

[54] **SHEET STACKING DEVICE**
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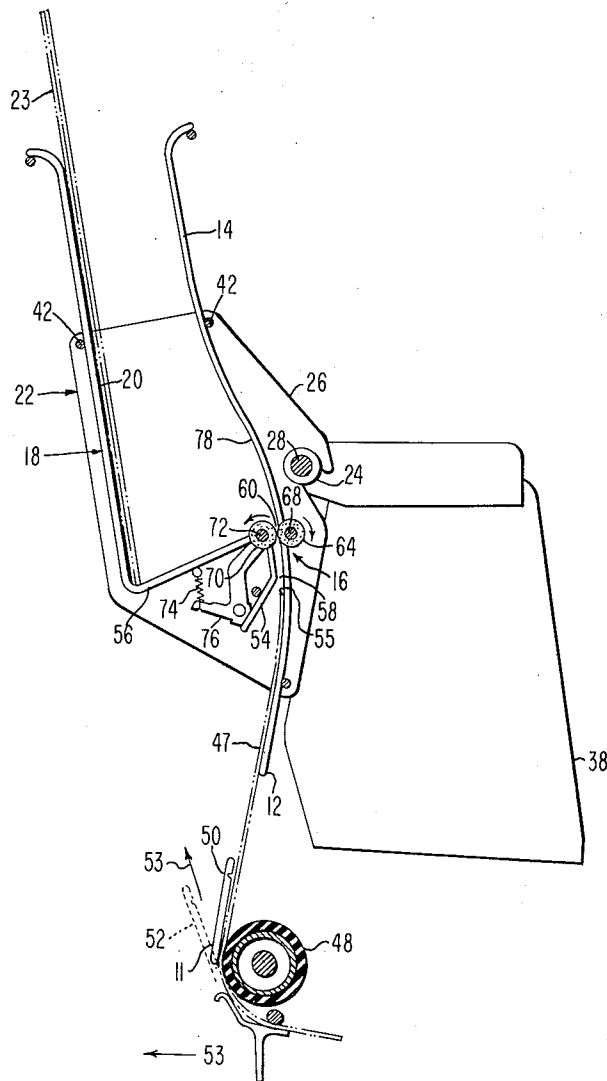
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[57] **ABSTRACT**
A sheet stacking device for serially stacking sheets in a substantially upright position where sheet ejection means impels a sheet upwardly into a vertically disposed sheet retainer. A sinuous guide opposingly displaced from the sheet retainer directs the sheet into engagement with the injecting means and assists in displacing the sheet securely into the sheet retainer by deflecting and bending the sheet in a predetermined degree and direction.

