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STACKER FOR FLEXIBLE CARDS, SHEETS AND THE LIKE

Filed Feb. 21, 1961

FIG. 1
(PRIOR ART)

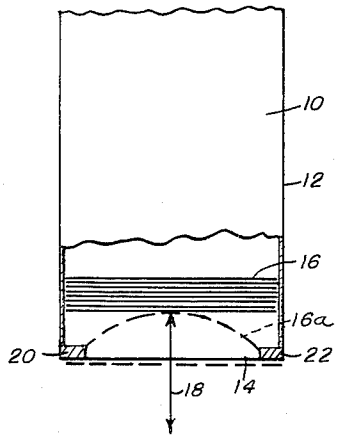
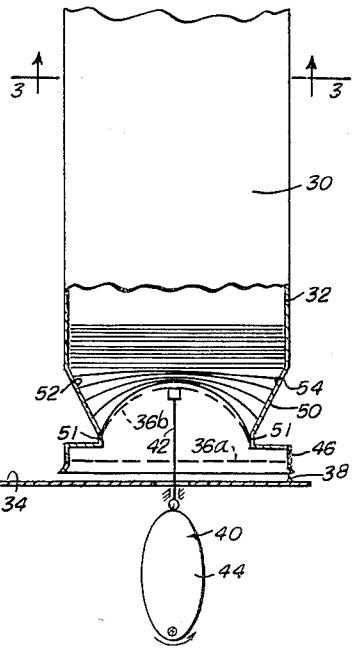


FIG. 2



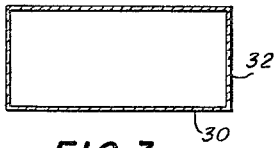


FIG. 3

INVENTORS
JOHN J. MACDONALD
JOHN E. WALDO
BY Joseph A. Genovese &
Max L. Libman ATTORNEYS

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STACKER FOR FLEXIBLE CARDS, SHEETS AND THE LIKE

John G. MacDonald, Washington, D.C., and John E. Waldo, Silver Spring, Md., assignors to Rabinow Engineering Co., Inc., Takoma Park, Md.

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This invention relates to the art of stacking of cards, sheets and the like.

Since our invention solves problems encountered in stacking sheets, cards and other flat, flexible objects, the term "article" as used herein, is defined as any flat object capable of being stacked by the apparatus and methods of our invention.

With the advent of high speed data processing equipment, there has been a concurrent demand for new and/or improved article handling techniques and equipment. One type of conventional equipment stacks articles in a compartment by successive feeding into an open end of the compartment. The articles are moved past stops at an end of the compartment before, during or after many kinds of data processing procedures. U.S. Patent No. 2,811,352 discloses a typical stacking machine where sheets are so inserted into a compartment. This patent typifies the prior art where sheets are moved past stops to the lower end of a stack. As the demand for increased speed occurred, there were attempts to insert articles past article supporting stops and into the compartment at greater rates.

By appreciably increasing the in-feed rate to about five to ten sheets per second the entire stack oscillates quite violently, and in some cases the articles actually jump from the top of the stack. One of the reasons for this undesired behavior is that the incoming article must be flexed an amount sufficient to allow two edges to pass the stops at the bottom of the compartment (when the stack is vertical), and the entire stack must be displaced that distance for each incoming article. An object of the invention is to overcome this difficulty by forming an arch of some of the articles at one end of the stack, and feeding the articles into one end of the arch, while the articles at the other end of the arch progress into and become part of the stack.

In carrying out the invention, we provide means which require a number of articles, for example, ten or twenty, to become arranged in an arch where the in-feed end of the arch preferably has a smaller radius of curvature than the opposite end. In fact, the opposite end of the arch may be virtually flat. As the articles are fed into the curved end of the arch, all articles of the stack are displaced slightly, with the amount of vertical displacement being proportional to the curvature of the individual articles making up the arch. Consequently, the last article of the arch which becomes displaced into the stack is required to move only a short distance, i.e. a distance equal to the thickness of the article, as it moves into the stack. This completely obviates the problems in the prior art relating to violent oscillations of the stack during high speed feeding.

