This invention relates to method and apparatus for the elimination of static electricity in the sheets of a pile of sheets being fed to a sheet fed press or other mechanism one after another from the top of the pile.

The problem of static electricity in a pile of paper sheets is old and well known. An unbalance of electrons in the sheets in the pile, unless substantially neutralized, causes a great deal of trouble by making the sheets cling to each other, so that it is very difficult to separate them for feeding one at a time. Very often, two or three or even more sheets will refuse to separate and will pass into the machine together, which, of course, is quite undesirable. This condition of unbalance is particularly critical along the edges of the sheets where air blowing devices are sometimes located for separating the sheets by directing air blasts against them.

Different means have been employed in an effort to eliminate this static problem, such as by passing the sheets over gas flames. This method works quite well except that it does not remove static electricity in the pile until the pile is run through, i.e., the static is not eliminated when the initial separation of the sheets is taking place. Of course, thereafter the sheets are neutralized and generally trouble free if continuously run through the different machines for various operations thereon. However, if for some reason the sheets are accumulated into piles again and stored prior to subsequent operations, it is highly possible and probable that the sheets will again become electrically unbalanced and thereby again present a static electricity problem when initially separating them.

Another disadvantage of the gas flame method is obviously the everpresent danger from the open flames themselves.

Static bars have been tried also for eliminating static electricity. These are air ionizing devices located above the paper pile and under which the sheets pass. These aid in eliminating static from the top sheet but not from those below which are protected from the bars by the sheets over them. Thus, the static remaining in the sheet or sheets below is often sufficient to cause the sheet to cling when lifted for feeding despite the substantial neutralization of the top sheet. This is particularly true where high speed feeding is taking place. Further, static bars inherently concentrate on the center of the top sheet rather than at the edges of the sheets where most of the unbalancing electrons collect.

I have observed that most of the static charge that is present in a pile of sheets tends to collect at the corners and edges of the sheets and with this fact in mind, I have invented a method of effectively eliminating this charge by directing ionized air at the edges of the top sheets in a pile of sheets which not only separates the top sheets along said leading edges but also neutralizes the charges collected along said edges through dissipation of said charges by virtue of the contact with said ionized air, and further, as the top sheet is advanced for feeding into a press or the like, the ionized air directed at said edges forces in between said top sheet and the remaining sheets to form a bridge or cushion therebetween and thereby substantially eliminates all static in the sheets contacting said ionized air. By directing the ionized air at the edges of several of the top sheets of the pile the elimination of the static charges collected along said edges is well under way by the time each of said sheets reaches the top of the pile and thus there is very little trouble from static electricity in separating the edges of the top sheet from the lower sheets as each comes to the top of the pile. The ionized air cushion, then, completes the neutralization of the static charge in the rest of each sheet. In an apparatus suitable for carrying out the above described method, I provide a static eliminator for presses comprising, in combination with a supported pile of sheets and means for forwarding the sheets one after another from the top of the pile, means disposed forwardly of the leading edge and adjacent the side edges of the pile of sheets in the region of the upper portion of the pile of sheets blowing ionized air toward said upper portion so as to lift and separate adjacent sheets in the upper portion and enter therebetween and substantially eliminate static therebetween and thereby free the sheets from one another.

Thus, I provide not only an air blast that tends to lift and separate the sheets on an air cushion but also neutralizes them by virtue of the air so blown being ionized. This inspires the rapid dissipation of the unbalancing electrons in the top sheets and more surely frees the sheets from each other and thus facilitates even during the speeds in feeder operations. My invention is additionally beneficial in that it eliminates static at the time the initial sheet separation is being performed.

It should be noted that I direct ionized air against only the leading and side edges of the sheets. This is not meant to imply that additional ionized air blowing means may not be employed against the rear edges of the sheets, but only that I have found it unnecessary to do so. It is obvious that additional ionized air could be directed toward the rear edge of the sheets to augment that blown against the forward and side edges without departing from my invention.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof and a present preferred method of practicing the same proceed.