9 Claims, 5 Drawing Figures



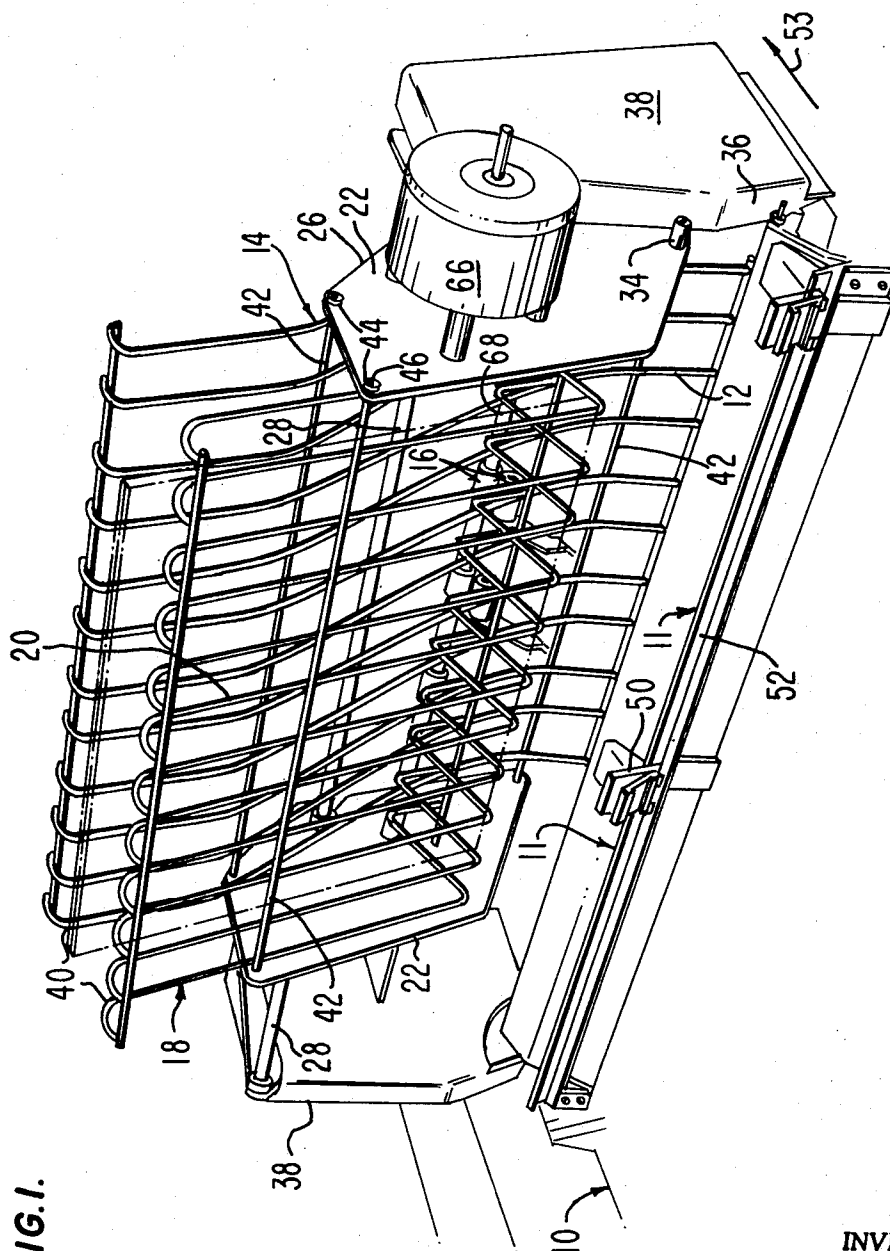
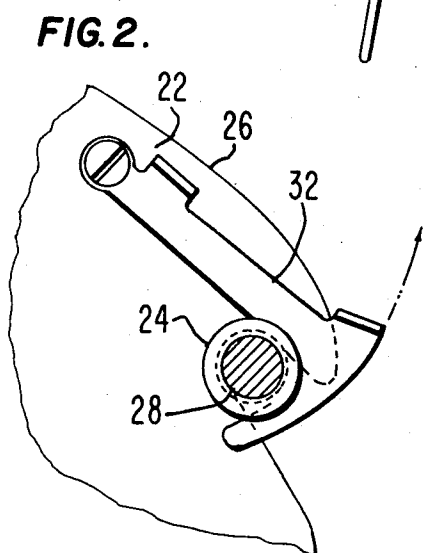
