Sept. 20, 1971 R. C. MARSHALL 3,605,375

BANDING MACHINE AND METHODS

Filed April 7, 1969 4 Sheets-Sheet 1

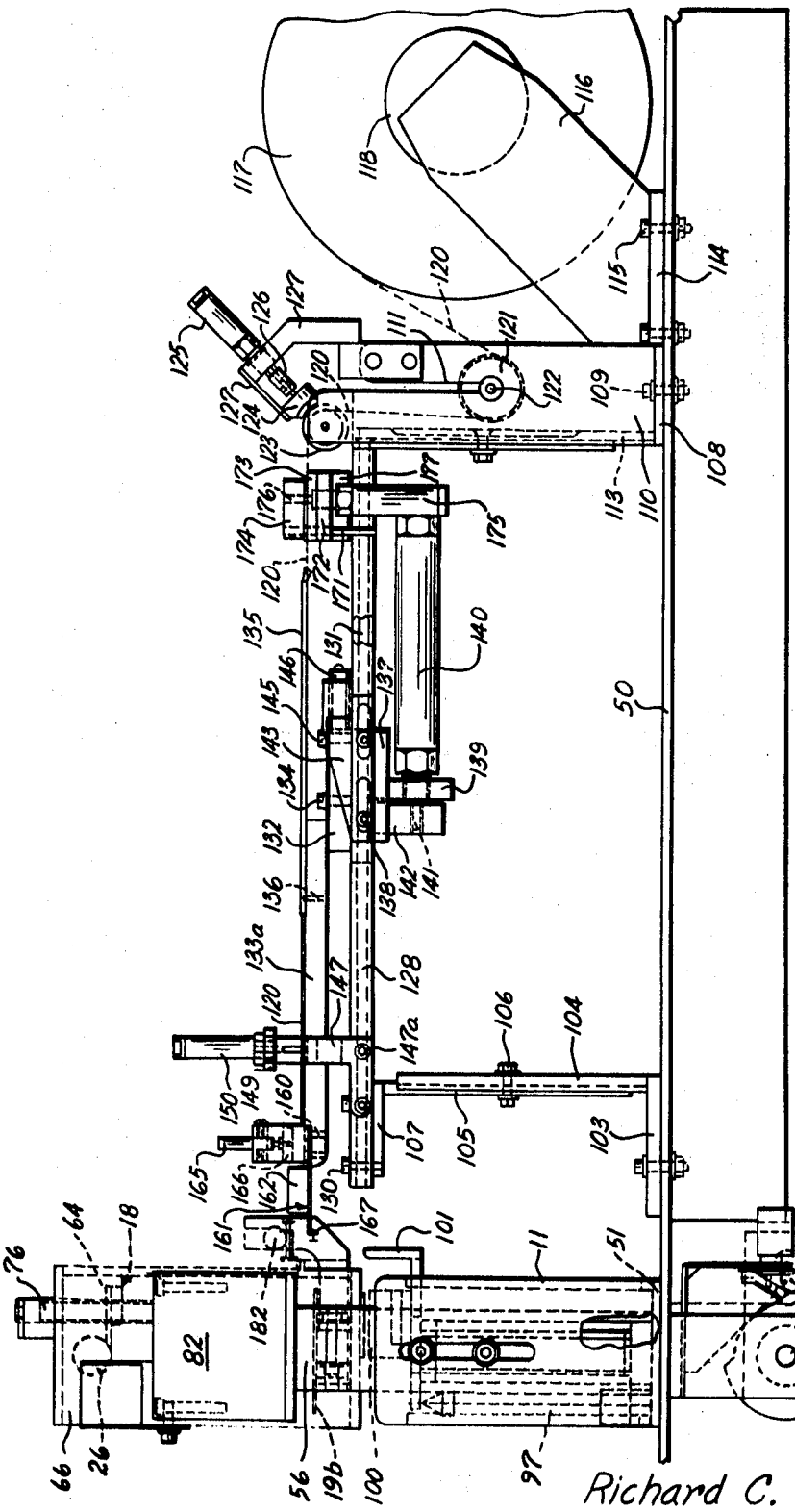


Fig. 1.