In the accompanying drawings, I have illustrated a present preferred embodiment of the invention and have illustrated a present preferred method of practicing the same in which:

FIGURE 1 is a partial top plan view of my static eliminator with a pile of sheets ready for feeding;
FIGURE 2 is an elevational view of FIGURE 1 viewed from the rear, with the pile of sheets removed;
FIGURE 3 is a side elevational view of FIGURE 2 viewed from the left thereof;
FIGURE 4 is an enlarged cross-sectional detail taken on the line IV—IV of FIGURE 1;
FIGURE 5 is an enlarged cross-sectional view taken on the line V—V of FIGURE 1;
FIGURE 6 is a cross-sectional view taken on the line VI—VI of FIGURE 1;
FIGURE 7 is an enlarged end view of a manifold partly in section taken on the line VII—VII of FIGURE 1; and
FIGURE 8 is an enlarged plan view of a manifold with a top portion removed.

Referring now to the drawings and initially to FIGURE 1, I have illustrated a pile of sheets 6 disposed upon a pile support 7 (see FIGURE 6). The frame of which is diagrammatically shown in FIGURE 3 and is designated generally by reference numeral 5; may be for the most part of conventional construction having the usual means (not shown) for raising pile support 7 step by step as sheets are fed forward from the top of the pile of sheets 6 so that the top sheet of the pile will remain at a substantially constant elevation during the feeding operation. This is well known to those skilled in the art and will not be further described. The feeder also has conventional means (not shown) for forwarding
the sheets one by one, such as by the customary suction cup means which lifts and advances the sheets from the top of the pile and is also well known to those skilled in the art.

The feeder is preferably equipped with joggers 8, as is customary in the art, which are cyclically operable to jog against the front edges of the sheets at the top of the pile so that if any sheets should be displaced during the forwarding of the sheets, they are jogged back into proper alignment with the remainder of the pile by the joggers.

The joggers 8 at the forward edge of the pile are shown more or less diagrammatically in FIGURE 2 and are mounted on a shaft 9 which partially rotates one direction and then the other cyclically to oscillate joggers 8 as each sheet is forwarded. Shaft 9 in turn is supported in frame 5 and is rotated by conventional means (not shown). The operation of the joggers is familiar to those skilled in the art and will not be further described herein.

Referring additionally to FIGURE 3, I provide a bridge means 10 which extends parallel to the forward edge of the top of the pile of sheets 6 and as illustrated in FIGURES 1 and 2, preferably comprises a series of three aligned manifolds 11 spaced from each other with joggers 8 disposed in said spaces.

As shown in FIGURES 5 to 7, manifolds 11 each comprise a generally vertical leg 12 which lies flush against the forward face of the pile below the top of the pile and an upwardly and forwardly inclined leg 13 connected with the leg 12 through a rounded edge of corner portion 14. A diagonal member 15 is continuously welded at reference 16 to the leg 12 and at reference 17 to the leg 13 to form an air passage 18 within manifold 11. End plates 19 are sealed in the end of air passage 18 to make a completely close and seal air passages 18 in manifolds 11. Air under pressure is admitted to air passages 18 by suitable means, for example, as shown in FIGURE 6 by flexible tubes 20 coupled to short lengths of pipe 21 inserted and welded in bores in the diagonal members 15. The tubes 20 are coupled to a central air manifold (not shown) connected with means for delivering air under pressure such as a pump or blower.

I provide slots or slots 22 in manifolds 11 preferably at the rounded edge or corner portion 14 thereof, the slots 22 preferably being disposed substantially in parallel vertical planes perpendicular to the leading edges of the sheets at the top of the pile. The air under pressure in air passages 18 passes out through the slots 22 and blows generally rearwardly and upwardly against the upper portion of the leading edge of the pile of sheets 6.

