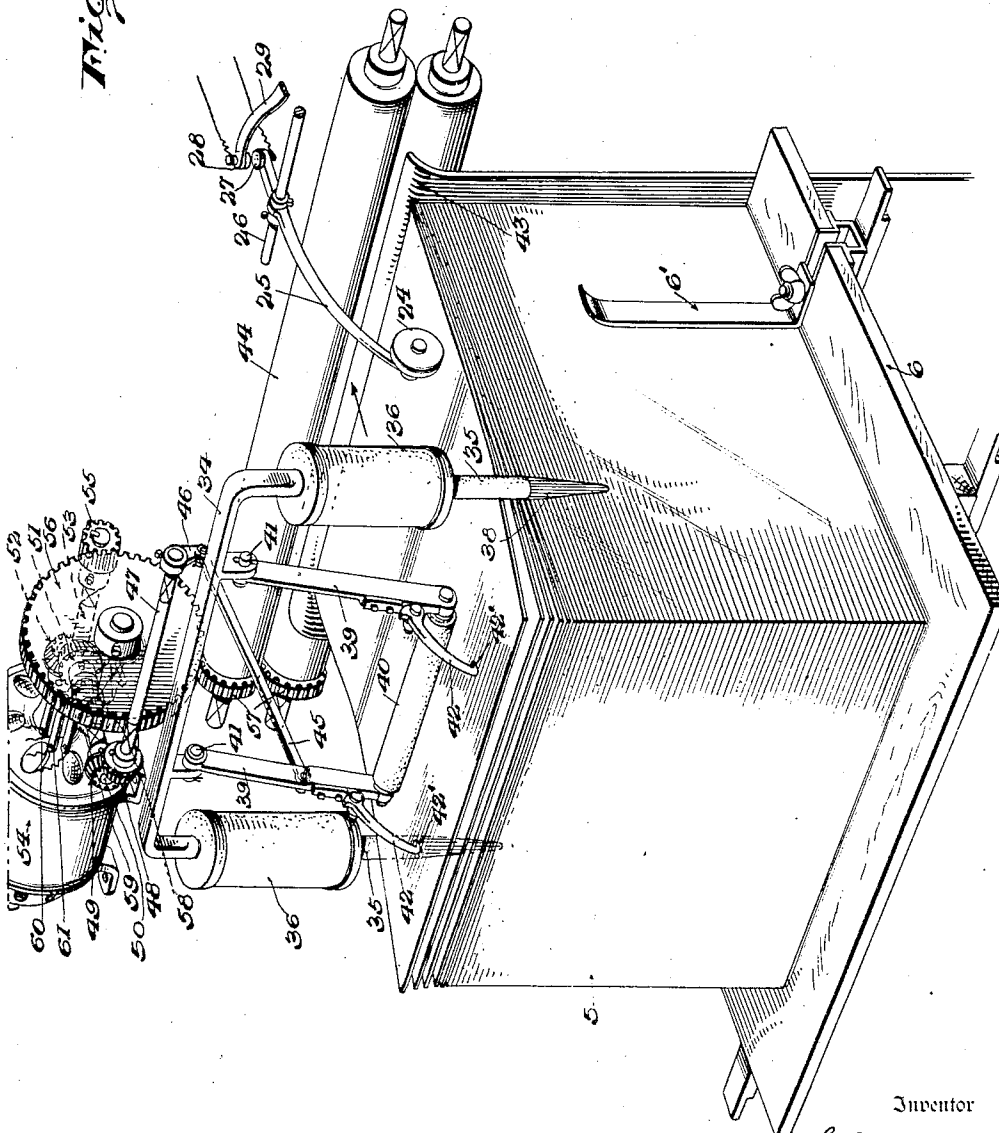
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METHOD AND APPARATUS FOR FEEDING SHEETS

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5 Sheets-Sheet 4

Fig. 4.



Inventor

Edwin S. Lincoln.

23

Cameron, Kerkam & Sutton.  
Attorneys

Aug. 9, 1932.

E. S. LINCOLN

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METHOD AND APPARATUS FOR FEEDING SHEETS

Filed June 11, 1930

5 Sheets-Sheet 5

Fig. 5.

