Aug. 3, 1965 R. C. PITNEY 3,198,515

AERODYNAMIC DOCUMENT HANDLING APPARATUS

Filed April 5, 1963

Fig. 1

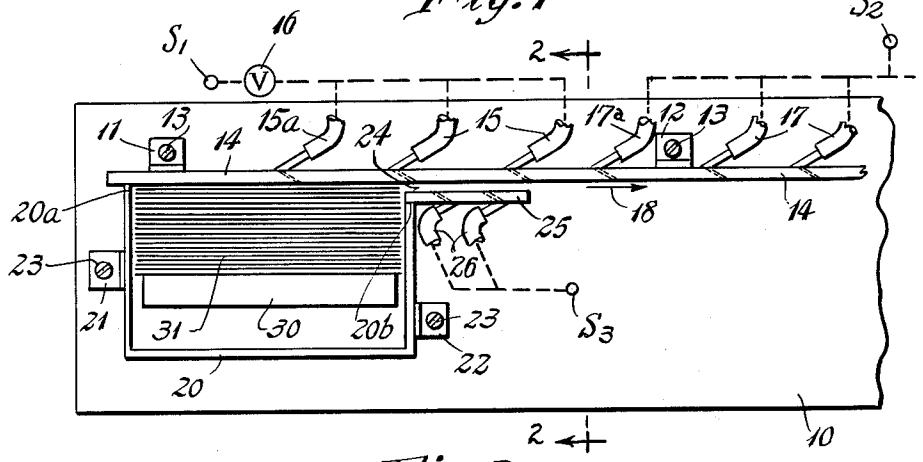


Fig. 2

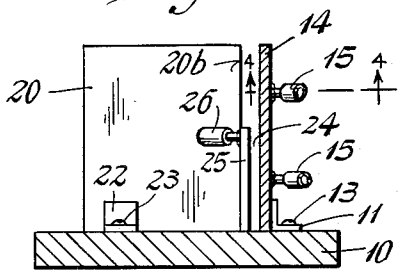
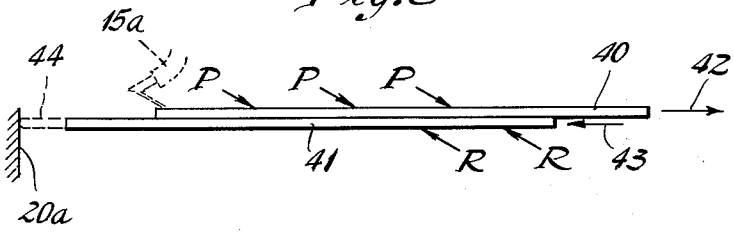


Fig. 3



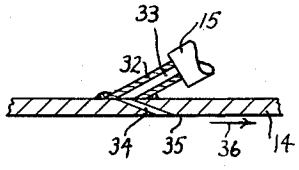


Fig. 4

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AERODYNAMIC DOCUMENT HANDLING APPARATUS

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This invention relates to a novel document separating and feeding device. More particularly the invention relates to an improved document manipulating means for aerodynamically separating and feeding documents one at a time from a document stack.

In the many recently proposed aerodynamic document handling systems having no moving parts the proper performing of the document separating and feeding functions has presented considerable difficulty. Prior apparatus used to produce these functions have included one or more baffle plates that are associated with an arcuate portion of the document guide track. In the operation of such arrangements some sort of arresting and/or direction reversal of the document movement is involved and this tends to increase the amount of document manipulation required to produce the separating and feeding functions. Also while the prior types of arrangements operate satisfactorily in certain systems they tend to become cumbersome in those applications where higher cyclic feed rates are required.

The primary object of the instant invention is to provide an improved aerodynamic document separating and feeding means having no moving mechanical parts.

Another object of the instant invention is to provide a novel aerodynamic document separating and feeding device wherein air jet means are used to restrain the feeding movement of documents other than a desired document.

Another object of the invention is to provide an improved document separating and feeding means whereby two aerodynamic document propelling means are arranged in opposed relation so as to apply to any two or more documents therebetween driving forces that are respectively disposed in opposite directions.