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BANDING MACHINE AND METHODS

Filed April 7, 1969 4 Sheets-Sheet 2

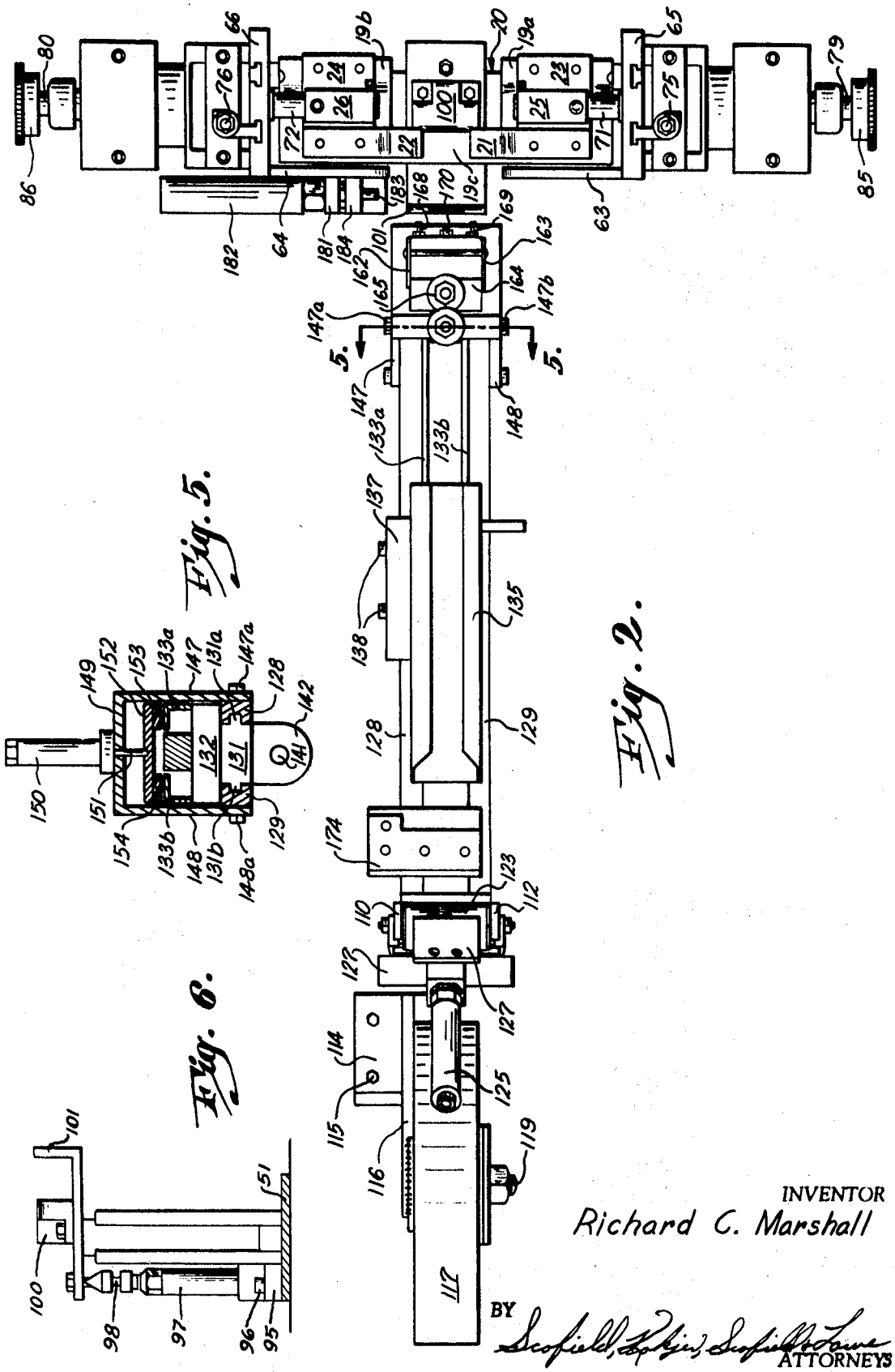


Fig. 2.

Fig. 5.

Fig. 6.