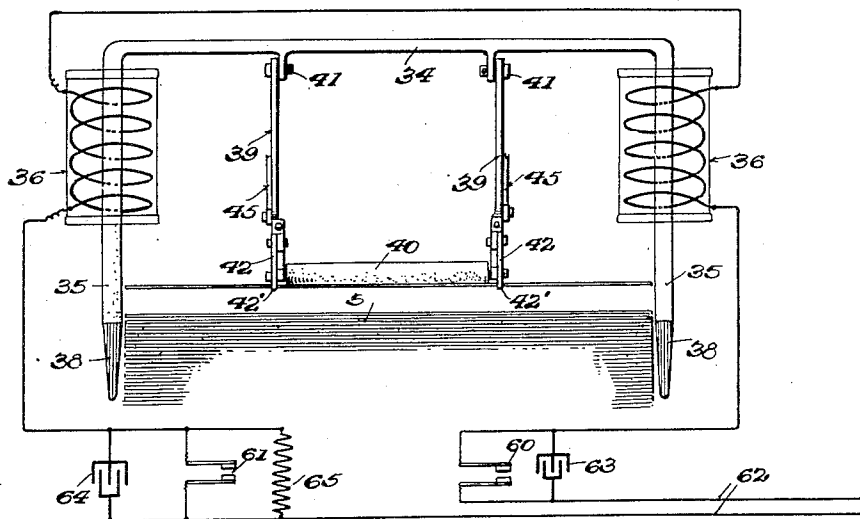


Fig. 6.

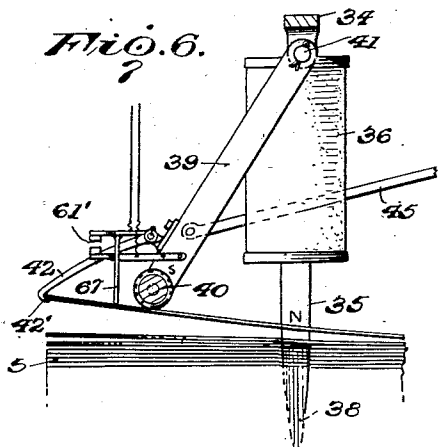


Fig. 7.

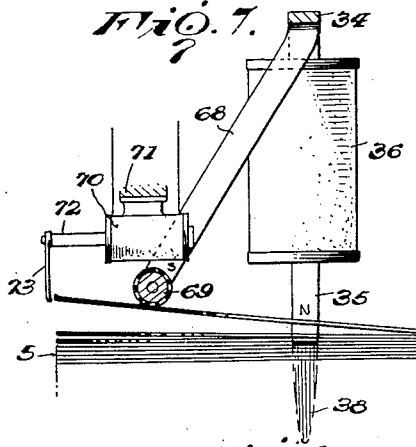


Fig. 8.

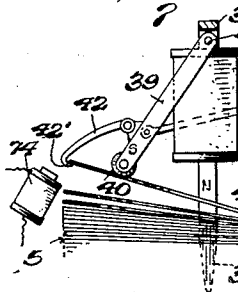


Fig. 10.

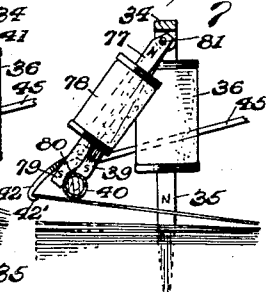
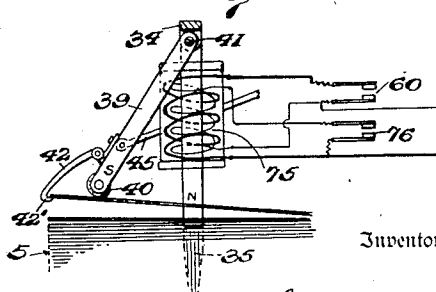


Fig. 9.



Inventor

Edwin S. Lincoln.  
Cameron, Kerkam & Sutton.  
Attorneys

## UNITED STATES PATENT OFFICE

EDWIN S. LINCOLN, OF SCARSDALE, NEW YORK, ASSIGNOR TO DEXTER FOLDER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

## METHOD AND APPARATUS FOR FEEDING SHEETS

Application filed June 11, 1930. Serial No. 460,526.

This invention relates to a method and means for separating and feeding a sheet or other article of magnetic material from a stack of such sheets.

It has been proposed heretofore to employ lifting magnets, which are positioned above the stack and are alternately raised and lowered or intermittently energized, to attract and lift sheets from a stack, but devices of this character have proved unsatisfactory for the primary reason that it has been found impracticable to prevent the picking up of more than one sheet at a time. Due to unavoidable variations in thickness of the sheets and permeability of the metal, the magnetic flux penetrates the top sheet and attracts the second sheet also, or the sheets may be stuck together or held together by air pressure so that the second sheet is carried up with the top sheet. Attempts have been made to overcome these difficulties by adjusting the intensity of the magnetic field, but adjustments of this sort are delicate and cannot be relied upon to prevent the sheets sticking together, and moreover, it has been found in many cases that when the intensity of the field is reduced sufficiently to prevent penetration, the lifting power is too small to obtain reliable operation.

