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SUCTION PICK UP WITH AIR BEARING

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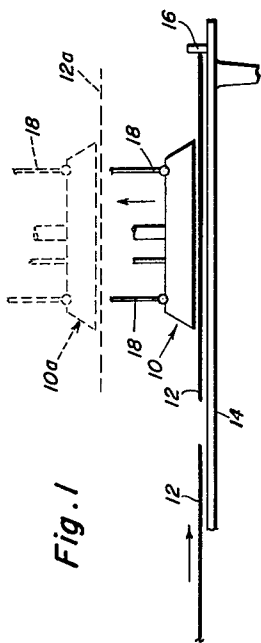


Fig. 1

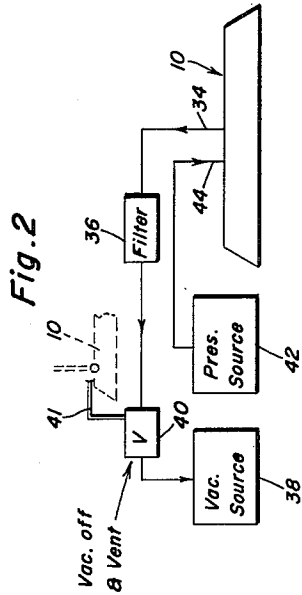


Fig. 2

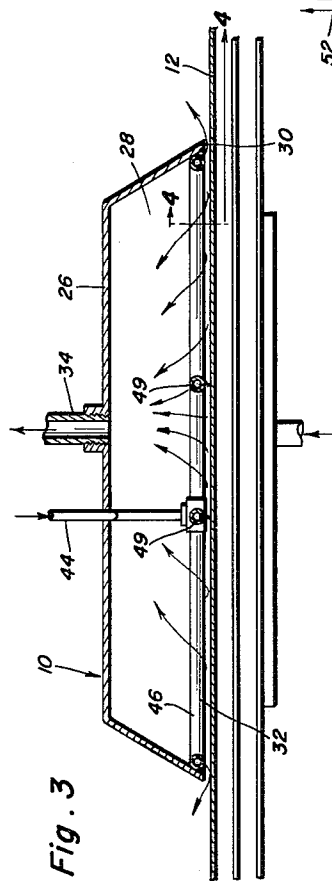


Fig. 3

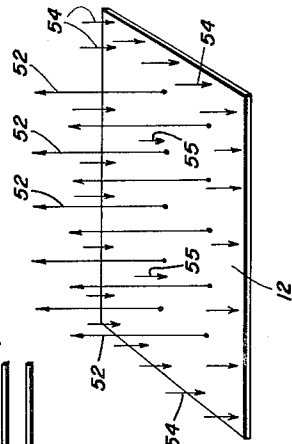


Fig. 5

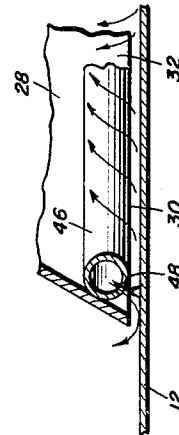


Fig. 4

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SUCTION PICK UP WITH AIR BEARING

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This invention relates to pneumatic pick up devices, and particularly to devices for handling cards, envelopes, card-sets, documents or other sheets or sheet-like articles. In the interest of brevity, the articles handled by my invention shall be referred to as "sheets" henceforth.

Many prior devices use suction to pick up sheets one at a time for the purposes of stacking, feeding, transporting, etc. In the usual arrangement such vacuum devices engage the surface of the sheet and hold it attached to the pick up device by suction. Subject to certain inherent limitations which are well known in the art, these devices are satisfactory.

In some instances it is either necessary or highly desirable that the surface of the sheet is not touched. For example, a sheet having a wet surface, or a sheet which cannot be marked in any way must not be touched. Also, carbon paper sheets, particularly in sheet or sheet-sets present a smearing problem. The usual prior art suction devices rely on firm, sealing contact of the sheet with the area of the suction head around the edges of the suction hole or holes, to adhere the sheet to the suction head.

An object of my invention is to provide a suction pick up device for sheets, wherein the sheets are not physically contacted by the suction head.

In practice of my invention I have a suction head with a sheet-confronting area provided with a suction opening (or openings). In addition, I provide sufficient pneumatic pressure at the edges of the suction opening to form an air bearing between the surface of the sheet and the surface of the suction head which confronts the sheet. Thus, the major affected area of the sheet is attracted toward the head by suction, and a smaller area around the edges of the suction opening are blown away from the suction head in a manner such that they remain slightly spaced from the suction head. In those instances where the sheet is highly flexible additional blowing force can be applied at a point or points within the major suction area to prevent buckling of the sheet.

It is realized that the above typical sheet is both pushed away from and pulled toward the suction head; however, the pulling force is greater than the pushing force so that the resultant force acting on the sheet will maintain the sheet closely adjacent to the suction opening in the head while the head is positioned adjacent to the sheet (in a rest position), and while it is lifted or otherwise displaced for transporting the sheet. Although there will be certain inefficiency in use of the vacuum (due to leakage of air into the vacuum chamber), the losses will not be appreciable in view of the overall benefits obtained by the system.

Other objects and features will become evident in following the description of the illustrated form of the invention.

FIGURE 1 is a diagrammatic view showing a typical application of my invention.

FIGURE 2 is a schematic view showing the suction and pressure circuits of my pick up device.

FIGURE 3 is a longitudinal sectional view on an enlarged scale showing my suction head and also showing it being used with a stack of sheets instead of single sheets as in FIGURE 1.

