Aug. 9, 1932. E. S. LINCOLN 1,870,337

SHEET FEEDING APPARATUS

Filed June 11, 1930 5 Sheets-Sheet 1

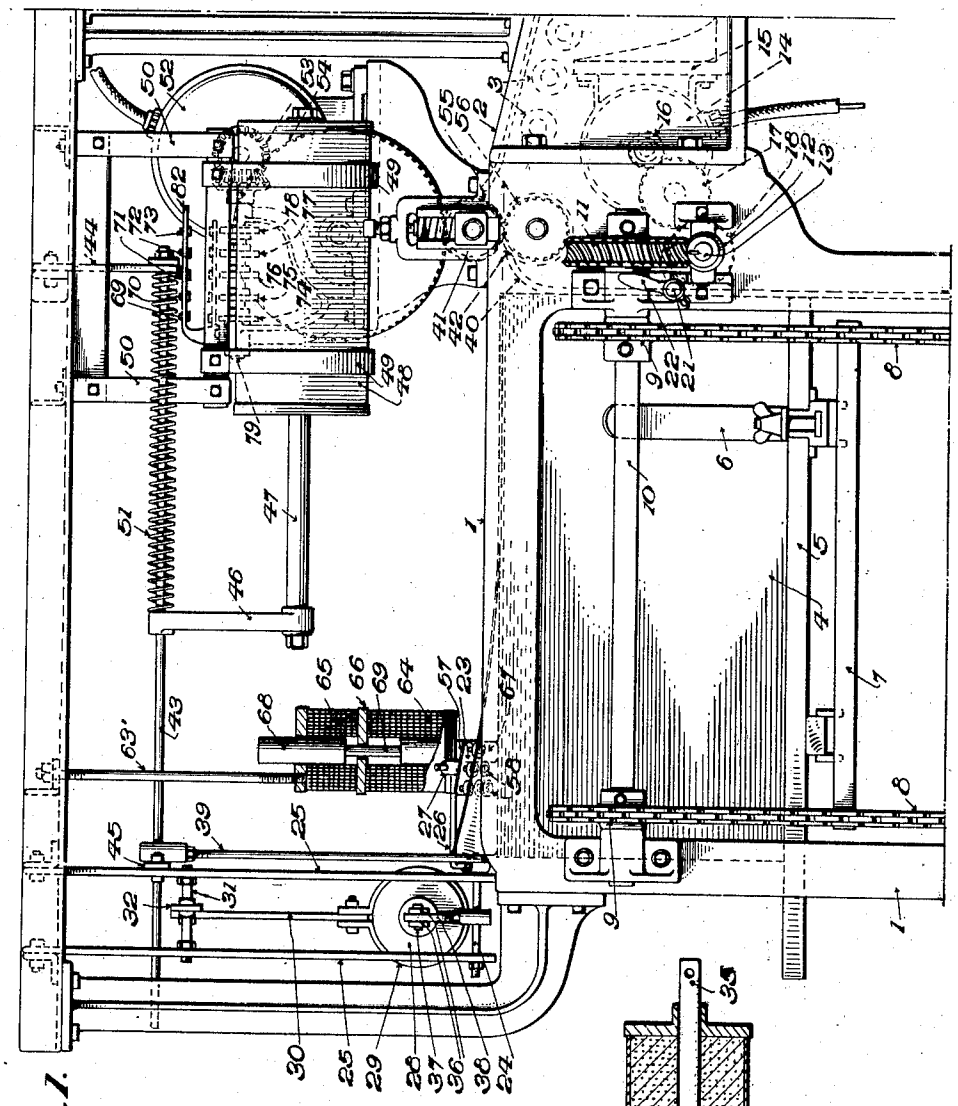


Fig. 1.

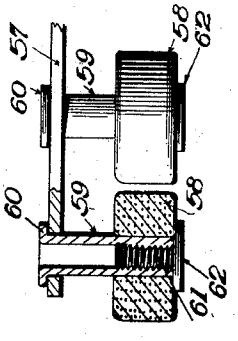


Fig. 6.

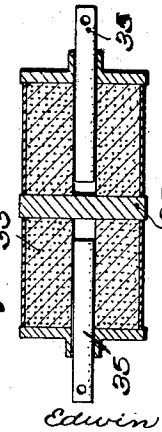


Fig. 7.