One of the objects of the present invention is to provide a novel method which will insure positive separation of individual sheets of magnetic material from a stack or pile of such sheets.

Another object is to provide a novel method for separating sheets from a pile wherein a magnetic field is set up to lift a sheet from a stack and with the sheet lifted is then weakened or partially deenergized to release all but the top sheet.

Another object is to provide novel magnetic means for separating and feeding sheets of magnetic material which means, while simple and inexpensive, is reliable and accurate and may be operated at relatively high speed without feeding more than one sheet at a time.

Another object is to provide novel means for separating and feeding sheets of magnetic material whereby the top sheet of the stack is positively lifted but all of the other sheets

are released to prevent the picking up of more than one sheet.

A further object is to provide novel magnetic sheet separating means which will effectively separate individual sheets one by one from a stack.

Several embodiments of the invention are illustrated in the accompanying drawings, but it is to be expressly understood that these drawings are for purposes of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In said drawings—

Fig. 1 is an elevation in section of an apparatus embodying the invention;

Fig. 2 is a plan view of said apparatus;

Figs. 3 and 4 are perspective views of the apparatus shown in Figs. 1 and 2, parts being removed for the sake of clearness;

Fig. 5 is a detail view showing a part of the apparatus of Fig. 1, together with the wiring connections therefor; and

Figs. 6 to 10 inclusive are details respectively illustrating different embodiments of the invention.

While the separating and feeding mechanism constituting the invention is adapted for and may be employed broadly in the separation and feeding of articles of magnetic material for any purpose, the drawings show the invention embodied in an apparatus for separating and feeding sheets of magnetic material, such as tin, from a stack to a feed or conveying table. Accordingly, a supporting frame 1 of any suitable construction and material, whereby the separating and feeding mechanism is supported, is associated with a feed table 2 of any suitable type that is provided with conveying rollers 3. As shown, the frame 1 is pivoted on a pin 4 so that the separating and feeding mechanism may be swung into and out of operative relation with the feed table 2. A stack or pile of sheets 5, of suitable magnetic material such as tin, is supported by a suitable table 6 that is preferably provided with suitable side register devices 6'. The table 6 is carried by an elevating mechanism of any suitable type, and

in the form shown, rests on flights 7 secured to elevator chains 8, the latter passing over and being driven by sprocket wheels 9 mounted on a pair of shafts 10, one at each side of the frame. The lower ends of the chains 8 pass over sprocket wheels 11 mounted on a pair of shafts 12 which rotate in adjustable brackets 13 secured to the frame 1 by set screws 14. The tension of the sprocket chains 8 may be adjusted by means of bolts 15.

For the purpose of rotating the sprocket wheels 9 to drive the elevator chains, each of the shafts 10 preferably carries a worm gear 16 meshing with a worm 17, the latter being mounted on a shaft 18 that rotates in bearings formed on the frame 1. Any suitable means may be employed to rotate the shaft 18 to elevate the table 6, and in the form shown, an electric motor 19, which is suitably mounted on a bracket 20 constituting a part of the frame of the feed table 2, carries a pinion 21 on its shaft meshing with an idler 22, which in turn drives a pinion 23 on the shaft 18. The motor 19 is preferably controlled automatically in order to maintain the top sheet of the stack at the proper elevation, and accordingly a roller 24 (Fig. 4) that is adapted to rest upon the top of the stack is carried at one end of an arm 25 pivoted on a rod 26 carried by the frame 1, the other end of arm 25 carrying a contact 27 cooperating with a stationary contact 28 that is carried by a bracket 29, likewise secured to the frame 1. Contacts 27 and 28 are connected in the circuit of motor 19, so that as the height of the stack decreases, the roller 24 falls until contacts 27 and 28 close, whereupon motor 19 is energized to elevate the table 6 until contacts 27 and 28 open. Thus the elevation of the top sheet of the stack is automatically maintained within proper limits. The table 6 is maintained in its elevated position by means of a ratchet 30 on the shaft 18, with which cooperates a pawl 31 that is carried by a shaft 32 mounted in the frame 1 and provided on its outer end with a handle 33. It is to be expressly understood, however, that the above described pile elevating mechanism and the operating and control mechanism therefor are shown for purposes of illustration only and constitute no part of the present invention.