Another object of the invention is to provide a stacking method which provides for the formation of an arch made of some of the articles themselves and of sufficient structural strength to form the support for the stack of articles even as it grows large by the feeding of additional articles into the in-feed end of the arch. By requiring the top of the arch (not mechanical stops) to support the stack, the stack is displaced only a distance equal to article thickness as new articles are added to the arch, and articles from the arch go into the stack.

Other objects and features of importance will become

apparent in following the description of the illustrated form of the invention.

FIGURE 1 is a diagrammatic view showing a conventional, prior art technique for feeding articles into a compartment.

FIGURE 2 is a diagrammatic view showing the principles of the invention.

FIGURE 3 is a cross sectional view taken on line 3—3 of FIGURE 2.

FIGURE 1 shows the operating principle of many prior devices. There is a compartment **10** made of a plurality of walls **12** and having an open end **14**. Articles **16** are fed into the open end of the compartment by a conventional feed mechanism diagrammatically represented as a pusher **18**. A pair of stops **20** and **22** are located at one end of compartment **10**, and the flexible articles **16** are pushed past the stops **20** and **22** as they are fed into the compartment. The illustrated stack must be moved upwardly a considerable distance from stops **20** and **22** in order to permit an incoming article **16***a* to be flexed past stops **20** and **22**, and allow it to spring outwardly to a flat position as the bottom article of the stack. This stacking by method of loading a compartment is satisfactory for a slow speed operation. However, modern demands have required that articles be stacked at rates of the order of five or more per second. At such speeds the stack oscillates violently, often causing the articles to jump out of the compartment, even when a heavy weight is placed on the top of the stack.

We have shown one embodiment of our invention in FIGURE 2. Compartment **30** is made of a plurality of walls **32** and may be of any cross-sectional shape, depending on the shape of the articles. A flat table **34** is located near the in-feed end of compartment **30**, and articles **36**, **36***a* and **36***b* are shown in the process of being loaded into the compartment. Article **36** is moved on the surface of the table by any suitable feed device. The movement of the article is in the direction of the arrow until arrested by stop **38** projecting from the table surface. The typical article **36** is lifted toward compartment **30** by a conventional feed mechanism **40**, diagrammatically represented as a pusher **42** operated by a rotary cam **44**. When the article occupies a position directly above the pusher, the latter moves upwardly, pushing the article toward compartment **30**. The article first enters the throat of guide **46** at the entrance of compartment **30**. Article **36***a* is shown in the guide. Upon further motion of pusher **42**, the article enters a device **50** which forms some of the articles into an arch. Article **36***b* is shown entering device **50**.

Device **50** is made of two sloping walls which define flat (or curved) cam surfaces **52** and **54** against which opposite edges of the articles slide as they move toward the bottom of the compartment proper. In forming the arch, the first article is moved into device **50** by applying an upward force at the center of the article. This causes the article to bend at the center while two edges frictionally slide against the lower straight walls **51** of device **50** and then the lowermost portions of surfaces **52** and **54**. Then, the next article fed in the same way, occupies the lowermost position. The entry of the new lowermost article of the arch into device **50** pushes the previous article upwardly a slight distance into a slightly wider part of device **50**. Thus, the curvature of the first article slightly decreases. This process is repeated until the arch is formed. By constructing an arch in this way it is important to observe that the in-feed end of arch has a smaller radius of curvature than the opposite end. The opposite end of the arch is made of one or a few articles which are virtually or actually flat.

After the arch is formed in this way (or in any other way) the arch is sustained by the opposite edges of the

articles binding against surfaces 52 and 54. However, as additional articles are fed into the smaller end of the arch, a corresponding number of articles are discharged from the opposite, flat end of the arch into the stack. The effect is that the articles discharged from the flat end of the arch become the lowermost articles of the stack.

In analyzing this process, it will become evident that the transition of articles from the flat end of the arch to the bottom of the stack requires the stack to move only the thickness of one article, while the arch is continually reformed by the incoming articles. Since most articles are very thin, the corresponding movement of the stack is very small. It has been found that this system eliminates the violent oscillations which accompany high speed article stacking in a compartment.