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BANDING MACHINE AND METHODS

Filed April 7, 1969 4 Sheets-Sheet 3

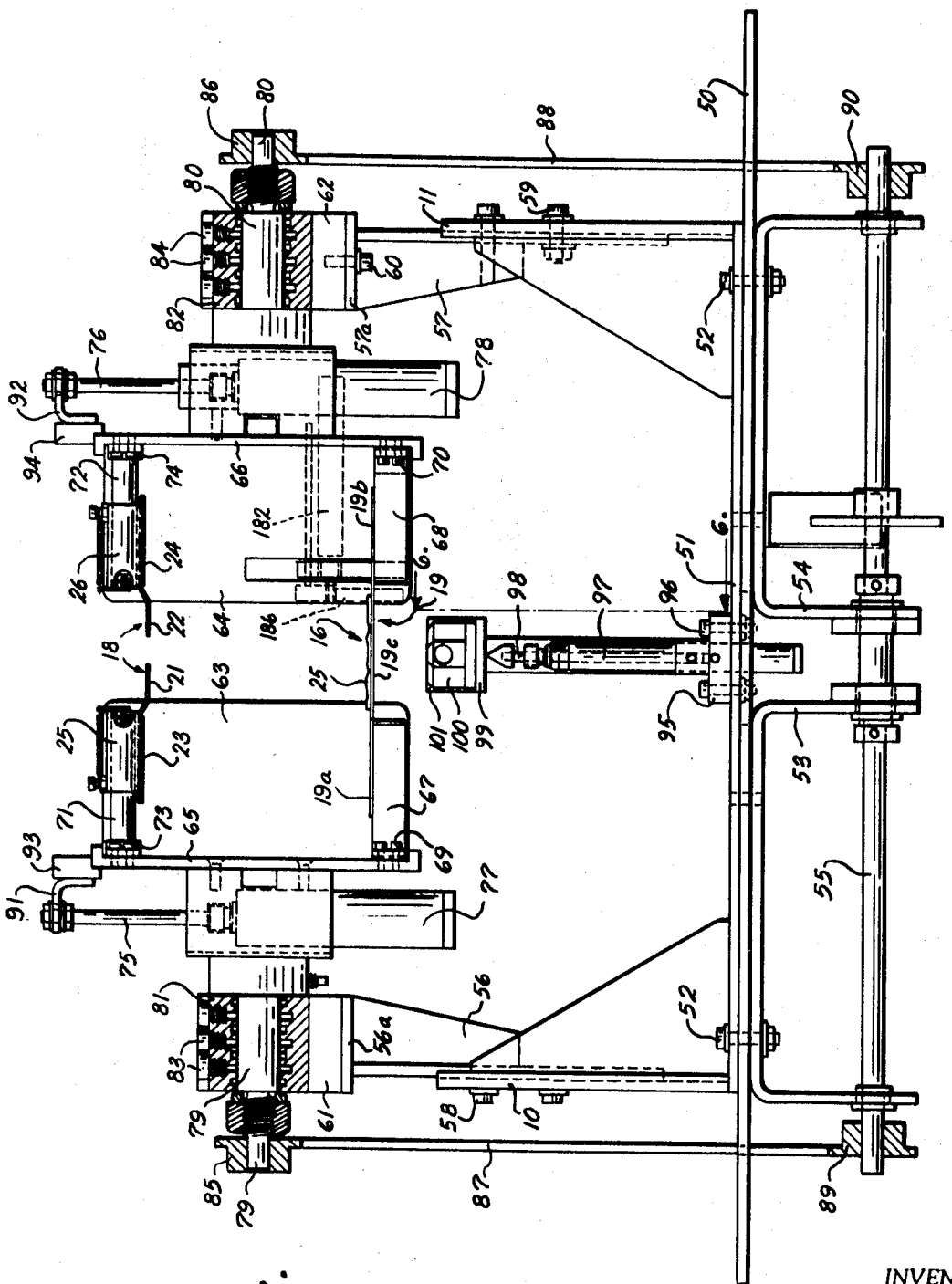


Fig. 3.