Means are provided for separating and lifting the individual top sheets from the pile 5 and forwarding the same one by one to the feed table 2, which means preferably operates magnetically. In the form shown, a yoke 34, of magnetic material such as iron, passes from side to side across the top of the pile 5 and is provided with depending arms 35 at both sides of the stack, each of said arms carrying a magnet coil 36. The yoke 34 may be supported in any suitable manner and as shown is carried by a pair of arms 37 of brass or other non-magnetic material,

which arms are secured to the sides of the frame 1. The coils 36 are wound so that the ends of the arms 35 are of north polarity, said arms being preferably provided with tips 38 of brass or other non-magnetic material, whereby the lines of force from the pole pieces 35 pass into the edges of the sheets and are concentrated in the uppermost sheets of the pile. Both edges of all of the sheets therefore have like south polarity. The magnetic circuit is completed by magnetic lifting means which are preferably positioned over the center of the pile intermediate the pole pieces 35 and which, in the form shown, are constituted by a pole piece affording a return path for the lines of force leaving the pole pieces 35. Accordingly, a pair of arms 39 of magnetic material depend from the central portion of yoke 34 and carry a pole piece 40, which is likewise of iron or other magnetic material and preferably, although not necessarily, a roller, the arms 39 and roller 40 constituting a depending pole piece which is pivoted to yoke 34 by means of pivot pins 41 for a purpose to be described hereinafter. The magnetic circuit for either magnet 36 may be traced through the pole piece 35, sheets 5, roller 40, arm 39, and yoke 34. When the magnets 36 are energized, the top sheet flies up into contact with the roller 40 while the remaining sheets are fanned out, as clearly indicated in Fig. 4, due to the magnetic repulsion between the sheets.

When the sheets have been thus separated and lifted, any suitable means may be employed to engage and forward the top sheet to the feed table 2. In the form shown, however, the swinging pole piece or frame is employed for this purpose, and to this end the arms 39 are each provided with a pivoted arm 42 having a hooked end 42'. Preferably, while the swinging frame is in a substantially vertical position, as shown in Fig. 4, the intensity of the magnetic field is weakened by suitable means, such as described hereinafter, whereupon all of the sheets except the top sheet drop back to the pile, but the top sheet is held firmly against the roller 40 since there is no appreciable air gap in the magnetic circuit. When the swinging frame is thereafter swung rearwardly to the position shown in Figs. 1 and 3, the roller 40 and the hooked arms 42, will ride over the sheet which is held against movement by its frictional drag on the remainder of the pile, until the hooks 42' drop over and engage the rear edge of the top sheet. Thereupon the swinging frame is swung forwardly past the vertical position, the hooked arms 42 carrying the entire top sheet along until the forward edge thereof passes over a front register and guide plate 43 into a pair of suitable feed rolls 44 which forward the sheet to the feed table 2.

The oscillating movement of the swing-

ing frame may be produced in any suitable way. Preferably, a link 45 that is pivoted at one end to one of the arms 39 is pivoted at its other end to a crank arm 46 on a shaft 47 mounted in suitable brackets secured to the frame 1. A bevel gear 48 on the other end of shaft 47 meshes with a bevel gear 49 on a shaft 50, likewise mounted in brackets secured to the frame 1. A bevel gear 51 on the opposite end of shaft 50 meshes with a bevel gear 52 on the shaft 53 of an electric motor 54, the latter being mounted on a shelf or bracket suitably secured to the frame 1. The motor 54 runs continuously and through bevel gears 52, 51 and 49, 48 rotates the crank arm 46 and oscillates the swinging frame to feed the sheets from the pile. The motor 54 is likewise adapted to drive the feed rolls 44 through a gear train comprising a pinion 55 on the motor shaft, an idler 56 rotatably mounted on a bracket secured to the frame, and intermeshing pinion 57 carried by the feed rolls 44. The gear trains between the motor 54 and shaft 47, and between the motor 54 and the feed rolls 44, may be suitably proportioned to produce the desired speed of oscillation of the swinging frame and of rotation of the feed rolls.

In order to synchronize the times of energization of the magnet 36 and of the weakening of the field thereof with the oscillating movement of the swinging pole piece or frame, the shaft 50 carries a pair of suitably designed cams 58 and 59, which actuate respectively sets of breaker points 60 and 61 carried by an arm 62 secured to the frame 1 in any suitable manner. Fig. 5 shows the circuit for the magnets 36, which are connected in series with the line wires 62 connected to a suitable external source. The breaker points 60 are in series with the line and are preferably shunted by a condenser 63, and the breaker points 61 are likewise in series with the line and are shunted by a condenser 64 and a resistance 65. Both sets of contacts are closed substantially simultaneously to energize the magnets 36 to pick up the sheet, and thereafter the contacts 61 are opened, whereby the resistance 65 is cut into the line and the current through the magnet coils is decreased, weakening the field to drop all of the sheets except the top sheet, as above described. Thereafter the contacts 60 are opened to break the circuit and deenergize the magnets. Condensers 63 and 64 prevent sparking across the contacts when they are opened due to the inductive effect of the coils 36. While the timing of the contacts is not critical, both sets of contacts are preferably closed during the rearward movement of the swinging frame as it approaches the vertical position, and the contacts 61 are opened slightly thereafter during the rearward stroke as the swinging frame passes the vertical position, but be-