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SHEET FEEDING APPARATUS

Filed June 11, 1930 5 Sheets-Sheet 2

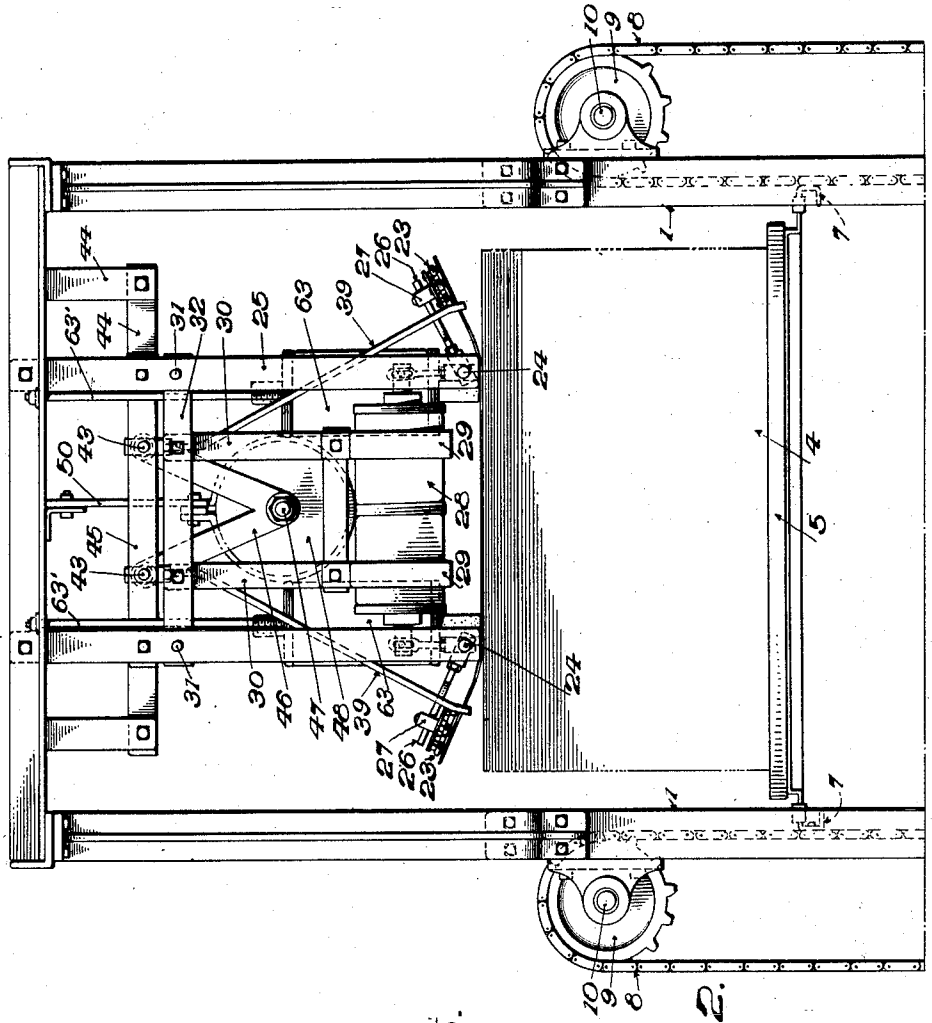


Fig. 2.

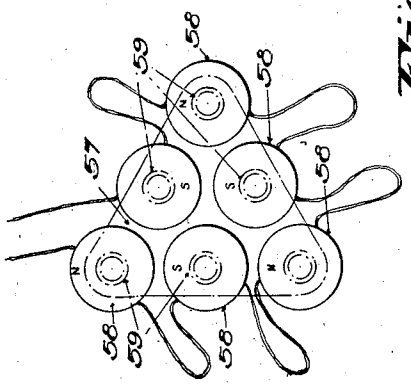


Fig. 5.