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BANDING MACHINE AND METHODS

Filed April 7, 1969 4 Sheets-Sheet 4

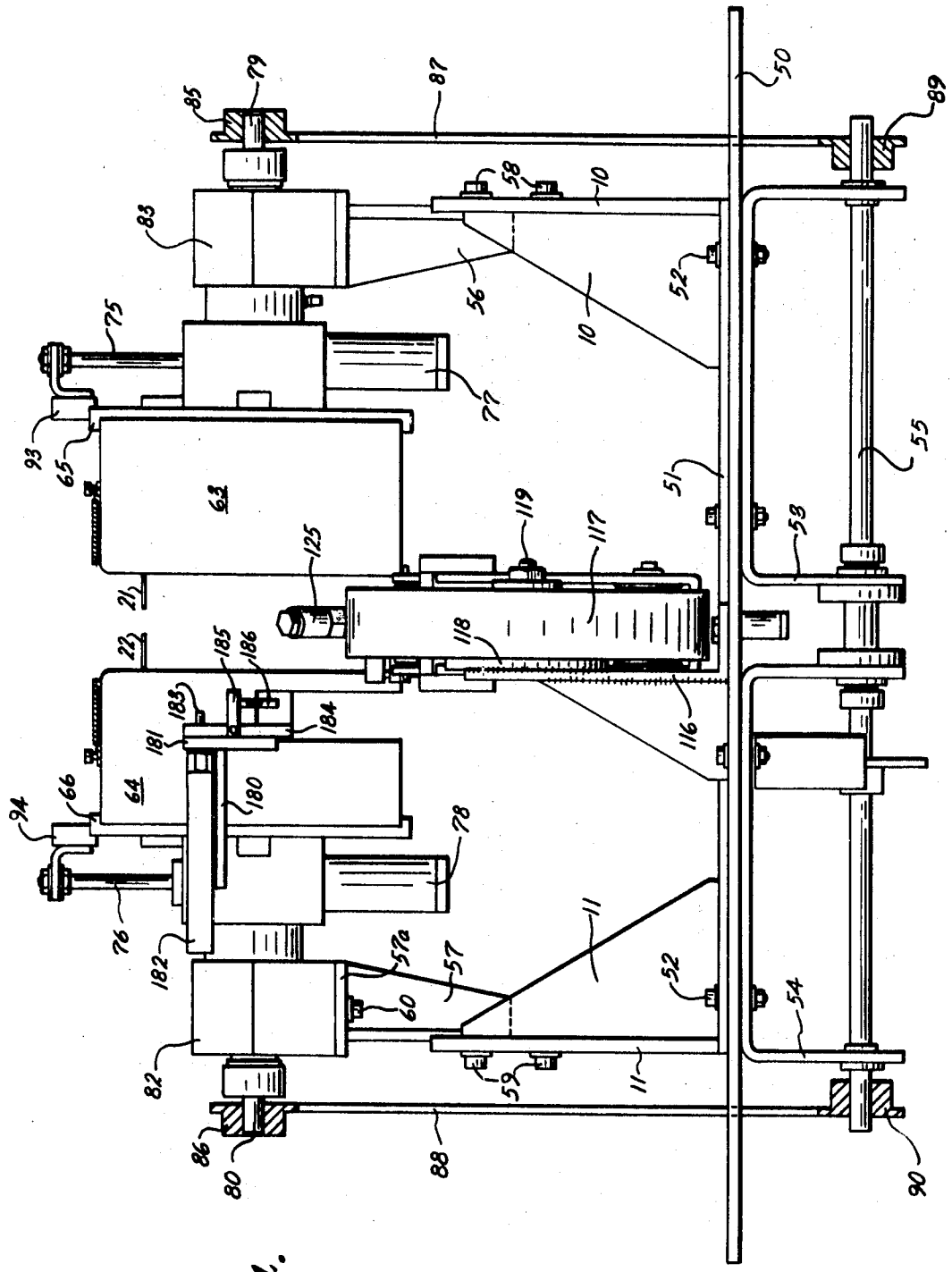


Fig. 4.

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United States Patent Office

3,605,375

Patented Sept. 20, 1971

3,605,375

BANDING MACHINE AND METHODS

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Continuation-in-part of application Ser. No. 613,615, Feb. 2, 1967. This application Apr. 7, 1969, Ser. No. 813,915

Int. Cl. B65b *13/02, 13/20, 27/08*

U.S. Cl. 53—3

7 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for banding packets of commercial paper. A heat sealable banding strip is withdrawn from a continuous supply and positioned on a base plate. A stack of commercial paper is placed on the base plate and pressure plates then press the stack. Next, additional banding material is wrapped about the base plate, stack, and pressure plates, and heat sealed on itself to encircle the assembly. Finally, the banding strip is severed from the continuous supply and the pressure plates are released to permit removal of the banded packet.

BACKGROUND AND SUMMARY OF THE INVENTION

This application is a continuation-in-part of my copending application Ser. No. 613,615, filed Feb. 2, 1967, entitled "Automatic Check Bander," now abandoned.

Heretofore, various banding devices have been developed and utilized in manufacturing facilities such as devices for the banding of envelopes into packets in association with envelope manufacturing processes wherein a multitude of packets are formed and banded in assembly line type fashion. These devices employ methods and apparatus of such a nature that their adaptation to commercial facilities such as banks and the like (where tremendous quantities of currency, checks and other commercial papers are banded on a daily and even hourly basis) is impractical. In such latter establishments, materials of this nature are typically banded through manual processes employing very simple mechanisms which serve only to compress the packet prior to a manual banding or wrapping of the band about the compressed packet thereby providing an extremely slow process consuming large quantities of man hours to complete a relatively simple operation.

An object of my invention is to provide new and improved banding apparatus and process wherein individual packets of material such as checks, currency or similar articles may be rapidly and efficiently banded together to form a packet.

Another object of the invention is to provide methods of and apparatus for improved flat material stack banding of such character that utilization thereof in banks and other commercial establishments becomes eminently practical, resulting in considerable savings in time, labor and expense.

Another object of the invention is to provide methods and apparatus wherein individual stacks of materials such as checks or currency may be placed into a banding device, said stacks thereafter quite rapidly banded and then ejected or removed from the device, with the latter thereafter automatically prepared for receipt of a following pack of material.

Another object of the invention is to provide methods of and apparatus for delivering a continuous strip of banding material to a band wrapping assembly or device, where a pack of material to be banded is placed in the wrapping assembly or device in spaced relationship to a portion of said strip and thereafter said strip is automatically wrapped about said pack of material, the apparatus and device and process being continuously operative, with all steps of the process and operation being executed in timed sequence, whereby the operator need only place the stack of material to be banded in the wrapping assembly, thereafter being able to extract therefrom a fully banded packet in a very short time interval.

This invention relates to banding mechanisms and methods and refers more particularly to mechanism and methods for rotating a pack of articles or materials to be banded about an axis thereof, with one end of a strip of heat sealable strip banding material applied thereto, thereby to wrap the strip of banding material about such pack.

The invention provides an improved and simplified device for banding packs of materials capable of being rotated about an axis thereof. It also provides for the banding of packs of materials by gripping an end of a heat sealable strip of banding material between the pack to be wrapped and a support surface having a high coefficient of friction therebetween, thereby to rotatively drive the pack and supporting surface and to cause the strip of banding material to be wrapped thereabout.

The instant invention relates to a machine for successively forming orderly bundles containing a plurality of elongate articles to be wrapped together, including means for wrapping the bundles with a wrapping strip. This is accomplished by an improved wrapping means which includes means for holding the articles and means for rotating the holding means to cause the articles to be rotated (instead of holding the articles still and rotating the wrapping mechanism around them).

The invention relates to high speed banding of checks, currency envelopes, and similar flat articles. This involves progressively assembling a stack of the flat articles, as fast as produced or delivered, in successive packs of varied number or size, and wrapping about each stack or pack a narrow band, whose overlap ends much be pressed and held together for adhesive or heat sealing contact.