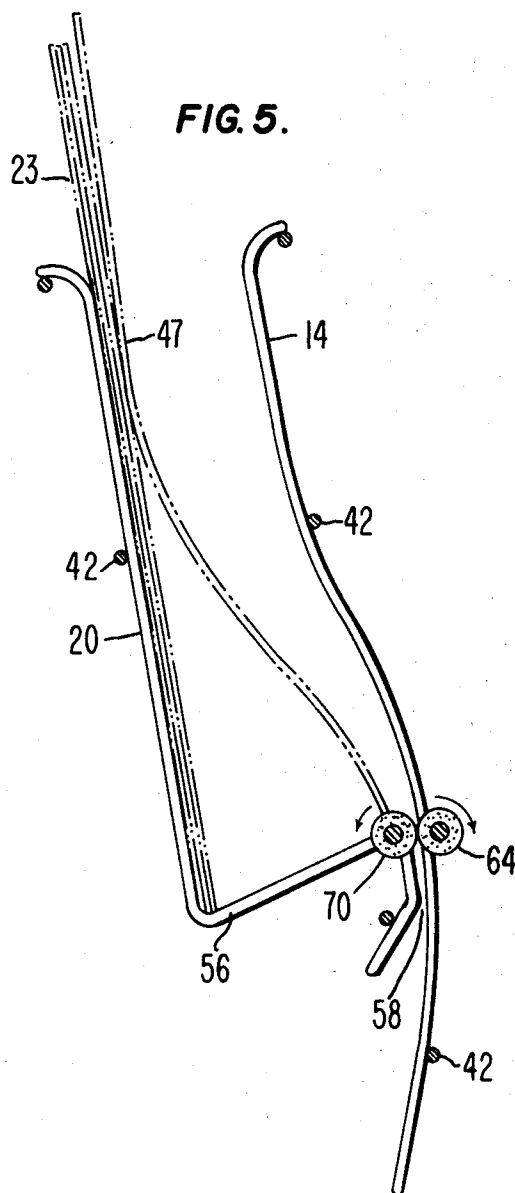
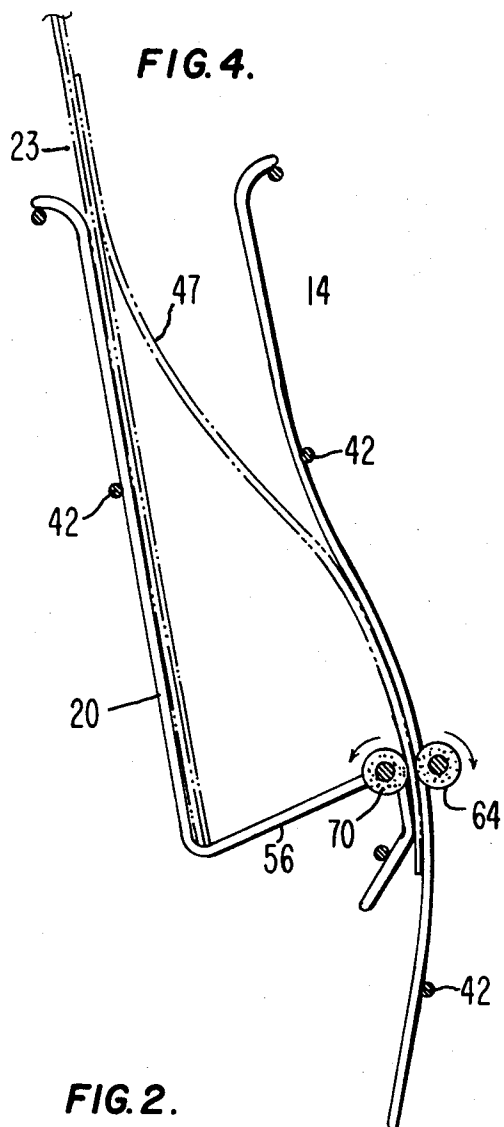