In a present preferred embodiment, manifolds 11 are made of a non-conductive material such as plastic. End plates 19 are slotted at their lower extremity as at reference 23 and rest on support rods 24 which fit into slots 23. Support rods 24, in turn, are supported by vertical support members 25 which are fastened to the lower portion of frame 5 (see FIGURES 2 and 3). Joggler shaft 9 passes through openings 26 in end plates 19 which provide a reasonably close fit yet permit shaft 9 to rotate readily. Thus, manifolds 11 are substantially rigidly supported on frame 5. A high voltage cable 26 passes beneath diagonal members 15 and is attached to manifolds 11 by plastic encasement 33 which are welded to the plastic diagonal member 15 of manifold 11. Metal spikes 27 are embedded in plastic encasements 33 and pierce cable 26 and diagonal members 15 with their points 28 extending into air passages 18 within manifolds 11, as shown in FIGURE 5. Thus, spikes 27 are completely insulated externally of air passages 18. Cable 26 is insulated, an insulated cable. Ground rods 29 pass generally centrally parallel through air passages 18 of each manifold 11 and are supported at their ends in openings 30 in end plates 19. The ends of ground rods 29 bear against metal spring washers 31 which are supported between jogggers 8 and end plates 19 by joggler shaft 9 passing therethrough. Thus, ground rods 29 are grounded to feeder frame 5. Cable 26 is connected to a high voltage source of electricity (not shown) and when a high voltage on the order of 10 to 15 thousand volts is passed therethrough, charges are blown from points 28 into the stream of air moving in air passages 18. The charged or ionized air is thereupon blown out of manifolds 11 through slots 22, in the aerosaid generally rearwardly and upwardly direction against the leading upper edges of the pile. The ionized air so blown performs several functions. First, it effectively partially separates the top sheets along the leading edges thereof and begins to eliminate the static electricity collected there; second, it forces between the sheets to form a bridge or cushion or air therebetween as the top sheet is advanced from the feeder; and third, all the while, it is neutralizing the static charges in the sheets as it contacts them so that the sheets will no longer tend to cling to one another but instead advance freely. By making manifolds 11 out of a non-conductive material and by insulating spikes 27 as shown and described, the charges emitting from points 28 are not materially diminished or dissipated from the airstream before striking the pile of sheets.

I further preferably provide blow nozzle assemblies 34 on each side of the pile of sheets as shown in FIGURE 1. Assemblies 34 preferably each comprise a series of five spacedly disposed nozzles 35 with the nozzle 35 provided in the top portion of the pile of sheets 6. Nozzles 35 are connected to air delivery tubes 36 at T's 37 and air under pressure is delivered from suitable blower or pump means (not shown) into tube 36 via flexible hose 38 nipple 39 and connector 40. Assembly 34 is of the floating type which is pivoted about bearings 41 and 42 as shown from FIGURE 4, connector 40 is supported in bearing 41 and is pressed into a suitable opening in the central T 37 of each assembly 34. Nipple 39 is inserted into connector 40 and held in place by a retaining screw 42 in connector 40 which rides in an annular groove 43 near the end of nipple 39. The outer hose of bearing 41 is carried in a plate 42 which is fixed to the lower end of a sliding arm 48. Thus, assembly 34 rotates freely within bearing 41. Assembly 34 is balanced about bearing 41 by counterweight 44 movably fastened to delivery tube 36 (see FIGURES 1 to 3) so that as the top sheet of pile 6 rises it bears against projection 45 attached to assembly 34 at the end of assembly 34 adjacent the forward end of pile 6 and causes the counterbalanced assembly 34 to pivot about bearing 41. This permits the air directed from nozzles 35 toward the side edges of the top of pile 6 to substantially parallel the top sheet in its upward travel and promotes the build up of an air cushion under the top sheet. The floating nozzle principle is old and familiar in the art and need not be further explained.

Assemblies 34 are each movably supported on a cross bar 46 mounted in frame 5. Assemblies 34 may be adjusted horizontally by sliding horizontal clamp 47 along bar 46 and vertically by sliding arm 48 in clamp 47. Clamp 47 is fastened in proper horizontal position to bar 46 by thumbscrew 49. Vertical sliding arm 48 has a clamp 50 fastened to the upper end thereof by thumbscrew 51. Thus, arm 48 is free to slide upwardly but is limited in its downward movement by clamp 50 bearing on clamp 47. This is precautionary, so that in the event that assemblies 34 are out of position when pile 6 is raised wherein the pile should strike assembly 34, assembly 34 is free to move upwardly with the pile and save said assembly from damage. The setting of assemblies 34, of course, depends upon the size of the sheets being run and the height of the pile maintained and those skilled in the art know where the assemblies should be located for a given job.