fore the hooked arms 42 reach the rear edge of the top sheet. Contacts 60 may be opened as soon as the swinging frame has commenced its forward movement and the edge of the sheet has been engaged by the hooked arms 42.

The operation of the apparatus is as follows:—

A pile table 6 with a pile of sheets thereon is placed in the machine, resting on the conveyor flights, and the circuit of the motor 19 is closed by a suitable switch which may be housed in a control box 66, Fig. 1. Motor 19 rotates the shaft 18 through the gearing above described and elevates the pile table 6 until the top sheets are at the proper height, whereupon the roller 24 is raised and the contacts 27, 28 are opened to break the motor circuit. The pile table is maintained in this position by the ratchet and pawl 30, 31. Thereafter the pile table is automatically elevated to maintain the top sheet at the proper height under the control of the roller 24. The supply circuit of the motor 54 is now closed by a suitable switch, likewise housed in the control box 66, whereupon the shaft 47 and crank arm 46 are rotated through the gearing above described to oscillate the swinging frame. As the latter makes its first rearward stroke and approaches the vertical position, the sets of breaker points 60 and 61 are closed by the cams 58 and 59, energizing the magnets 36 to full strength. The magnetic flux, following the path described above, causes the top sheet to fly up in contact with the roller 40, the several sheets next to the top sheet being fanned out as shown in Fig. 4, and the hooked arms 42 resting on the top of the elevated sheet. As the swinging frame continues rearwardly, the breaker points 61 are opened, cutting in the resistance 65 and weakening the magnetic field, whereupon all of the sheets except the top sheet drop back to the pile, and as the swinging frame reaches the rearward limit of its movement as shown in Figs. 1 and 3, the hooks 42 drop over and engage the rear edge of the sheet. The swinging frame is now moved forwardly, the hooked arms 42 carrying the top sheet with them and feeding the forward edge thereof between the feed rolls 44, and in the meantime contacts 60 are opened and the magnets deenergized. The oscillation of the swinging frame continues at a relatively rapid rate, the sheets being fed off one by one and the pile table being automatically elevated until all of the sheets have been fed.

Fig. 6 shows another embodiment of the invention wherein the cam 59 on the shaft 50 is eliminated and breaker points 61' are opened to cut in the resistance 65 by the upward movement of the top sheet. In the form shown, one of the contacts is mounted rigidly on the swinging frame 39 and the other

is pivoted thereto and has a depending arm 67 which is engaged by the top sheet as the latter flies upwardly when the magnets 36 are energized. This construction eliminates the timing of the contacts and insures that resistance 65 shall be cut into circuit at exactly the right moment.

In Fig. 7, the swinging pole piece 39, 40 is replaced by a rigid pole piece comprising an arm or arms 68 and a pole piece 69 which is preferably a roller. When the top sheet has been lifted as has been described above, it is forwarded into engagement with the feed rolls by means of a solenoid 70 suitably mounted by a bracket 71 on the frame of the machine and having a plunger 72 that is provided with a depending hook or hooks 73. The solenoid 70 may be intermittently energized in any suitable manner to synchronize its operation with the energization of the lifting magnets, suitable means such as those described for energizing the magnet 36 being employed for this purpose.

Other means may be employed to weaken the field of the magnet 36 at the proper instant to release all of the sheets except the top sheet. In Fig. 8, a magnet or magnets 74 are positioned at the rear side of the stack with their south poles closely adjacent to the rear edge of the sheets next to the top sheet when in their elevated position. When the magnets 74 are energized, they serve to weaken the magnetic field which tends to hold the sheets in elevated position by diverting the flux from the swinging pole piece 39, 40. Consequently, all of the sheets drop back to the pile except the top sheet, which is maintained in elevated position due to the fact that it is in contact with the pole piece 40.

In Fig. 9, the magnets 36, which are energized when the contacts 60 are closed, are opposed by an oppositely wound coil 75 controlled by a pair of contacts 76. When the contacts 76 are closed and the winding 75 energized, the magneto motive force of the combined magnets is reduced and the flux tending to hold the sheets in elevated position is reduced correspondingly, so that the sheets drop back to the pile with the exception of the top sheet, which is in contact with the roller 40.