This invention further relates to a process of banding stacks of flat sheet-like objects positioned one on top of the other, such as labels, card boards, flat folding boxes, sheets of paper, newspapers, letters, etc.

Hitherto stacks of labels, etc. have usually been banded manually by means of a paper strip, the ends of which were glued together one on top of the other. Many other branches of industry also require this work of banding several or numerous flat, sheet-like, stacked up objects such as typing paper, newspapers, sheets of cardboard, letters, etc.

This invention is also concerned with process and mechanism for training flexible material, such as a strip of banding material about packages and the like. In the process, a free end of banding material is gripped at the package, thereafter, the banding material being drawn onto the package from a supply by means whereby the banding strip is circulated orbitally and unidirectionally in a binding plane about the package.

A purpose of the instant invention is to provide methods of and apparatus for banding packages within a considerable range of sizes.

This invention additionally relates to improved banding machines for envelopes and like articles. Such machines, once actuated, may automatically apply and secure a wrapping band of plastic or paper tape or similar material around a stack of envelopes or similar articles to produce a bundle containing a number of such articles which can be handled thereafter as a unit. Many prior machines for this purpose are relatively slow in operation, undependable in action and require the constant attention of an operator in order to perform reliably.

The term "envelope" is intended to include all articles of like flat character such as cards, folders, mailing pieces, etc. which are adapted to be banded in the manner here discussed.

My device is adapted in a first instance to handle repeatedly stacks of material which are uniform in height or which have a counted number of articles therein. However, it also can repeatedly handle both undersized and oversize packages with or without counting of the elements therein.

My device also accommodates a wide variety of size and types of materials to be banded in the banding machine without making major alterations to the necessary mechanisms (variations in lateral width, length, or thickness of the stack).

Another object of the invention is to provide a compact machine which occupies a relatively small floor space and which may be moved from one location to another to serve different banding needs or other materials processing or classifying equipment.

An object of the invention is to provide methods and apparatus whereby the article pack banding operation may be quickly and easily effected in an automatic manner (once the device is initially activated by the operator) which substantially reduces, if not completely eliminates, the need for skilled manual labor and which utilizes inexpensive material for the banding operation so the cost of packaging and banding is not unduly increased.

The banded package produced by the instant method and apparatus is such that the individual members or items of the pack are so firmly united with each other that they in effect constitute a single unit. Thus, if the package is engaged, lifted or carried by grasping one of the members of the pack at any portion thereof, its mates will follow along undisturbed, without essentially changing their relative positions.

The invention provides a fully automatic (once activated) and foolproof banding operation which can be completely integrated with the normal operations (such as classifying and feeding) involving the materials to be banded.

One feature is a method of combining numbers of just-opposed or just-stocked articles into a unitary package by wrapping around a group or stack of said articles a narrow, flexible band comprising (1) laying a leading portion of a continuous strip or band across a support for said stack of articles, (2) engaging said stack of articles with said band portion, (3) paying out an additional length of said strip to wrap the median portion of said group around side surfaces and edges thereof, (4) moving the trailing portion of said ribbon to overlapping face to face engagement with said leading portion to join said portions and (5) severing said strip after joinder.

The inventive apparatus may be broadly described as a

machine for wrapping stacks of articles with tape, said machine including a supporting structure and wrapping means, said wrapping means comprising a first lower flat jaw member rotatably attached to said supporting structure, a second set of upper flat jaw members also rotatably attached to said supporting structure, said jaw members movable toward and away from one another whereby to form a stack compressing assembly with the stack of articles to be wrapped carried between said jaw members, means for laying the free end from a supply of tape on the lower one of said jaw members, means for rotating said upper and lower jaw members and a stack of material seized therebetween, whereby to cause said pack to be rotated thereby to wrap tape from said supply around said pack, and means for moving said jaws toward and away from one another.

According to the present invention, a banding machine includes a stack reception and support zone, means to draw a length of banding tape from a supply and to position it across said reception and support zone preparatory to the reception of a stack thereon, a gripper device adapted to grip the stack and the leading free end of the tape, said gripper rotatably moveable to draw more of said tape around the remaining sides of the stack in the zone, whereby the stack is encircled by a loop of tape, means to secure the free end of the tape to the portion thereof leading from said loop back to the supply, and means to sever the secured loop from said portion.

An apparatus for bundling elongate flat articles including means for transferring a tie band from a source of supply thereof to the position where a plurality or stack of articles is gripped in preparation to banding or tying.

The invention provides a mechanism for wrapping the heat sealable tape about a rotating stack of articles, the tape being applied to the stack by devices which are composed of a relatively few moving parts.

The machine has an article support where a number of articles are accumulated in bundle form. Once positioned on the bundle forming station, the articles are compressed into a compact stack or bundle, this operation involving a pair of spaced gripping jaws engaging opposite sides of the stack. The bundle is then rotated about its axis, while a tape applying assembly spaced along the axis of the rotating bundle applies heat sealable tape to the bundle, thereby securing the articles into the bundle.

Presently known check processing devices produce bundles of checks in a steady stream of bundles. Mechanisms which are associated with the output of such devices must, therefore, be capable of accepting and working with a constant feed of bundles of checks at high speeds.