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SHEET FEEDING APPARATUS

Filed June 11, 1930 5 Sheets-Sheet 3

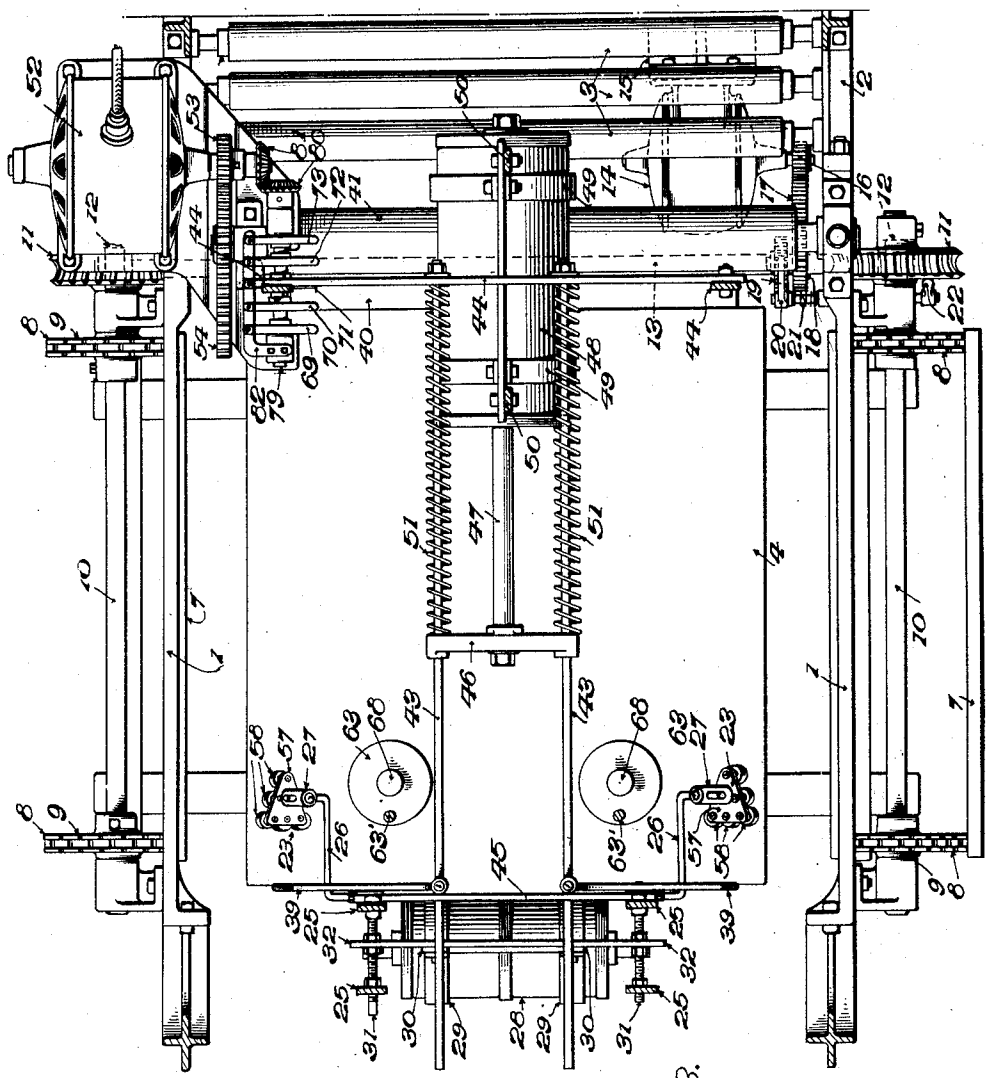


Fig. 3.

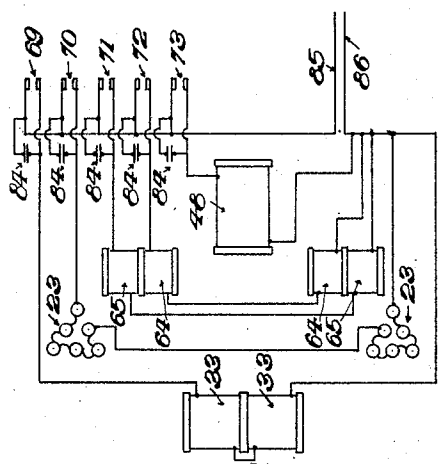


Fig. 4.