Fig. 10 shows an embodiment of the invention wherein the use of making and breaking contacts is eliminated. In this embodiment the swinging frame or pole piece 39, 40 carries the hooks 42 which feed the elevated top sheet forwardly after it has been lifted by the magnetic field established by magnets 36 and passing through the pole pieces 35, the sheets of the stack, the roller 40, arms 39, and yoke 34, all as above described. Pivoted on the pins 41 is a second swinging frame comprising an arm or arms 77 which carry a magnet 78 provided with a lower pole piece

79, the latter being provided with a concave portion 80 to receive the roller 40. The magnet 78 is so wound that its field, which passes through the roller 40 and arms 39, tends to counteract the field of the magnet 36 therein. The frame 77 and magnet 78 can swing from the position shown in Fig. 10 forwardly to a vertical position, but their movement is then limited by a shoulder 81 which engages the yoke 34 and prevents further rotation in a forward direction. In the operation of this embodiment, the magnets 36 and 78 are energized continuously, the swinging frame 39 being oscillated by suitable mechanical means as hereinbefore described and the swinging frame 75 being free to oscillate within permitted limits. Assuming the frame 39 has been swung to its extreme forward position to deliver a sheet to the feed rolls and to have commenced its return movement in a rearward direction, the frame 77 and magnet 78 will be in a vertical position, and the field in the swinging pole pieces 39, 40 will be principally that due to magnets 36. This field will cause the top sheet to fly up into contact with roller 40 and the next several sheets will be fanned out as has been described above. As the swinging frame 39 continues its rearward oscillation, it reaches the vertical position and closely engages the swinging frame 77, the roller 40 being in contact with the concave portion 80 of the pole piece 79. The magnetic circuit of magnet 78 is now completed through the roller 40 and arm 39 and is practically entirely magnetic, so that the magnet 78 reduces the effective field of the magnets 36 in the roller 40 and arms 39; consequently all of the sheets except the top sheet drop back to the pile. The swinging frames 39, 40 and 77 continue rearwardly together to the position shown in Fig. 10, wherein the hooks 42 engage the rear edge of the elevated top sheet, and then swing forwardly together to feed the sheet to the feed rollers. When the swinging frames reach their vertical position, however, the forward movement of frame 77 is stopped by engagement of shoulders 81 with yoke 34, and the swinging frame 39 continues forwardly alone to complete the feeding stroke, whereupon the influence of the magnet 78 is decreased and the strength of the field, due to magnets 36, increases sufficiently to cause the top sheets to fly up again as above described.

The apparatus described above is simple and economical to construct and operate and is free from mechanisms and parts which are apt to get out of order and cause service difficulties, while at the same time it is reliable and efficient in operation and capable of separating and feeding individual sheets from a pile at a rapid rate. The apparatus effectively separates the sheets and admits air between them, preventing the picking up of more than one sheet at a time, and when combined with

the weakening of the magnetic flux to release all except the top sheet, provides a method of separating and feeding the sheets which positively insures the separation of the individual sheets from a stack one at a time.

While several embodiments of the invention have been described and illustrated in the drawings it is to be expressly understood that the invention is not limited thereto and that the method may be carried out in a variety of ways and changes made in the form, construction and arrangement of the parts without departing from the spirit of the invention. Reference is therefore to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:—

1. Means for separating a sheet of magnetic material from a stack comprising a pair of pole pieces of like polarity at opposite sides of the stack, a pole piece of opposite polarity above the stack, whereby the top sheet is lifted from the stack, and means for forwarding the lifted top sheet.

2. Means for separating sheets of magnetic material from a stack comprising a magnetic means having pole pieces of one polarity at opposite sides of the stack and a common pole piece of opposite polarity above the stack, and means for forwarding sheets lifted from the stack by the magnetic field.

3. Means for separating sheets of magnetic material from a stack comprising magnetic means including a pole piece of one polarity at one side of the stack and a pole piece of opposite polarity above the stack, and means carried by said last-named pole piece and adapted to engage a sheet to remove it from the stack.

4. Means for separating sheets of magnetic material from a stack comprising a pair of magnets having their north pole pieces at opposite sides of the stack and a common south pole piece above the center of the stack, means for energizing said magnets to lift the top sheet from the stack, and means for forwarding the lifted top sheet.

5. Means for separating sheets of magnetic material from a stack comprising a pair of electro-magnets having like pole pieces at opposite sides of the stack, a pole piece of opposite polarity above the stack, means for energizing said electro-magnets, means for weakening the magnetic field, and means for forwarding sheets lifted by the magnetic field.