FIG. 1.

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SHEET STACKING DEVICE

BACKGROUND OF THE INVENTION

This invention relates generally to material or article handling apparatus and more particularly to devices or apparatus for stacking thin items or sheets.

Apparatus for handling or transporting thin items such as paper documents usually form a component part of a larger system in which the document is printed upon, read, or in some other way utilized. In a common variety of automatic accounting machines, for example, a paper document in the form of a striped ledger, carries accounting information for a particular account. When an operator wishes to make entries in a group of accounts each ledger is hand-fed into a transport apparatus of the machine where it is programatically displaced in relation to a printing element according to a predetermined printing format. After the recordings have been completed on each ledger, the transport apparatus of the accounting machine must eject a completed ledger before another can be fed to the transport apparatus. Many of the prior art striped ledger accounting machines have made no provision for stacking ejected ledgers, thus the operator of such a machine is required to pick up each ejected document and place it in an appropriate location before the next ledger is inserted. A device that neatly stacks ejected documents in a position easily accessible to an operator consequently saves an operator of such a machine a substantial amount of time.

The provision of such a stacker has proven to be a difficult problem, especially when working with relatively large documents such as striped ledgers. To accommodate large documents the stacker device must also be large, so that an extremely cumbersome design is difficult to avoid. Economic considerations dictate that the device be capable of operative attachment to existing machines without major modifications to those machines. Another factor complicating the design of the stacker is that many business machines eject documents or ledgers from the rear of the machine in relation to the position of an operator. Since it is desirable that the documents be stacked in a position that does not require an operator to leave his station, a provision must be made to divert and stack the documents in such a position. In addition to these problems the stacker device should be light in weight, self-contained, and easily removable and attachable to a business machine. With due regard for manufacturing costs, no prior art stacker device has been found that meets all of these requirements.

It is, accordingly, an object of the present invention to provide an efficient sheet or document stacker that is adaptable for use with existing sheet transport apparatus.

It is a corollary object of the present invention to include all operative elements of the stacker device in a single stacker module so that it may be removed from and attached to sheet transport machinery as an operable entity.

It is another important object of this invention to provide a stacker in which the position of sheet stacking is easily accessible to a machine operator.

It is another object of this invention to provide a stacker that is simply constructed of inexpensive, readily available materials.

It is still another important object of this invention to provide a stacker that is light in weight so that an operator may easily remove or replace the device from or upon a business machine.

SUMMARY OF THE INVENTION

In accordance with the invention these and other objectives are fulfilled by a stacking device comprised of a sheet guide that intercepts sheets ejected from an associated sheet transport apparatus and directs the sheets into engagement with sheet injector means that operate to drive the sheets upwardly along the sheet guide and into a stack retainer. The sheet guide is sinusously formed in a predetermined relationship with the stack retainer so that it bends and deflects the sheets away from the injector means and securely into the stack retainer. Residual energy stored in the bent sheets it utilized to displace the sheets in a spontaneous manner toward the stack retainer.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a more complete understanding of the invention, a preferred embodiment thereof will hereinafter be described in reference to the drawings in which:

FIG. 1 is a perspective view of the sheet stacking device as it would appear when mounted on an accounting machine;

FIG. 2 is an enlarged detailed view from FIG. 1;

FIG. 3 is a cross-section of a side elevation of the stacking device;

FIG. 4 is a view similar to FIG. 3 showing a sheet being driven upwardly by the stacking device; and

FIG. 5 is also a view similar to FIG. 3 showing a sheet settling into abutment with a stack after being driven upwardly by the device.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein like reference characters designate identical elements in each of the Figures, and particularly to FIG. 1, there is illustrated a preferred variety of stacking device mounted on an automated accounting machine 10 having a sheet or ledger transport capability. When the accounting machine 10 has completed its necessary operations upon a ledger, that ledger is ejected from an ejection line 11 of the machine by driving means contained therein. A lower portion 12 of a sinuous sheet guide 14 directs the ejecting sheet into engagement with the sheet injector means of the stacking device, such as the illustrated opposing rollers 16 positioned in the stacking device at or near the point where the ejection means of the accounting machine 10 becomes ineffective. Once engaged by the opposing rollers 16, the sheet or ledger is driven upwardly along the sinuous sheet guide 14 ultimately to be injected into a stack retainer 18 in a manner to be more completely described below.

A flat side 20 of the retainer 18 and the sinuous sheet guide 14 are maintained in opposing spaced apart relationship by side supports 22 that are fixed in laterally spaced relationship at opposite ends of the retainer 18 and guide 14. So disposed the side supports 22 also function to block lateral motion of a stack 23 sup-

ported within the stack retainer 18. Attaching the stacking device to the illustrated accounting machine 10, as best shown in FIG. 3, may be simply accomplished by sliding open-ended slots 24 on the rearward edges 26 of the side supports 22 into engagement with a transverse mounting bar 28 disposed above the ejection line 11 of the accounting machine 10. A latch 32, pivotally mounted on each side support 22, as shown in FIG. 2, is then pivoted downwardly to effectively close the open end of the slot 24, thus locking the stacking device to the transverse mounting bar 28. The position of the open-ended slots 24 being rearwardly offset from the center of gravity of the stacking device causes the device to pivot counterclockwise, as illustrated, to a limit established by a stop 34 (FIG. 1) extending from the side supports 22 contacting a front side 36 of an upright support 38.