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SHEET FEEDING APPARATUS

Filed June 11, 1930 5 Sheets-Sheet 4

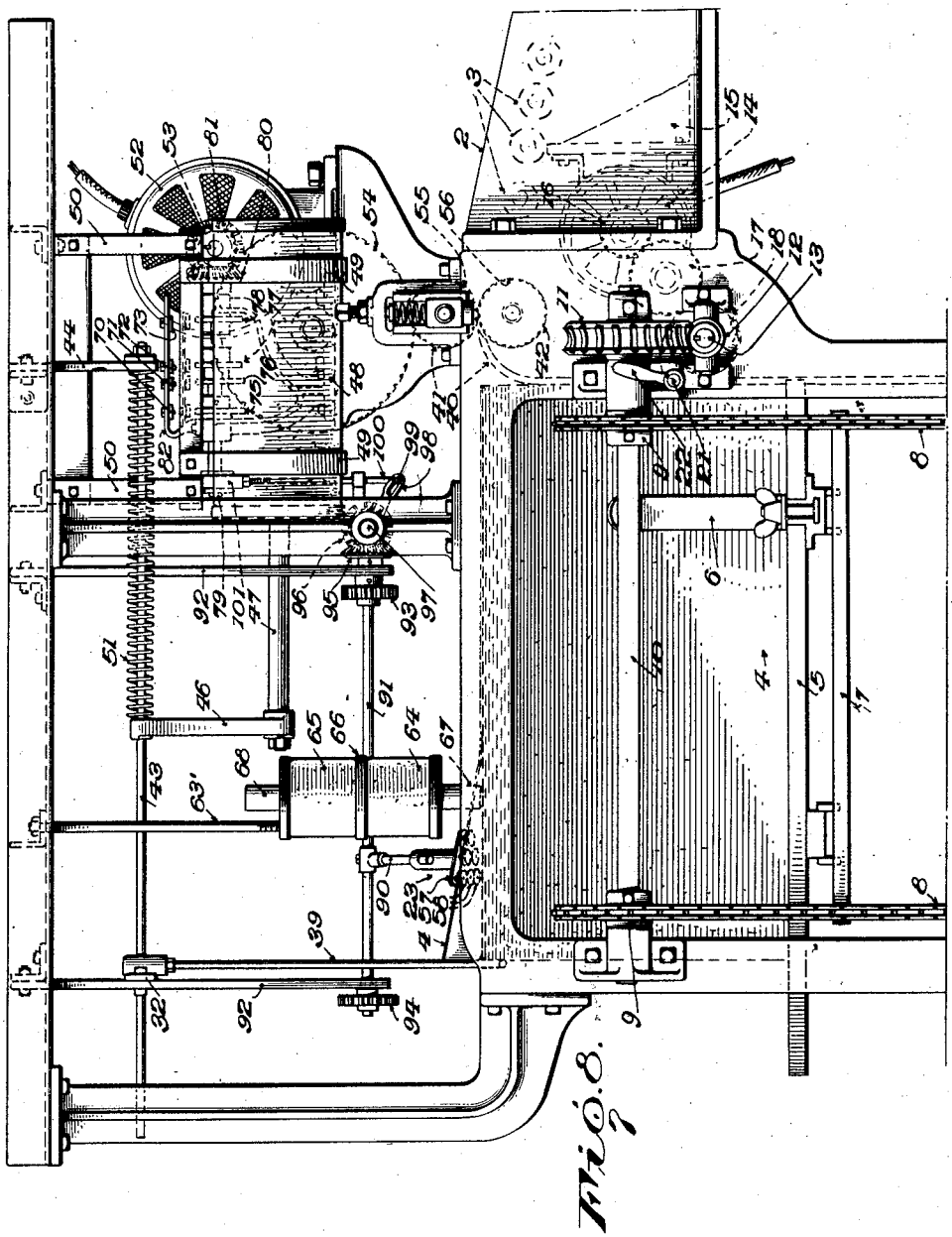


Fig. 8.

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SHEET FEEDING APPARATUS

Filed June 11, 1930 5 Sheets-Sheet 5

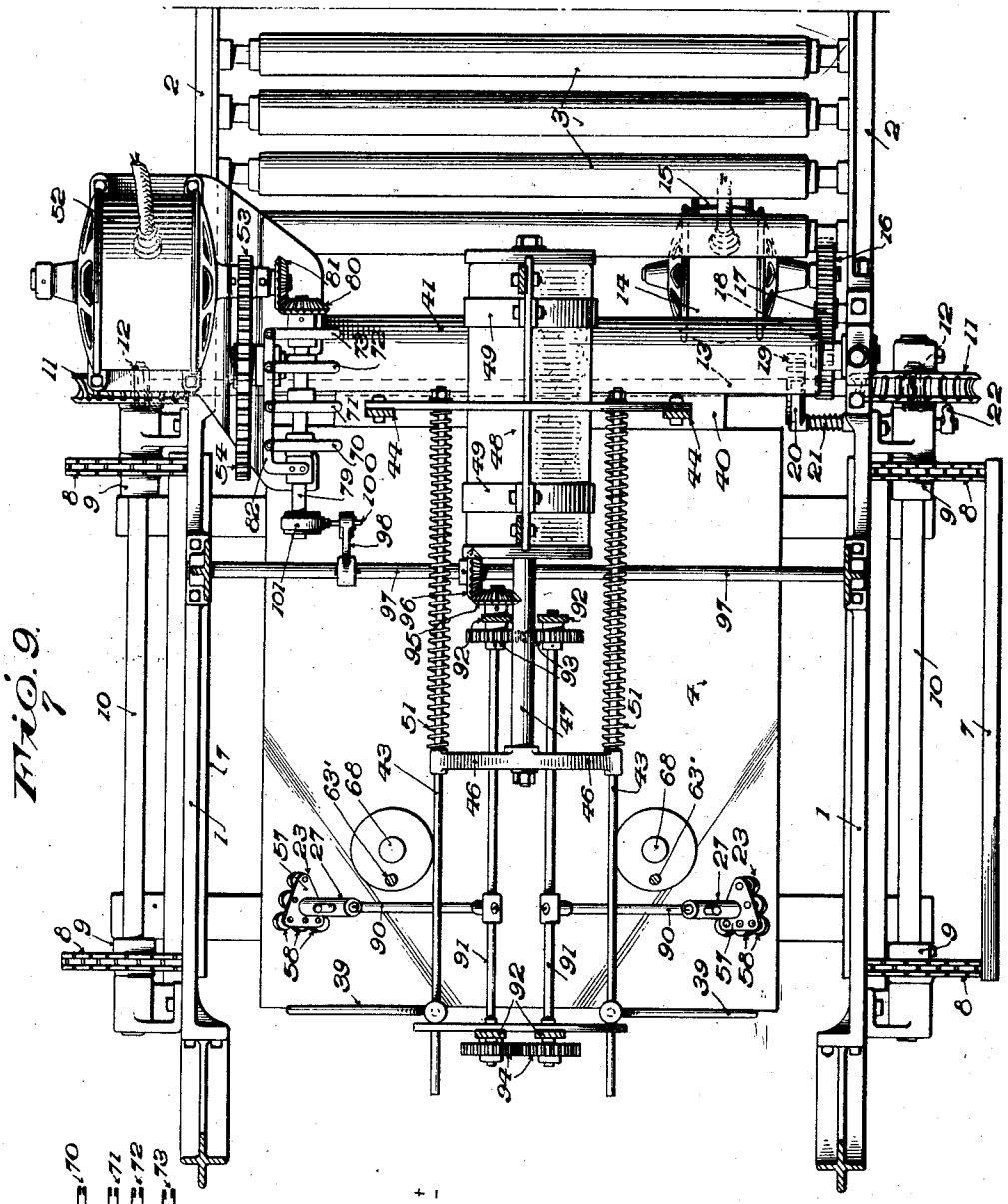


Fig. 9.