6. Means for separating sheets of magnetic material from a stack comprising a magnetic means having pole pieces of one polarity at opposite sides of the stack and a common pole piece of opposite polarity above the stack, means for weakening the magnetic field, and means for forwarding the sheets lifted from the stack by the magnetic field.

7. Means for separating sheets of mag-

netic material from a stack comprising a magnetic means having pole pieces of one polarity on opposite sides of the stack and a common pole piece of opposite polarity above the stack, means for intermittently energizing said magnets to lift the top sheet from the stack, means for releasing all sheets except the top sheet, and means for forwarding the lifted top sheet.

8. Means for separating sheets of magnetic material from a stack comprising a pair of electro-magnets having like pole pieces at opposite sides of the stack, a pole piece of opposite polarity above the stack, means for intermittently energizing said electro-magnets, means for weakening the magnetic field of said electro-magnets after each energization thereof, and means for forwarding sheets lifted by the magnetic field.

9. Means for separating sheets of magnetic material from a stack comprising magnetic lifting means, means for automatically weakening the effective magnetic field of said lifting means during operation thereof, and means for forwarding sheets lifted by said lifting means.

10. Means for separating sheets of magnetic material from a stack of sheets comprising magnetic lifting means, means for intermittently energizing said lifting means, means for automatically weakening the effective magnetic field of said lifting means while the same is energized, and means for forwarding sheets lifted by said magnetic field.

11. Means for separating sheets of magnetic material from a stack comprising a magnet having a pole piece at one side of the stack, a swinging pole piece above the stack, and means carried by said swinging pole piece adapted to engage a sheet to remove it from the stack.

12. Magnetic sheet separating means comprising a yoke of magnetic material having depending arms, a magnet coil for each of said arms, and a pole piece depending from said yoke between said arms.

13. Magnetic separating means comprising a yoke having depending arms, a magnet coil for each of said arms, and a swinging pole piece pivoted to said yoke between said arms.

14. Magnetic sheet separating means comprising a yoke having depending arms, a magnet coil for each of said arms, a swinging pole piece pivoted to said yoke between said arms and means carried by said pole piece to engage the edge of the sheet.

15. Magnetic sheet separating means comprising a pair of magnet coils, a swinging pole piece between said coils, and means adapted to engage the edge of the sheet to remove it from the stack.

16. Magnetic sheet separating means comprising a member of magnetic material having depending arms, a magnet coil for each

of said arms, a pole piece depending from said member between said arms, and means for forwarding sheets.

17. Magnetic separating means comprising a member of magnetic material having depending arms, said arms having tips of non-magnetic material, a magnet coil for each of said arms, and a pole piece depending from said member between said arms.

18. Magnetic sheet separating means comprising a pair of pole pieces, said pole pieces having tips of non-magnetic material, a magnet coil for each of said pole pieces, a swinging pole piece between said pair of pole pieces, and means carried by said swinging pole piece to engage and forward a sheet.

19. Magnetic sheet separating means comprising a yoke of magnetic material having depending arms, a magnet coil for each of said arms, and a swinging pole piece pivoted to said yoke between said arms and comprising a depending arm and a roller carried thereby.

20. Magnetic sheet separating means comprising a pair of pole pieces, a magnet coil for each of said pole pieces, a swinging pole piece between said pair of pole pieces, means carried by said swinging pole piece to engage the edge of a sheet, and means to oscillate said swinging pole piece.

21. Apparatus for separating sheets from a stack comprising a pair of pole pieces, means for intermittently magnetizing said pole pieces with like polarity to lift the top sheet from the stack, means for weakening the effective magnetic field, and means for forwarding the lifted sheet.

22. Apparatus for separating sheets from a stack comprising a member of magnetic material having a plurality of depending arms, and means for magnetizing said yoke with the ends of two of said arms of like polarity and opposite to the polarity of an intermediate arm.

23. Apparatus for separating sheets from a stack comprising a member of magnetic material having depending arms, means for intermittently magnetizing said member with the ends of said arms of north polarity, a pole piece depending from said member intermediate said arms, said pole piece having south polarity, and means for forwarding sheets lifted by the magnetic field.

24. Apparatus for separating sheets from a stack comprising a member of magnetic material having a plurality of depending arms, means for intermittently magnetizing said member with the ends of two arms of like polarity and opposite to the polarity of an intermediate arm, means for weakening the magnetic field, and sheet forwarding means.

25. Apparatus for separating sheets from a stack comprising a yoke of magnetic material having depending arms, means for in-

termittently magnetizing said yoke with the ends of said arms having north polarity, a pole piece depending from said yoke between said arms and having south polarity, means for weakening the effective magnetic field between said arms and pole piece, and sheet forwarding means.