Accordingly, it is an object of the present invention to provide a device for applying a band around the varying sized groups or packs of checks at high speed.

Another object of the invention is to provide a check banding device in which the banding tape is under complete control at all times and which uses a heat sealable tape during the banding operation.

Another object of the invention is to provide a banding tape control structure whereby the tape is carried through the machine in a precise manner during the entire banding operation and during the preparation therefor and the aftermath thereof.

Uniform accurate banding can be accomplished at high speed.

The machine lends itself to acceptance to a wide variety and size of feed materials and packs of feed materials.

An object of the invention is to provide methods of and apparatus for packaging articles such as paper money in predetermined or variable sums. Usually, such packages comprise bills of the needed amounts totally a required figure, these bills being stacked and wrapped with a band on which the total is marked. It has been customary in the past to do this packaging on an individual basis, with operators who count out the individual basis, with operators who count out the individual bills,

place them in a stack and slip the stack into a preformed band. This process has been found to be inefficient and time consuming, and is especially unsatisfactory during rush hours, when institutions such as banks must hand out large amounts of money in a small space of time. The conventional hand packaging process is also unsatisfactory in that it is subject in great extent to human error, since there is no simple mechanical procedure which must be followed in packaging the bills.

Another object of the present invention is to overcome the disadvantages of previous methods of packaging paper money and to provide an improved device whereby this packaging may be done with extreme rapidity and with a minimum chance of error.

Another object is to provide a banding machine which reduces the actions required by the operator to a minimum, providing a simple mechanical procedure for each operator which is the same, no matter what the value and number of the bills on the package may be.

Another object of the invention is to provide an improved banding machine which is versatile in operation which can be used to make packages of widely different number and denominations of bills.

Another object of the invention is to provide an improved banding machine and process in which the bills, checks, etc. will be held firmly by the surrounding band after the package is formed.

A typical wrapping machine or banding machine of the kind to which this invention relates comprises (1) a support for an article to be wrapped, (2) a banding mechanism which acts first to secure the free end of a supply of tape with respect to the article or stack of articles to be banded (3) thereafter, the mechanism acts to draw tape from the supply thereof and apply it to the article. In order to make the tape binder thus apply to the article or stack as securely as possible, the wrapping operation is continued ordinarily until an overlap of the tape has been formed. A heat seal is effected. The tape is then severed. The newly formed free end of the tape supply is then fixed or placed in a position where it may be automatically attached to or affixed with relation to another article or stack of articles to be wrapped by a succeeding wrapping operation.

In this kind of a banding machine, it is convenient and desirable to guide the tape being applied or to be applied to the article or stack of articles by passing it over supporting surfaces which, in addition to serving to guide the tape with respect to the stack, additionally dispose the tape conveniently for serving and for subsequent attachment to another stack of articles to be banded.

Another object of the invention is to provide methods of and apparatus for banding stacks of materials, said method and apparatus capable of performing the desired banding operation in that it incorporates elements and components which continuously engage and support the banding strip, film or wrap during the banding operation.

This invention thus relates, in general, to methods of and apparatus for banding stacks of material with a pliable material supplied in a continuous, elongated web. It further relates methods of and apparatus for banding stacks of material capable of utilizing a pliable wrapping strip of the type characterized as resilient, heat sealable film.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals are employed to indicate like parts in the various views:

FIG. 1 is a side view of a banding device constructed in accordance with a preferred embodiment of the invention and shown with parts thereof broken away to more clearly illustrate the details of construction;

FIG. 2 is a plan view of the device as shown in FIG. 1;

FIG. 3 is a front view of the device of FIG. 1 (taken from left to right from the left side of the view of FIG. 1);

FIG. 4 is a rear view of the device of FIG. 1 (taken from right to left from the right side of the view of FIG. 1);

FIG. 5 is a sectional view along line 5—5 of FIG. 2 in the direction of the arrows; and

FIG. 6 is a side view taken along line 6—6 of FIG. 3 in the direction of the arrows.

The band wrapping assembly includes a cradle or material pack holding and retaining means (particularly cradle plates **63** and **64**) rotatably mounted with respect to the basic frame on a pair of vertical support members **10** and **11**. The band wrapping assembly is operatively driven in a rotatable manner about a transverse axis by a chain drive system (chains **87** and **88**).

The combined pack and band holding assembly includes a pair of spaced, opposed retainers generally designated (lower) **16** and (upper) **18** interconnected by a driving assembly. The latter effects relative up and down movement (simultaneously) between said retainers **16** and **18** whereby to engage opposed surfaces of the material pack in a clamping engagement. The pack is clamped in a desired relative position to a longitudinally extending length of banding material **25**, one end portion of the banding material disposed adjacent the lower one of the clamped surfaces of the pack between the lower retainer (plate **19**) and the pack and transverse to the axis of rotation of the holding assembly.