With an accounting machine similar to the one illustrated in FIG. 1, the only modification of the machine that is necessary to accommodate the stacking device is the provision of the transverse mounting bar 28 on which the stacking device is pivotally supported. Since upright supports 38 already exist on the illustrated machine 10, a suitable platform for securing the transverse mounting bar 28 is already available. As illustrated, the stacking device may be laterally displaced along the mounting bar 28 to intercept an ejected document from any position along the ejection line 11. Thus, it can be seen that by a simple provision of the transverse mounting bar 28 secured above the ejection line 11, an accounting or other business machine may be adapted to accommodate the present invention.

The particular structures of the sinuous sheet guide 14 and stack retainer 18 provides a high degree of sheet support and a low degree of sheet friction while maintaining the weight of the stacker device at a remarkably low level relative to its required size. Both the guide 14 and the retainer 18 are similarly formed of a plurality of wires 40 or wire-like members longitudinally aligned relative to the direction of sheet transport. Cross braces 42 formed of similar wires support the longitudinal wires 40 coplanarly in spaced apart, parallel relationship. Ends 44 of predetermined ones of the cross braces 42 extend through holes in the side supports 22 where they are fixed by appropriate fastening means, as at 46.

In operation, a ledger or sheet 47 from the exemplary accounting machine 10 is ejected tangentially from a platen 48 thereof, such as shown in FIG. 3. A sheet deflector 50 of the accounting machine 10 may be oriented to direct an ejected sheet 47 either upwardly toward the sinuous guide 14 of the stacking device, as shown, or it may be pivoted counterclockwise as at 52, to allow the sheet 47 to be ejected in a more forward direction 53. A sheet 47 thus forwardly deflected would obviously not be injected into the stack retainer 18 but instead would be taken from the platen 48 by an operator. The provision of the pivotal deflector 50 of the accounting machine serves the purpose of allowing the machine to handle either unit record types of documents that would lend themselves to stacking or a continuous medium such as those driven by pin wheels engaging marginal perforations in the medium. Being concerned with the stacking of unit records or sheets, the deflector 50 is considered positioned, as illustrated, to direct an ejected sheet 47 into abutment with the lower portion 12 of the sinuous guide 14.

Following the progress of an upwardly ejected sheet 47, its upper edge 55 passes a lip 54 of a stack retainer ledge 56 on its way into a throat 58 formed by the lip 54 and the sinuous guide 14. The throat 58 is terminated by the opposing drive rollers 16. The point of contact between the two rollers, termed their bite 60, is positioned adjacent the sinuous guide 14 so that when the rollers engage the sheet and drive it upwardly, it is maintained in constant abutment with the sinuous guide. The distance of the bite 60 of the opposing rollers 16 from the platen 48 of the accounting machine 10 is also important for it must be such that when the trailing edge 62 of an ejected sheet leaves the driving influence of the platen, the sheet has reached engagement with the opposing drive rollers. Should the bite 60 of the opposing drive rollers 16 be substantially closer to the platen 48 than the length of a sheet, the sheet would be influenced by two driving means over a substantial duration of time; thus requiring synchronization of the opposing drive rollers with the platen. It is sufficient, however, that the bite 60 of the opposing rollers be slightly closer to the final engaging position of the platen 48 than the length of a sheet.

In the common configuration, one of the opposing rollers is driven and the other is idle. The driven one 64 of the rollers is rotated, as illustrated in FIG. 1, by an electric motor 66 appropriately coupled therewith. In the present instance an output shaft of the motor is connected by a pulley and belt arrangement (not shown) to an axial shaft 68 of the driven roller 64. An idle roller 70 is pivotally biased about a supporting shaft 72 against the periphery of the driving roller by a tension spring 74 coupled at one end to a cross brace 42 of the stack retainer 18. The other end of the tension spring 74 is connected to the opposite end of an idler arm 76 that journals the idle roller 70, the supporting shaft 72 projecting intermediately therethrough. The supporting shaft 72 and the drive roller shaft 68 are vertically supported and journaled at opposite ends by the respective side supports 22. Each of the shafts carry a like plurality of drive and idler rollers spaced laterally along the injector throat 58 of the stacking device, as shown in FIG. 1. Thus, an upper edge 55 of an ejected sheet 47 is uniformly driven upwardly at each laterally spaced roller position.