Another object of the invention is to provide an improved aerodynamically operated document separating and feeding device wherein a continuously operating reverse air jet means serves to ruffle the leading documents in a stack and to restrain the same from movement out of a stacked condition, and wherein an intermittently operated air jet means when actuated is capable of transporting the leading document away from the document stack; said continuously operating air jet means serving to restrain a transport movement of all of said documents excepting said leading document during the intermittent operation of said air jet means.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

FIG. 1 is a plan view of one embodiment of the instant invention.

FIG. 2 is a sectional view taken along section line 2—2 of FIG. 1.

FIG. 3 is a diagrammatic sketch illustrating the operational nature of the apparatus of FIGS. 1 and 2.

FIG. 4 is a sectional view taken along section line 4—4 of FIG. 2.

Referring to FIGS. 1 and 2 there is shown a base plate **10** on which is mounted as by means of brackets **11** and **12** and screws **13** a straight length of document guide track **14**. Coupled to the guide track are two groups of spaced air conduit lines which serve to establish a series of document propelling air jets along the longitudinal document guide surface of the track **14**. The first group of lines **15** are connected through a suitable valve **16** to a

common air pressure source S1 while the second group of lines **17** are connected to a common continuous air pressure source S2. Any suitable control means may be used to operate the valve **16** in the timed manner described below. The particular manner in which air lines **15** and **17** are coupled to the document guide surface of the track **14** will be discussed below. Suffice it to note here that air from said lines is directed along track **14** as indicated by arrow **18**, FIG. 1, and such will propel a document along said track. This general aerodynamic technique for transporting a sheet along a guide surface is discussed in U.S. Patents 545,013; 2,981,411 and 2,953,-711 and in British Patent 820,036. A generally U-shaped stack container or frame **20** is mounted, as by brackets **21, 22** and screws **23**, on the base **10** and is disposed in a position facing the upstream end of track **14**. The upstream end **20***a* of container **20** abuts the adjacent face portion of the track while the other end **20***b* of the container is spaced a short distance **24** from the adjacent face of the track. The container end **20***b* is provided with a vertically shortened and bent off length of track **25** which is disposed susbtantially parallel to the adjacent opposed portion of track **14** and which is provided with air lines **26** that are connected to a common continuous air pressure source S3, the connections of air lines **26** to the associated track being similar to those for air lines **15** and **17**. From FIG. 2 it may be seen that the air lines **26** are distributed along the top portion of the short track **25** while the air lines **15** are distributed along track **14** at different levels. If desired all the lines **15** may be disposed at the same vertical height above base **10**. A weight **30** may be provided inside the document container **20** so as to retain a stack of documents **31** in an upright condition facing the adjacent portion of track **14**.

The manner in which the various air lines **15, 17** and **26** are coupled to their respectively associated guide surfaces is illustrated in FIG. 4. Here for example the flexible line or hose **15** is connected to a tubular fitting **32** that is welded or otherwise secured to the rear side of the track **14**. The bore **33** in the tubular fitting communicates with an inclined bore **34** formed through the wall of said track; the bore **34** being adapted to direct air from line **15** along the guide surface **35** of track **14** in a direction illustrated by arrow **36**. In accordance with Bernoulli's principle of fluid flow this film of air moving along the guide surface **35** will be capable of holding a document on said surface and frictionally propelling the same along said surface.

In the operation of the apparatus of FIGS. 1 and 2 a stack of documents **31** is first placed in the container in the region between the weight **30** and the adjacent face of the track **14**. The air supply source S3 being continuously effective affords a constant flow of air to the left, as seen in FIG. 1, along the short track **25** so as to not only ruffle the leading documents of the stack but also to continually bias said documents towards the left end **20***a* of the stack container **20**. The air supply source S2 also being continuously effective affords a constant air flow to the right, as seen in FIG. 1, along just the downstream portion of track **14**. The valve **16** is normally in its "off" condition so that normally no air flow occurs in lines **15**. When it is desired to separate the leading document from the stack and feed the same along the track **14** the valve **16** is momentarily turned to its "on" condition so as to afford an air flow to the right, as seen in FIG. 1, along the upstream portion of track **14**. This air flow, which is effectively stronger than the reverse air flow along track **25**, will cause the leading document in the stack to be aerodynamically drawn toward the adjacent surface of track **14** and then propelled to the right, as seen in FIG. 1, along said track. The valve **16** is left in its "on" condition only momentarily, it being returned to the nor-

mal "off" condition at a time no later than the instant when the trailing edge of said leading document passes the track air port associated with the first air line **15***a*. At this time the leading end of the document will have passed the port associated with the first air line **17***a* and in that air flow is continuous through all the lines **17** the document will continue its downstream transport movement after the valve **16** is turned to an "off" condition.