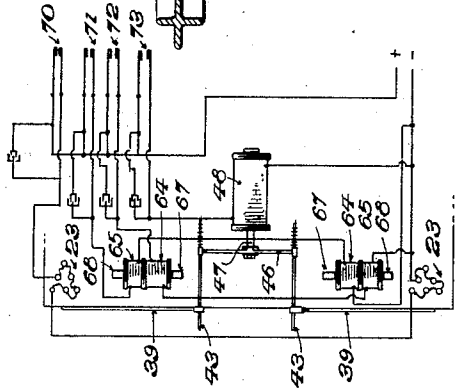


Fig. 11.

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UNITED STATES PATENT OFFICE

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SHEET FEEDING APPARATUS

Application filed June 11, 1930. Serial No. 460,528.

This invention relates to means for separating and lifting sheets one by one from a stack of such sheets, and more particularly to means for separating and lifting sheets of magnetic material.

Heretofore in apparatus of this character, much difficulty has been experienced in preventing the picking up of more than one sheet at a time. Due to the fact that metallic sheets, of tin, for example, tend to stick together until air has been admitted between them, the second sheet tends to be picked up with the top sheet. Moreover the magnetic lifting flux tends to penetrate the top sheet into the second sheet and to lift the latter also, particularly where the sheets are stuck together. However, when it is attempted to control the magnetic flux to prevent such penetration, by cutting down the strength of the magnet or by concentrating the flux in a small sheet area, it is generally found that the lifting effort is too small.

One of the objects of this invention is to provide novel sheet separating means which will reliably separate sheets of magnetic material from a stack at a rapid rate.

Another object is to provide novel magnetic lifting means whereby the flux does not penetrate through the top sheet to the second sheet, but yet sufficient lifting effort is obtained.

A further object is to provide a novel lifting magnet which provides a lifting flux of low density distributed over a large sheet area.

A still further object is to provide novel operating means for lifting magnets.

Other objects will appear more fully hereinafter as the description of the invention proceeds.

Several embodiments of the invention have been illustrated in the accompanying drawings, but it is to be expressly understood that such 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 a side elevation of an apparatus embodying the invention;

Fig. 2 is a rear end elevation of said apparatus;

Fig. 3 is a top plan view of said apparatus;

Fig. 4 is a wiring diagram for said apparatus;

Fig. 5 illustrates diagrammatically a form of magnetic lifting unit;

Fig. 6 is a side elevation, partly in section of a portion of a magnetic lifting unit as illustrated in Fig. 5;

Fig. 7 is a section through the solenoid adapted to operate the magnetic lifters;

Fig. 8 is a side elevation of another embodiment of the invention;

Fig. 9 is a top plan view of Fig. 8; and

Fig. 10 is a wiring diagram for the embodiment shown in Fig. 9.

While the separating and feeding mechanism constituting the invention is broadly adapted for and may be employed in the separation and feeding of sheets 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. A stack or pile of sheets 4, in this instance of tin, is supported by a suitable table 5 preferably provided with suitable side register devices 6. The table 5 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.

For the purpose of rotating said sprocket wheels to drive the elevator chains, each of the shafts 10 preferably carries a worm gear 11 meshing with a worm 12, the latter being mounted on a shaft 13 that rotates in suitable bearings formed on the frame 1. Any suitable means may be employed to rotate the shaft 13 to elevate the table 5, and in the

form shown, an electric motor 14 which is suitably mounted on a bracket 15 constituting a part of the frame of the feed table 2 carries a pinion 16 on its shaft meshing with an idler 17 which in turn drives a pinion 18 on the shaft 13. Any suitable means, either manually or automatically operated, may be provided to control the circuit of the motor 14 whereby the top sheets of the stack are elevated to the desired height at which they are maintained by means of a ratchet 19 on the shaft 13 with which cooperates a pawl 20 that is carried by a shaft 21 mounted in the frame 1 and provided on its outer end with a handle 22. It is to be expressly understood, however, that the above described pile elevating mechanism is shown for purposes of illustration only and constitutes no part per se of the present invention.