FIGURE 4 is an enlarged sectional view taken on line 4-4 of FIGURE 3.

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FIGURE 5 is a perspective schematic view showing the suction and pressure action on a typical sheet.

FIGURE 1 shows my pick up device used with sheets 12 which are fed horizontally on table 14 to the stop 16. Although any suitable mechanical means can be used for cycling head 10 of my device from the pick up position (shown in full lines) to the transport position at 10a (shown in dotted lines), in the interest of simplicity I have shown lift rods 18 attached to head 10 and movable by a suitable actuating mechanism (not shown).

In operation, sheet 12 beneath head 10 is adhered to the head and moved to position 12a (shown in dotted lines) at which a take-away device (not shown) removes the sheet from head 10 at position 10a. The take-away device is assumed to be conventional and of any design.

The details of pick up head 10 are shown best in FIGURES 3 and 4. The head consists of a housing having walls 26 defining a suction or vacuum chamber 28. The lower surface 30 of the head circumscribes suction opening 32 which is in direct communication with the suction chamber 28. An air conductor 34, for instance a tube, hose, etc. is attached to head 10 by conventional coupling and is in communication with suction chamber 28. As shown in FIGURE 2 a filter 36 (optical) can be interposed in the suction line 34 which is ultimately attached to a vacuum source 38. Valve 40 is also interposed in suction line 34 between the vacuum source and filter 36. Again, the valve is optional but when used, it can be timed with the motion of head 10, e.g. by locating the valve actuator 41 in the path of head 10 or otherwise.

A source 42 of pneumatic pressure is connected by pressure line 44 to manifold 46 (FIGURES 3 and 4) located along the edges of opening 32 and near surface 30. Manifold 46 as illustrated, is made of a tube provided with a plurality of blowing apertures 48 acting as nozzles with their axes directed toward the surface of sheet 12 (FIGURE 4) and outwardly from chamber 28. It is understood that the manifold 46 may be constructed in other ways, for instance it may be cast integral with the head structure or may take the form of a plurality of individual tubes. Also, to prevent a very flexible sheet from buckling too much, additional blowing nozzles 49 of the manifold can be located at selected positions in opening 32.

In operation (FIGURES 3-5), when head 10 is brought in confronting relationship to a sheet 12, the area of the sheet slightly inward of the edges of opening 32 is drawn toward the interior of the head by the suction of chamber 28, and this is shown by the longer arrows 52 in FIGURE 5. Concurrently, the area of the sheet adjacent to surface 30 (adjacent to the edge of opening 32) is acted upon by the air blowing through opening 48 (and 49 when provided), but the total pressure blowing on the surface of sheet 12 (arrows 54 for apertures 48, and arrows 55 for apertures 49) is considerably less than the suction pressure. The blowing air flows into chamber 28 and to the exterior of the head thereby forming an air bearing for the sheet where it directly confronts surface 30 of head 10.

When head 10 has supported the sheet as described above, the head can be moved by moving means 18 or the equivalent. To remove the sheet, it can either be slid on its air bearing parallel or substantially parallel to surface 30 because the top surface of sheet 12 will not contact surface 30 of head 10. If desired, valve 40 can be used to vent the vacuum in chamber 28 to facilitate removal of the sheet from the head after the sheet has been transported by the head.

It is understood that the illustrated embodiments of the invention have been given by way of example only. All modifications falling within the scope of the following claims may be resorted to.

I claim:

1. A sheet transport to pick up and to move sheets without touching them during pick up and moving, said transport comprising a suction head having a sheet confronting surface adapted to confront the surface of a sheet, a suction chamber in said head and adapted to be connected with a suction source, said chamber having a suction opening in said confronting surface, means to move said head to a position at which said sheet confronting surface is adjacent to the surface of the sheet so that the vacuum in the region of said surface draws said sheet toward said head, pneumatic pressure conducting means preventing contact of the sheet with said head by providing a layer of air therebetween and localized in the region of the edges of said opening, the pulling pressure exerted on said sheet as a result of the suction of said opening being greater than the pneumatic pressure applied to said sheet by said pressure conducting means so that upon movement of said head said sheet is moved therewith, and said head moving means moving said head with the sheet so supported.

2. A sheet transport for flexible individual sheets, said transport comprising a head provided with a vacuum cavity, means for connecting said cavity to a vacuum source, said head having a sheet confronting surface at the edges of said cavity and defining the edges of a main suction opening adapted to confront a sheet, means for moving said head from a remote position to a position at which said main suction opening and said surface confront said sheet thereby enabling the suction to draw said sheet toward said main suction opening and said surface, pneumatic pressure conductors adjacent to said edges of

said suction opening, means for connecting said conductors to a source of pneumatic pressure, said conductors having blowing apertures at said edges of said opening and arranged to blow air between the sheet and said sheet confronting surface thereby forming a pad of air between said surface and sheet while the sheet is held by the suction of said main suction opening, an air manifold connected with said pressure source and having a blowing aperture in the region of the center of said main suction opening and directed toward the sheet to provide a pressure force on the sheet at a location which prevents the sheet from buckling inward of said main suction opening but without structurally contacting the sheet, the force exerted on the sheet as a result of the suction of said opening being greater than the combined pressure forces exerted on said sheet by said pneumatic pressure source through said manifold and conductors so that the sheet is suspended adjacent to the head with a pad of air separating the sheet from said confronting surface of the head, and said moving means moving said head and the sheet to a remote location while so suspended.

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