The lower retainer **16** is comprised of a base plate **19** for receiving the strip of banding material thereon and also the material pack to be banded, the latter in overlying relationship to said band. Base plate **19** includes a pair of opposed plate portions **19***a* and **19***b* connected along their rearward edge portion by central strip **19***c*. Thus, said portions **19***a* and **19***b* and said central strip **19***c* have edge portions defining a centrally located notch **20** (FIG. 2).

The upper retainer **18** is comprised of a pair of horizontally opposed, pressure plate assemblies **21** and **22**, each adapted for clamping engagement with the upper surface of the material pack to be banded, whereby to retain said pack between the base plate **19** and the pressure plate assemblies **21** and **22**. The pressure plate assemblies **21** and **22** are each movable transversely of the longitudinal axis of the banding assembly horizontally toward one another to a central position before clamping engagement with the material pack and are movable in a reverse manner outwardly from the central position upon completion of the banding operation.

The pressure plate assemblies **21** and **22** are each comprised of a frame **23** or **24**, a pressure plate **21** or **22**, and a pressure cylinder **25** or **26**.

When the pressure plates **21** and **22** are in central position, their end portions are each disposed in overlying opposed relationship to the central strip **19***c* of the base plate **19** whereby the pressure plate end portions **21** and **22** and said central strip **19***c* are employed for clamping the strip of banding material between said central strip **19***c* and the pack of material, thereby holding said strip of banding material in a desired relative position adjacent one of the side surfaces of the pack of material.

It should be noted that, upon the band wrapping operation, the strip is wrapped over the opposed end portions **21** and **22** of the pressure plates, rather than in contacting relationship with the upper surface of the pack of material. The pressure plates **21** and **22** are then disengaged from between the wrapped strip and the pack of material by providing pressure to the pistons **25** and **26** to drive the plates **23** and **24** outwardly away from one another, thus sliding the end portions **21** and **22** from beneath the strip. The pressure plates **21** and **22** then return inwardly over the strip retaining compression on the pack. The base plate **19** and the pressure plates **21** and **22** are then vertically displaced from one another and

return means such as springs employed to return the plates **21** and **22** to their central position.

In operation, the apparatus initially has a longitudinal strip **25** of banding material disposed transversely to the axis of the rotation of the holding assembly and in overlying contacting relationship to the central strip **19***c* of base plate **19** and extending rearwardly therefrom. A pack of material, such as currency, checks or similar articles are then laid in overlying contacting relationship to the opposed portions **19***a* and **19***b* of the base plate **19**.

During the wrapping operation of the band about the pack, the band is wrapped over and around the central end portions **21** and **22** of the pressure plates such that the pressure plate portions **21** and **22** are disposed between the strip and the pack of material. Upon completion of the rotary movement of the holding apparatus the pressure plates **21** and **22** are driven from their central position between the longitudinal strip and the pack of material. The pressure plate assemblies are then separated, together with the base plate, from clamping engagement with the banded stack of material. The stack, now fully banded, is lying on base plate **19** and may be removed manually or may be ejected by the forward driving action as a new longitudinal portion of banding strip is delivered for disposition on base plate **19**.

Referring to the various figures of the drawings, there is seen a cabinet top or base plate **50**. Mounting brackets **10** and **11** are vertically mounted on base plate **51** which is secured to plate **50** by bolts **52**. Bolts **52** also secure shaft brackets **53** and **54** under plate **50** which rotatably mount and receive shaft **55** therebetween. Upper mounting brackets **56** and **57** are mounted in vertically adjustable fashion on members **10** and **11** by bolts **58** and **59**. Fixed onto platform seat **56***a* and **57***a* by bolts such as **60** (through platform **57***a*) are means **61** and **62** to mount the check pack handling and wrapping assembly.

Cradle plates **63** and **64** have forward extension members **65** and **66**. Base plate **19** is mounted on vertically extending slides of rack and gear systems in extensions **65** and **66** by members **67** and **68** and by bolts **69** and **70**. Pressure cylinders **25** and **26** are connected to plates **65** and **66** by tubular extensions **71** and **72** and bolts **73** and **74**. Check engaging plates or arms are mounted on extensible piston members in cylinders **25** and **26**. Tubular supporting members **71** and **72** are each operatively connected to one of the rack members (not seen) of a double rack and gear drive system. Bottom plate **19**, via bolts **69** and **70**, is mounted or operatively connected to the other rack member of the double rack and gear system. The double rack and gear system is operatively connected to the driving piston arms **75** and **76** of vertical pneumatic cylinders **77** and **78**. Return springs (not seen) are operatively connected to said driving pistons.

A flow of air to cylinders **77** and **78** effects downward movements of the piston arms **75** and **76**, causing the double rack and gear system to be actuated, thereby pulling base plate **19** and arms **21** and **22** into clamping relationship with longitudinal band and material pack placed on plate **19**. The air pressure systems of cylinders **77** and **78** are operatively connected through a pressure relief valve (not seen) whereby only a predetermined pressure is applied to the material pack and band with said valve activating a switch for cutting off the flow of pressure through cylinders **77** and **78**. As pressure medium is supplied to cylinders **77** and **78**, same is also supplied through a conduit operatively connected to the cylinders **25** and **26** for driving the arms **21** and **22** to their central position.