Suitable means are provided for separating and lifting the rear corners or rear edge of the top sheet from the top of the pile and for thereafter feeding the sheet off the pile. In the form shown, where sheets of magnetic material are to be fed, the separating and lifting means preferably comprises magnetic lifters, preferably one for each rear corner of the sheet, said lifters being preferably of a type hereinafter described that is particularly adapted to prevent the penetration of the lifting flux through the top sheet. Said lifting units are each designated as a whole by 23 and suitable means are provided for lowering the lifters into contact with the top sheet of the stack and for raising the same to lift the top sheet. In the form shown, each of the magnetic lifters 23 is lowered and raised by means of a rockshaft 24 rotating in brackets 25 secured to the frame 1 and carrying rock arms 26 on which the magnets are adjustably mounted by means of posts 27 through which the arms 26 pass. Preferably the shafts 24 are oscillated by means of a solenoid 28 that is mounted by means of straps 29 and arms 30, from rods 31 that are supported in the brackets 25 and carry a cross arm 32 to which arms 30 are attached. The operating solenoid 28 is shown in detail in Fig 7, and comprises a pair of operating coils 33, separated by a non-magnetic plate 34, and a pair of plungers 35, one for each coil 33. When the coils 33 are energized, plungers 35 are drawn into the coils toward the center, and preferably have a tight sliding fit so that they are cushioned to prevent impact against plate 34. The ends of plungers 35 may be bifurcated at 36 as shown in Fig. 1 and pins 37 extend through said bifurcations and through slots in the ends of arms 38 that are secured to the rockshafts 24. When the coils 33 are energized and the plungers 35 are pulled into the coils, shafts 24 are rocked by the arms 38 to raise the lifting units 23 so as to pick up the rear corners of the top sheet, as clearly shown in Figs. 1 and 2. When the solenoids are deenergized, the weight of the lifting units is sufficient to cause them to fall back into contact with the next sheet, or if desired suitable resilient means or the like may be employed to accomplish this end.

When the rear corners of the sheet have been lifted as above described, the sheet is fed forwardly off the pile by means which as shown comprise a pair of reciprocating fingers 39 which engage the lifted rear corners and push the sheet forwardly until the forward edge thereof passes over a curved guide plate 40 and into engagement between rotating feed rollers 41 and 42. The fingers 39 may be reciprocated in any suitable manner, and, as shown, are secured to horizontal rods 43 which extend slidably through suitable supporting members 44 and 45 at the front and rear of the apparatus respectively. A V-shaped bracket 46, the arms of which are rigidly connected to the rods 43, is carried by the plunger 47 of a solenoid 48, the latter being supported by straps 49 and brackets 50 from the frame 1. Resilient means are provided for normally maintaining the fingers 39, rods 43 and plunger 47 in retracted position, said means as shown comprising coil springs 51 surrounding each of the rods 43 and interposed between the bracket 46 and the supporting member 44. When the solenoid 48 is energized, the plunger 47 is pulled forwardly against the tension of springs 51, whereby fingers 39 move forwardly into engagement with the elevated rear corners of the sheet and push it forwardly until it is engaged by the feed rollers 41, 42 and fed off the pile to the conveying rollers 3 of the feed table 2. Any suitable means may be employed for rotating said feed rollers, which means may comprise a motor 52 having a pinion 53 on its shaft that meshes with an idler 54 which in turn engages one of a pair of intermeshing gears 55, 56 carried on the ends of the feed rollers 41, 42 respectively.

The lifting units 23 preferably have the form shown in Figs. 5 and 6. A top supporting plate 57 of suitable magnetic material, to which the posts 27 are secured, carries a plurality of magnetic units having polarities as indicated in Fig. 5. Preferably electro-magnets are provided and the polarities are controlled by the direction of winding of the coils. As shown, each unit 23 comprises six electro-magnets triangularly arranged, with adjacent magnets having opposite polarities so that the flux is uniformly distributed over the area covered by the unit. By this means the lifting flux which is necessary to lift the corner of the sheet is distributed over a substantial area of the sheet so that the density of the flux passing through any one portion of the sheet is kept low, with the result that sufficient lifting effort is obtained without penetration of the magnetic flux through the top sheet.

Preferably, each of the magnet coils 58 is adjustably carried by its supporting plate 57 in order to allow for any unevenness of the sheet surface, and accordingly each coil 58 is mounted on a hollow sleeve 59 of magnetic material passing freely through the plate 57 and having on its upper end a flange 60. The coils 58 may be secured on the sleeve 59 by any suitable means such as screws 61 threaded in the sleeves 59 and having enlarged heads 62 to support the magnet coils.

In some instances it is desirable to provide means for positively holding down the portions of the sheet adjacent the corners which are lifted by the lifting units 23, so that the sheet is positively flexed to effect the initial separation thereof from the next adjacent sheet. To this end, holding down magnets 63 may be employed, said magnets being suitably supported from the frame by means of rods 63′. Said holding down magnets are preferably of a type described and claimed in a co-pending application and are adapted to hold down the sheet while it is initially flexed and thereafter to lift the held down portion of the sheet from the stack. Referring to Fig. 1, each magnet 63 comprises two operating coils 64 and 65 that are separated by a plate 66 of suitable non-magnetic material such as brass. A double acting plunger is provided for the coil, comprising two magnetic core portions 67 and 68 connected by a rod 69 preferably of non-magnetic material, said rod passing freely through an opening formed in the plate 66. When the upper coil 65 is energized, core 68 is pulled into the coil so that core 67 is positively held down against the sheet. When coil 65 is deenergized and coil 64 energized, the core 67 is pulled upwardly into the solenoid and by magnetic attraction lifts the top sheet from the pile.