26. Apparatus for separating sheets from a stack comprising a pair of magnets, a swinging pole piece between said magnets, means for energizing said magnets with like polarity opposite to the polarity of said pole piece, and sheet engaging means carried by said pole piece.

27. Apparatus for separating sheets from a stack comprising a yoke of magnetic material having depending arms and a swinging pole piece intermediate said arms, means for magnetizing said yoke, sheet engaging means carried by said pole piece, a motor, and operative connections between said motor and swinging pole piece to oscillate the latter.

28. Apparatus for separating sheets from a stack comprising a yoke of magnetic material having a pair of depending arms, means for magnetizing said yoke, sheet gripping means pivoted to said yoke between said arms, and means for oscillating said gripping means, said gripping means constituting a pole piece having polarity opposite to the polarity of said arms.

29. Apparatus for separating sheets from a stack comprising a yoke of magnetic material having a pair of depending arms, a swinging pole piece pivoted to said yoke between said arms, means for magnetizing said yoke, sheet engaging means carried by said pole piece, a motor, and means to oscillate said pole piece comprising a crank arm and link operatively connecting said motor with said pole piece.

30. Apparatus for separating sheets from a stack comprising a yoke of magnetic material having a pair of depending arms and a swinging pole piece pivoted to said yoke between said arms, means for intermittently magnetizing said yoke, means for weakening the effective magnetic field, sheet engaging means carried by said pole piece, a motor, and operative connections between said motor and pole piece to oscillate the latter.

31. Apparatus for separating sheets from a stack comprising a pair of stationary pole pieces and a swinging pole piece intermediate said stationary pole pieces, means for intermittently magnetizing said pole pieces, means for weakening the effective magnetic field, sheet engaging means carried by said swinging pole piece, and means to oscillate said swinging pole piece including a crank arm and link operatively connected thereto.

32. Apparatus of the class described comprising a yoke of magnetic material having depending arms and a swinging pole piece between said arms, means for magnetizing

said yoke with said arms of like polarity, means for oscillating said swinging pole piece, means synchronized with said oscillating means for energizing said magnetizing means, and sheet forwarding means.

33. Apparatus of the class described comprising a pair of magnets and a swinging pole piece between said magnets, means for oscillating said swinging pole piece, means synchronized with said oscillating means for energizing said magnets, and sheet forwarding means carried by said swinging pole piece.

34. Apparatus of the class described comprising a magnetic yoke having a pair of depending arms and a swinging pole piece between said arms, a magnet coil, means for oscillating said swinging pole piece, and means synchronized with said oscillating means for closing the energizing circuit of said coil.

35. Apparatus of the class described comprising a magnetic yoke having a pair of depending arms and a swinging pole piece between said arms, means including a coil for magnetizing said yoke, means for oscillating said swinging pole piece, means synchronized with said oscillating means for closing the energizing circuit of said coil, means for weakening the effective field of said coil, and sheet forwarding means.

36. Apparatus of the character described comprising a magnetic yoke having a pair of depending arms and a swinging pole piece between said arms, a magnet coil, means for oscillating said swinging pole piece, means synchronized with said oscillating means for closing the energizing circuit of said coil, a resistance, means for inserting said resistance in series with said coil, and sheet forwarding means.

37. Apparatus of the character described comprising a magnetic yoke having a pair of depending arms and a swinging pole piece between said arms, a magnet coil, means for oscillating said swinging pole piece, means synchronized with said oscillating means for closing the energizing circuit of said coil, a resistance, means including a contact carried by said swinging pole piece and operated by a lifted sheet to insert said resistance in series with said coil, and sheet forwarding means.

38. Apparatus of the character described comprising a magnetic yoke having a pair of depending arms and a swinging pole piece between said arms, a magnet coil, means for oscillating said swinging pole piece, means synchronized with said oscillating means for closing the energizing circuit of said coil, a resistance, means for inserting said resistance in series with said coil after each energization thereof, and sheet forwarding means carried by said pole pieces.

39. The method of separating individual sheets from a stack of sheets which consists

in applying simultaneous magneto motive forces to the stack to lift the top sheet of the stack and thereafter automatically weakening the magnetic field during application thereof to release all but the top sheet.

40. A method of separating individual sheets from a stack of sheets which consists in intermittently applying magneto motive forces to the stack to lift the top sheet from the stack and weakening the magnetic field after each application thereof to release the sheets adjacent the top sheet.

In testimony whereof I have signed this specification.

EDWIN S. LINCOLN.

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