In most cases only the leading document in the stack is transported along the track **14** for each cyclic operation of valve **16**; however once in a while two documents will move together in the feed direction, i.e. a second document that is at least partially superimposed with respect to the leading document will tend to be frictionally transported away from the stack with said leading document. When this situation occurs the second or superimposed document which is aerodynamically isolated from lines **15** by the leading document will be immediately driven in an opposite direction back into a stacked condition by the reverse aerodynamic drive action of the adjacent air flow through lines **26** and along track **25**. The diagrammatic sketch of FIG. 3 illustrates this aerodynamic document separating action. Here the forward propulsive aerodynamic forces exerted on the leading document **40** by the pulsed air flow through lines **15** are indicated by arrows P while the aerodynamic braking or reverse driving forces exerted on a superimposed document **41** which is frictionally moving with the leading document **40** are indicated by arrows R. This combination of document driving and braking forces will cause the leading document **40** to be transported to the right as indicated by arrow **42** and the superimposed document **41** to be braked and if necessary to be transported to the left as indicated by arrow **43**. The leading document is thus separated and fed from the document stack to that downstream portion of track **14** that is serviced by the continuously effective air lines **17** and any superimposed documents tend to be simultaneously driven to and held in a position against the left end **20***a* of the stack container as indicated by dotted lines **44** of FIG. 3. In the normal case where just a single document, is being separated and fed the reverse aerodynamic forces R although acting directly on the adjacent face of the single document **40** will not prevent the forward feeding movement of the latter in that as noted above the overall effective document driving action of forces P is greater than that of the reverse forces R.

As will be apparent the instant device is capable of efficiently serially separating documents from a stack and successively feeding the same along track **14**. Because no moving parts are involved the instant apparatus is relatively inexpensive to fabricate and maintain. One prototype of the above described device has been successfully tested at a operational piece rate of 300–400 documents per minute.

Since many changes could be made in the embodiment of the invention as particularly described and shown herein without departing from the scope of the invention, it is intended that this embodiment be considered as exemplary and that the invention not be limited except as warranted by the following claims.

What is claimed is:

1. An aerodynamically operated document separating and feeding device: comprising

document retaining means for retaining a stack of documents;

a document guide track extending away from said retaining means and having a document guide surface formed thereon;

air jet means for aerodynamically feeding the leading document in said stack along said guide surface;

a second document guide track extending away from said document retaining means and having formed thereon a second document guide surface which faces a portion of the first mentioned guide surface; and

air jet means connected to said second document guide track and operatively arranged at an acute angle relative to said second guide surface to direct at least one jet of air along said second document guide surface in a direction opposite to the document feed direction whereby any additional document that is travelling with a lead document may be aerodynamically braked and reversely driven with respect to the associated lead document.

2. An aerodynamically operating document separating and feeding device: comprising

a first elongated document guide track having a document guide surface formed thereon;

first conduit means for directing a flow of air along said first guide track surface;

valve means operatively disposed in said conduit means;

container means for retaining a plurality of stacked documents in opposed relation with respect to an initial end portion of said first guide track surface;

a second relatively short document guide track disposed adjacent the document exit end of said container means and having a document guide surface formed thereon that faces an adjacent opposed portion of said guide track surface; and

second conduit means for directing a flow of air along said second guide track surface, said first and second conduit means being arranged so that the direction of air flow along said first guide track surface is opposite to that of the air flow along said second guide track surface, whereby for each cycle of operation of the device just the leading document in said container means is separated and fed along said first guide track surface under the action of the said air flow along said first guide track surface and whereby any additional document tending to so move with said leading document is driven in a reverse direction back into said container means under the action of said air flow along said second guide track surface.

3. Apparatus as defined by claim **2** wherein the vertical dimension of said second guide track is effectively less than that for the adjacent portion of said first guide track, and wherein the effective longitudinal force exerted on a document by the air flow along said first guide track surface is greater than that effectively exerted by the air flow along said second guide track surface.

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