Means are provided for energizing and deenergizing the various magnetic circuits in timed relation whereby a continuous operation is obtained. Obviously, any suitable arrangement of circuits and operation thereof may be adapted. For purposes of illustration, the magnets are arranged in five circuits, one including the coils 33 of the operating magnet 28 in series, one including all of the electro-magnets 58 of both magnetic lifting units 23 in series, one including the upper coils 65 of the magnets 63 in series, one including the lower coils 64 of the magnets 63 in series, and the last including the solenoid 48. In the arrangement now to be described, these five circuits are controlled by five sets of contacts that are mechanically operated in any suitable manner. As shown in the drawings, five pairs of contacts 69, 70, 71, 72, and 73 are arranged to be closed in timed relation by cams 74, 75, 76, 77 and 78, mounted on a rotating shaft 79 driven by a beveled gear 80 meshing with a beveled gear 81 on the shaft of motor 52. The upper contact of each pair may be mounted on a stationary arm 82 secured to the frame 1, and the lower contacts mounted on a similar arm 83, the cams being arranged to bend the lower contacts upwardly into engagement with the upper contacts in a manner well known in the art. Preferably each set of contacts is shunted by a condenser 84 as shown in Fig. 4 to prevent arcing.

The operation of the apparatus above described will be understood from the foregoing description taken in connection with Fig. 4 showing the arrangement of the circuit. Assuming the apparatus is ready for operation, with the feeding fingers 39 retracted by springs 51, and with the magnetic lifting units 23 lowered into engagement with the top sheet of the stack 5, cams 74, 75 and 76 operate to close the sets of contacts 69, 70, and 71 substantially simultaneously. Contacts 69 complete a circuit from main 85 through the operating coils 33 in series of the magnet 28 to the main 86. Contacts 70 complete a circuit from main 85 through the magnetic lifting units 23 to main 86. Contacts 71 complete a circuit from main 85 through the coils 65 in series of the magnets 63 to the main 86. The energization of these circuits causes the plungers 67 of magnets 63 to be held positively in engagement with the sheet, while the magnetic lifting units are energized to hold the corners of the sheet and magnet 28 is energized to lift the lifting magnet. This operation results in bending or flexing the corners of the sheet upwardly free of the next adjacent sheet, so as to admit air therebetween. After the corners have been bent upwardly, the high point of cam 76 passes out of engagement with contacts 71 which open, deenergizing the holding down coils 65, and at the same time cam 77 operates to close contacts 72. A circuit is not completed from main 85 through contacts 72 and coils 64 in series to main 86, and the energization of these coils lifts the plungers 67 which lift with them the rear edge of the top sheet. Cam 77 now operates to close contacts 73, completing the circuit of solenoid 48, whereby the fingers 39 are pulled forwardly to feed the sheets off the pile as above described. Preferably the lifting magnets 23 are deenergized at this time to free the sheet by the high point of cam 75 passing away from contacts 70. As soon as the sheet has been pushed forward sufficiently, contacts 69 and 72 are permitted to open by cams 74 and 77, whereupon the lifting magnets 23 fall back into engagement with the next sheet, and as soon as the feeding stroke is completed, contacts 73 open and springs 51 retract the feeding fingers 39. The operation is then repeated to separate and feed the next sheet from the pile.

In the embodiment illustrated in Figs. 8

to 10 inclusive the electro-magnetic means described above for operating the magnetic lifting units 23 is replaced by suitable mechanical means for lifting and lowering the magnetic lifters, the operation of this embodiment being otherwise the same as described above. In this embodiment the magnetic lifting units 23 are carried by arms 90 passing through the posts 27, said arms being secured to oscillating shafts 91 that are mounted in bearings formed in front and rear supporting brackets 92. As the shafts 91 oscillate, arms 90 are rocked to raise and lower the lifting magnets 23. Any suitable means may be employed for oscillating the shafts 91 which are preferably geared together by means of intermeshing pinions 93 and 94 on the front and rear ends respectively of each of said shafts. In the form shown, one of the shafts 91 carries a bevel gear 95 that meshes with a bevel gear 96 secured to a transverse shaft 97 that rotates in suitable bearings formed on the frame 1. Shaft 97 has an oscillatory motion which, as shown, is provided by a rock arm 98 secured thereto, said rock arm having a pin and slot connection 99 with a rod 100 that is reciprocated vertically by means of an eccentric 101 secured to an extension of the shaft 79. The wiring connections for the magnetic circuits are shown in Fig. 10, and are the same as those shown above in Fig. 4, except that the operating magnet 28 with its coils 33 and the contacts 69 and cam 74 are omitted. The gear ratios employed are such that the raising and lowering of the magnets 23 takes place at a suitable speed, and the contacts 70, 71, 72 and 73 are operated in timed relation with the oscillation of shafts 91 whereby the operation of the apparatus is the same as that described above.