It is understood that various changes and modifications may be made without departing from the protection of the appended claims. For example, compartment 30 is shown vertical. The compartment may be disposed at any angle, including horizontal, with similar results. The sloping surfaces 52 and 54 enable the arch to be formed and sustained quite easily. These walls need not necessarily slope the full height of the arch. They may be parallel in which case the arch will have approximately the same radius of curvature at both ends. For instance, walls 51 (FIGURE 2) may be made somewhat longer and the sloping walls above them made horizontal. In such a case the arch will be generated and sustained between walls 51. Note, however, even in this form of our stacker, the stack being supported by the center of the arch, would not be subjected to the same oscillatory movement as in the prior art. The reason is that there would be a concave entrance at one end of the arch and a convex stack support formed by the opposite end.

We claim:

1. A stacker for a stack of flexible articles comprising; means to form an arch of some of the articles with the top of the arch bearing against one end of the stack, and means to feed additional articles into the opposite end of the arch with an accompanying discharge of articles from said arch top into the stack.

2. The method of arranging flexible articles in a stack comprising the steps of; forming an arch of plurality of articles by curving the articles and constraining at least two of their opposite edges, the radius of curvature of one end of the arch being smaller than the radius of curvature of the opposite end, the arch having strength sufficient to support a stack of articles; and feeding additional articles into the arch at the smaller radius end whereby the additional articles become part of the smaller radius end of the arch and the articles forming the larger radius end become part of said stack supported by the arch.

3. Apparatus for high speed arranging of flexible articles in a stack, said apparatus comprising a feed mechanism for the articles, and means engaging opposite edges of the articles to retain some of the articles in an arch which forms the structural support for the other articles which constitute the stack, as articles are successively added to the arch by said mechanism.

4. The apparatus of claim 3 wherein the arch is comparatively flat at the end thereof supporting the stack and curved at the opposite end which is fed by said mechanism.

5. The apparatus of claim 3 wherein said retaining means include at least one sloping surface.

6. In a device to stack flexible articles; a compartment having an open end; a mechanism to feed articles into said compartment through said open end; article constraining means at said open end of the compartment to retain a plurality of articles in an arch which forms the structural support for an end of the stack in the compartment, said arch having an approximately flat end supporting the stack and a curved end to which additional articles are added by said mechanism, and as articles are added to said curved end, articles from the flat end leave the said means and become part of said stack with the amount of displacement of the stack being approximately the same as the thickness of an article.

7. A stacker for flexible articles, comprising a compartment, a feed mechanism, and means between said compartment and mechanism for curving the incoming articles and forming an arch of curved articles with curvature of articles at the in-feed end of the arch being greater than the curvature of articles at the opposite end.

8. The stacker of claim 7 wherein the arch is approximately flat at said opposite end so that as articles are fed into said in-feed end of the arch, articles from the opposite end enter said stack by moving only a distance approximately the same as the thickness of an article.

9. The stacker of claim 8 wherein said means are cam surfaces.

10. The stacker of claim 9 wherein said cam surfaces cooperating with the arch of articles therein constitute the structural support for one end of the stack of articles.

11. The method of stacking flexible articles comprising the steps of forming an arch of a plurality of articles with the in-feed end of the arch being curved and the opposite end being essentially flat, adding additional articles to the in-feed end of the arch with an accompanying discharge of articles from the flat end of the arch, whereby each discharged article is displaced a distance approximately equal to the thickness of one article.

12. In a device to stack thin, flat, flexible articles, a feed mechanism having a member adapted to push successive articles by contacting the articles on the flat surface of the articles between a pair of opposite edges thereof, a pair of walls between which the successive articles are pushed by said member of said mechanism, said walls having ingress portions spaced apart less than the distance across said articles between the said opposite edges thereof so that the articles are required to flex as they enter the space between the ingress portions of said walls, said walls also having divergent portions connected to said ingress portions so that as the articles are successively pushed into said space they collectively form an arch whose radius of curvature becomes greater as more articles engage said divergent portions of said walls, a compartment in registry with the space between the divergent portions of said walls so that as further articles are pushed into the space between the ingress portions of said walls the articles between said divergent wall portions enter said compartment and the arch itself forms the structural support for the articles in said compartment.

References Cited in the file of this patent

UNITED STATES PATENTS

2,754,119 Morgan et al. ---------- July 10, 1956