As the upper portion of a sheet is driven upwardly by the opposing drive rollers 16, it is bowed inwardly toward the flat side 20 of the stack retainer 18 by a concave sector 78 of the sinuous guide 14. The upper edge 55 of the driven sheet is then displaced toward the stack 23 residing uprightly in abutment with the flat side 20 of the stack retainer 18. Continuous upward displacement of the sheet 47 imparts a slight S-shaped curve thereto, as illustrated in FIG. 4. Finally, the trailing edge of the sheet 47 is driven upwardly beyond the bite 60 of the opposing drive rollers 16, as shown in FIG. 5, and the sheet settles into upright abutment with the stack 23.

There are several important factors which account for the efficient manner in which sheets are displaced toward the flat side 20 of the stack retainer 18, after being driven free of the opposing drive rollers 16. First, the S-shaped curve of the sheet, which results from the disposition of the concave sector 78 with respect to the flat side 20, stores a small amount of residual energy in the sheet 47 so that when the trailing edge thereof is

driven free of the bite 60 of the rollers 16 this residual energy is released effectively forcing the trailing edge of the sheet toward the stack 23. In addition, the periphery of the idle rollers 70 frictionally influence the trailing edge of the sheet 47 toward the stack 23. The rotational axis of the idle rollers 70 is vertically positioned so that the periphery thereof extends above the upper surface of the ledge 56 of the stack retainer 18. A trailing edge of a sheet driven free of the opposing rollers 16 and coming into contact with the periphery of the idle rollers 70 is abruptly forced in the direction of rotation of the idle rollers toward the stack 23. Another factor that assists in the stacking function is the disposition of the stack retainer 18. With the ledge 56 inclined downwardly from the injection throat 58 of the device, a component of the weight of each sheet is directed toward the stack 23 so that a sheet effectively falls toward the flat side 20 of the stack retainer 18. The stack retainer 18 being inclined in the direction of sheet transport utilizes this gravitational advantage for maintaining the stack 23 in secure abutment with the flat side 20 thereof.

While the invention has been described in conjunction with a preferred embodiment it is evident that many modifications and alternatives not truly departing from the inventive concept residing therein will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace within the appended claims all such modifications and alternatives that reside within the inventive concept disclosed herein.

What is claimed is:

1. In sheet transport apparatus having an ejection line from which sheets are serially ejected, a device for uprightly stacking ejected sheets comprising:

a stack retainer having a flat side slightly inclined from vertical in the direction of sheet transport for supporting a front side of a sheet stack, and a ledge extending from said flat side in substantially normal relationship therewith for supporting sheet edges of a stack,

opposing drive rollers disposed outwardly of said ledge from said flat side for impelling a sheet engaged thereby upwardly and over said ledge, and

a sinuous sheet guide opposingly displaced from the flat side of said stack retainer and extending downwardly toward the exit position of said sheet transport apparatus for guiding an ejected sheet into engagement with said rollers, an upper portion of said sheet guide being bowed inwardly toward said flat side for bowing a sheet driven upwardly by said rollers, whereby the residual energy of the bowed sheet assists in displacing the sheet toward said flat side when driven free of said rollers and over said ledge,

said stack retainer and said sinuous sheet guide being formed of a plurality of wire-like members each longitudinally aligned with the direction of sheet travel and laterally supported coplanarly in spaced apart relationship by wire-like cross braces.