Instead of conventional air blowing nozzles, which simply blow air, I use ionizing air blowing nozzles 35 which
ionize the air passing through the nozzle. Ionizing air blowing nozzles 35 which are known to those skilled in the art, to the best of my knowledge and belief have never been before employed in the aforementioned floating type assembly at the sides of the pile directed at the side edges of the top sheets of the pile. Referring again to FIGURE 4, the body 52 of nozzle 35 is a non-conductor such as plastic, having air passages 55b therein.

A high voltage cable 53 passes through body 52 and is connected to a source of high voltage electricity (not shown). The head 54 of the nozzle forms an air chamber 55 in the end of nozzle 35. A pin 56 inserted in plastic body 52 passes through cable 53 with its point 57 extending into air chamber 55. Nozzle head 54 is made of conductive metal and is grounded to frame 5 via ground wire 58 embedded in nozzle body 52 which bears against a metallic washer 59 held against ground wire 58 by jam nut 60 on threaded nipple 61. Threaded nipple 61 connects nozzle 35 to T 37. Thus, charges are emitted from point 57 into the air passing through chamber 55 to charge or ionize said air. The discharge end of chamber 55 contains an insulating plastic sleeve 62 so that the charge in the air passing out therethrough will not be dissipated or materially diminished before blowing against the pile of sheets 6.

I have found that it is not necessary that five nozzles 35 be used in each assembly 34 and that the employment of only a single nozzle 35 in each assembly 34 near the forward end of the pile will give surprisingly good results. Nevertheless, for a better air cushion and a more complete elimination of static, I have found the use of additional nozzles 35 in each assembly 34 preferable.

The above described apparatus is very effective in carrying out my earlier described method. It can be readily understood that as the ionized air is directed at a number of the sheets near the top of the pile and specifically at the edges thereof where the unbalancing static charges tend to collect, that the edges of said top sheets are substantially neutralized by the time they come to the top.

It can further be readily understood that as the top sheet is first raised at its leading edge by the air from manifolds 11, assembly 34 is pivoted by the pressure of said top sheet on projection 45 and thus nozzles 35 are aligned parallel with the top sheet at all times. This insures that the ionized air from nozzles 35 blows under the top sheet to aid the blast of ionized air from manifolds 11 in creating an air cushion under the top sheet and further insures that a more complete neutralization of the sheet is accomplished by virtue of the ionized air contacting the entire surface of the sheet.

While I have shown and described a present preferred embodiment of the invention and have illustrated a present preferred method of practicing the same it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claim.

I claim:

A method of separating sheets in a pile in which the sheets are held together by static electricity comprising blowing ionized air against an edge of the pile at the top of the pile initiating eliminating of the static electricity at the edges of several of the top sheets of the pile, the air forcing its way in between the edges of the top sheet and the edge of the sheet next below and gradually forming a cushion of ionized air between the top sheet and the sheet next below which further the eliminating of the static electricity between the top sheet and the sheet next below and facilitates separation of the top sheet from the sheet next below and withdrawing the top sheet in the direction of said edge.

References Cited in the file of this patent

UNITED STATES PATENTS

1,169,428 Rogers ................ Jan. 25, 1916
1,731,030 Thompson .............. Oct. 8, 1929
1,867,038 Upham ................ July 12, 1932
2,883,190 Manthei .............. Apr. 21, 1959
2,995,000 Bader ................ Aug. 8, 1961
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,083,011

March 26, 1963

August A. Saul

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 31, for "of" read -- or --; line 39, after "FIGURE 6" insert a comma; column 6, line 24, for "edges" read --edge--.

Signed and sealed this 17th day of September 1963.

(SEAL)
Attest:

DAVID L. LADD
Commissioner of Patents

ERNEST W. SWIDER
Attesting Officer