The apparatus above described is at once simple and economical to construct and operate, and provides rugged and reliable separation of sheets one by one from a stack of sheets. The magnetic lifting unit prevents penetration of the magnetic flux through the top sheet of the stack and at the same time obtains sufficient lifting effort by distributing a flux of relatively low density over a relatively large area of the sheet whereby the tendency for the second sheet to be attracted with the top sheet is largely eliminated. A positive separation of individual sheets is afforded by the combination of magnetic lifting units of this character with means for holding down the adjacent portions of the sheet so that the same is positively bent or flexed prior to being elevated and fed off the pile. When the feed rollers 41 and 42 are operated at fairly high speed to move the sheets quickly off the pile, the sheets may be fed at a very rapid rate. While only two embodiments of the invention have been described and illustrated in the drawings, it is apparent that the invention is capable of a variety of mechanical expressions and that changes may be made in the form, details of construction and arrangement of the parts, without departing from the spirit of the invention. Reference is therefor to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In apparatus of the class described, the combination of a lifting magnet adapted to lift a portion of a sheet from a pile, a pivotally mounted arm supporting said magnet, means for rotating said arm about its pivot to lift said magnet, and means for feeding the lifted sheet off the pile.

2. In apparatus of the class described, the combination of a magnet adapted to lift the rear portion of a sheet from a pile, a pivotally mounted supporting arm for said magnet, means for rotating said arm about its pivot to raise said magnet, and reciprocable means movable into engagement with the elevated rear portion of the sheet to feed it off the pile.

3. In apparatus of the class described, means for lifting the rear portion of a sheet from a pile, a pivotally mounted supporting arm for said means, a magnet for rotating said arm about its pivot to raise said lifting means, and reciprocating means movable into engagement with the elevated rear portion of the sheet to feed it forward.

4. In apparatus of the class described, means for lifting the rear portion of a sheet from a pile, a pivotally mounted supporting arm for said means, means for rotating said arm about its pivot to raise said lifting means, means movable into engagement with the elevated rear portion of the sheet to feed it forwardly, and a magnet for moving said last-named means.

5. In apparatus of the class described, the combination of an electro-magnet adapted to life the rear portion of a sheet from a pile, a pivotally mounted supporting arm for said electro-magnet, an electro-magnet for rotating said arm about its pivot to raise said first named electro-magnet, reciprocating means movable into engagement with the elevated rear portion of the sheet, an electro-magnet for moving said means, and means for intermittently energizing the first two electro-magnets and the last named electro-magnet in timed relation.

6. In apparatus of the class described, the combination of a movably mounted lifting magnet, magnetic means for raising said magnet to lift a portion of a sheet from a pile, means movable to engage said elevated portion to feed the sheet forwardly, and means for energizing said magnet and magnetic means in timed relation to the operation of said feeding means.

7. In apparatus of the class described, the

combination of magnetic means for engaging a portion of a sheet, means for lifting said magnetic means to raise said portion, magnetically operable means to take the sheet from said first means and feed it forwardly, and means for operating all of said means in timed relation.

8. In apparatus of the class described, the combination of a sheet lifting magnet, a pivotally mounted arm supporting said magnet, a solenoid including a movable member, means operatively connecting said member with said arm to rock the latter about its pivot to lift a portion of a sheet, and means for forwarding the sheet raised by said lifting magnet.

9. In apparatus of the class described, a pair of lifting magnets adapted to lift portions of a sheet from a pile, pivotally mounted arms supporting said magnets, a solenoid having a pair of oppositely movable members, and means operatively connecting each of said members with one of said supporting arms.

10. In apparatus of the class described, a lifting magnet comprising a support and a plurality of electro-magnets mounted thereon, the polarity of each electro-magnet differing from that of the adjacent electro-magnet, and means for intermittently energizing said electro magnets.

11. In apparatus of the class described, a lifting magnet comprising a support and a plurality of spaced electro-magnets carried by said support, said electro-magnets having a pole adjacent the pole of another electro-magnet and differing in polarity therefrom to provide a substantially uniformly distributed flux over the area covered by said poles, and means for intermittently energizing the electro-magnets.

12. In apparatus of the class described, a support and a plurality of sheet separating electro-magnets carried by said support and each movable relatively thereto, each electro-magnet having a pole adjacent the pole of an adjacent electro-magnet and differing in polarity therefrom, and means for intermittently energizing said electro-magnets.

13. In apparatus of the class described, a lifting magnet comprising a support, a plurality of members of magnetic material carried thereby and movable relatively thereto, and an energizing coil carried by each of said members.

14. In apparatus of the class described, a lifting magnet comprising a support, a plurality of members of magnetic material carried thereby and movable relatively thereto, and an energizing coil carried by each of said members, said coils being connected for energization from a common source and being wound to provide adjacent poles of unlike polarity.

15. In apparatus of the class described, a lifting electro-magnet comprising supporting means of magnetic material and a plurality of spaced cores carried by said means, a pole of each core having polarity differing from that of an adjacent pole of an adjacent core to provide a substantially uniformly distributed flux over the area covered by said poles, and means for intermittently energizing said electro-magnets.

In testimony whereof I have signed this specification.

EDWIN S. LINCOLN.