2. For attachment to sheet transport apparatus having a position from which sheets are serially ejected, a device for uprightly stacking ejected sheets comprising:

laterally spaced side supports having latching means for mounting said supports in predetermined positions upon the sheet transport apparatus;

a stack retainer formed of a plurality of laterally spaced wire-like members supported on cross braces fixed between said side supports, said wire-like members forming a flat side inclined slightly from vertical in the direction of sheet transport for supporting a front face of a sheet stack and a ledge extending in substantially normal relationship therefrom for supporting sheet edges of a stack;

opposing drive rollers disposed outwardly of said ledge from said flat side for impelling a sheet upwardly and over said ledge, said rollers being mounted for axial rotation on respective shafts journaled at opposite ends in parallel relationship by said side supports;

drive means mounted on one of said side supports and driveably coupled to one of said shafts; and

a sinuous sheet guide supported by side supports in opposing relationship with the flat side of said stack retainer, said sinuous sheet guide having a lower portion for directing a sheet ejected from the sheet transport apparatus into engagement with said opposing drive rollers and a concave sector directed toward the flat side of said stack retainer for likewise directing a sheet driven upwardly by said opposing drive rollers.

3. A unitary sheet stacking device removably attachable to an accounting machine or the like, said machine having sheet ejection and handling means including a pair of upright support members and a connecting mounting bar, said unitary device comprising:

a. a pair of side supports attachable to said sheet handling means,

b. a sinuous stack retainer interposed between and supported by said pair of side supports said stack retainer having a flat side for supporting a front side of a sheet stack, and a ledge extending from said flat side in substantially normal relationship therewith for supporting sheet edges of a stack,

c. a sinuous sheet guide supported by said side supports and displaced from said stack retainer to form a sheet injection throat, said sheet guide serving to direct a sheet ejected from said ejection means of said accounting machine or the like into said injection throat, and

d. sheet injector means including a plurality of opposing drive rollers mountably disposed within said injection throat and drive means supported by at least one of said side supports and coupled to said opposing drive rollers,

said stack retainer and said sheet guide being formed of a plurality of wire like members each longitudinally aligned with the direction of sheet travel and laterally supported coplanarly in spaced apart relationship by cross braces,

whereby, upon attachment of said unitary sheet stacking means to said sheet handling means of said accounting machine or the like record sheets serially processed by said accounting machine and ejected by said sheet ejection means thereof are advanced into and stacked within said stack retainer for periodical and delayed removal therefrom.

4. The unitary sheet stacking device defined in claim 3 wherein each of said pair of side supports comprises:

a. an open-ended slot effective for attachably receiving said mounting bar of said sheet handling means

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- of said accounting machine or the like upon attachment of said device thereto,
- b. a pivotally mounted latch enclosably disposed relative to said open-ended slot such that said mounting bar may be locked within said slot upon said attachment, and
 - c. a stop limitably associated with a corresponding one of said upright support members of said sheet handling means following said attachment.
5. The unitary sheet stacking device defined in claim 3 wherein said sinuous stack retainer comprises one flat side opposingly displaced from said sinuous sheet guide and a ledge extending toward said sheet guide from said flat side forming said injection throat therewith.
6. The unitary sheet stacking device defined in claim 5 wherein said sinuous sheet guide and the opposing flat side of said stack retainer are inclined slightly from vertical, such inclination being effective to impart a gravitational component of force toward said flat side to a sheet injected therein.
7. The unitary sheet stacking device defined in claim 5 wherein said sinuous sheet guide has a concave por-

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tion opposing said flat side, a lower portion of said concave portion extending downwardly of said ledge for guiding a sheet into engagement with said sheet injector means, an upper portion of said guide being bowed toward said flat side for conformably bending an injected sheet.

8. The unitary sheet stacking device defined in claim 5 wherein said plurality of opposing drive rollers mountably disposed within said injection throat and forming a part of said sheet injector means are effective for impelling the trailing edge of a sheet engaged thereby over said ledge of said stack retainer.

9. The unitary sheet stacking device defined in claim 5 wherein the axes of said opposing rollers are laterally displaced and parallel with the surface of said ledge, said axes being positioned so that the periphery of the rollers positioned closest to the ledge extend upwardly of said ledge so that the trailing edge of a sheet driven free of said rollers is frictionally impelled by said periphery toward said flat side.

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