The check stack holding assembly, as seen in FIGS. 2, 3 and 4, has a pair of rotatably mounted spindles **79** and **80** received in bearings **81** and **82** at its connections to the frame members **56** and **57**. Each of said spindles **79** and **80** has pressure medium flow conduits defined therein (not seen) for effecting the flow of the pressure medium such as air through them and into cylinders **77** and **78**. Bearings or mounting portions **81** and **82** encircling said spindles **79** and **80** have flow connections **83** and **84** to effectively supply the fluid pressure through the ducts in spindles **79** and **80** to cylinders **77** and **78**.

Each of the spindles **79** and **80** has a sprocket wheel **85** or **86** operatively connected thereto for driving engagement with chains **87** or **88**. Chains **87** and **88** are operatively engaged with a pair of opposed sprockets **89** and **90** mounted at the ends of shaft **55**.

It is thus seen that cradle plates **63** and **64** carry a base plate **19** and upper arms **21** and **22**. Arms **21** and **22** may be moved inwardly and outwardly relative to one another by virtue of pneumatic cylinders **25** and **26**. Upper arms **21** and **22** and lower plate **19** may be moved toward and away from one another (vertically in the view of FIG. 3) by means of the double rack and gear system described. The latter is driven by pneumatic cylinders **77** and **78** which connect by arms **91** and **92** to the other ends of piston rods **75** and **76** and blocks **93** and **94**. The latter each connected to one of the vertical members of the rack and gear system on each of plates **65** and **66**. Vertical movement of the arms **75** and **76** move the check stack engaging upper and lower means toward and away from one another, this pneumatic pressure being supplied through conduits such as **83** thereafter passing through like conduits (not seen) in spindles **79** and **80**. The means for rotating the cradle plates **63** and **64** carrying the check engaging means is provided by the chains **87** and **88** engaging the upper and lower sprockets on the spindles **79** and **80**.

Fixed atop secondary base plate **51** is a mounting plate **95**, secured by bolts **96** (FIG. 3). Plate **95** carries an upwardly extending pneumatic cylinder **97**. On the upwardly extending piston arm **98** cylinder **97** is mounted a horizontal plate **99**. Mounted on plate **99** is a heat sealing means (heating element) **100** the rearward portion of said plate **99** bearing vertically extending tension bar **101**. As may best be seen in FIG. 2, the heat sealing means **100**, when the cradle plates **63** and **64** are vertical, may pass upwardly through the gap **20** in lower plate **19** in front of plate portion **19***c*. Tension bar **101**, on the other hand, passes upwardly behind plate portion **19***c*.

Referring particularly to FIGS. 1, 2 and 4, at **103** is seen the base plate for mounting bracket **104**. The latter receives another vertically sliding plate **105** therein which is vertically adjustable with respect thereto via bolts **106**. Fixed to plate **105** is a horizontal shelf **107**. To the right in the view of FIG. 1 is a second base plate **108** fixed to plate **50** by bolts **109**. Plate **108** supports a vertical side plate **110** having a slot **111** therein. Side plate **110** is duplicated on the other side of base plate **110** with a parallel vertical side plate **112**. A front vertical plate **113** makes a three sided housing positioned on base plate **108**, the housing being open rearwardly.

Another base plate **114** is secured to plate **50** by bolts **115**, supporting a rearwardly extending but vertical plate or mounting bracket **116**. A reel or roll **117** of heat sealable film, tape or banding material is removably mounted on a central core **118** fixed to the bracket **116**, same removably fixed thereon by bolt **119**. The forward extension **120** of the heat sealable film then passes under a dancing roller or roll **121**, same carried by a shaft **122** received in the slots of the plates **110** and **112** as seen at **111**. Film **120** then passes upwardly over a roller **123** which cooperates with brake shoe **124** powered by pneumatic cylinder **125** having piston **126** carrying shoe **124**. Bracket **127** mounts the back brake with respect to plates **110** and **112**.

Elongate horizontal track members **128** and **129** are fixed at their rearward end to plate **113** and at their forward ends by bolts to shelf **107** (see FIG. 5). An elongate feed rack shaft or bar **131** is received for sliding to and fro movement in a horizontal direction by said tracks **128** and **129** by means of elongate flanges **131***a* and **131***b* along the sides thereof. Mounted above shaft **131** and

connected thereto for to and fro motion therewith is a mating block **132**. Fixed to the forward top portion of block **132** is a pair of elongate angles **133***a* and *b* forming with their upper faces a tapeway. The means fixing block **132** to feed rack shaft **132** is bolt or screw **134**. Mounted on top of elongate angles **122***a* and *b* and extending rearwardly thereof is an elongate tape or film receiving channel **135**. This is held down on bar **133** by screws **136**. Frame **137** is fixed by screws **138** to the outer side of the track **128**. Rigidly mounted to frame **137** and extending vertically downwardly therefrom is plate **139** to which is mounted (extending rearwardly therefrom in a horizontal direction) pneumatic cylinder **140**. Piston rod **141** of cylinder **140** is fixed into a block **142** which is rigidly fixed to the underside of shaft or bar **131**. Also fixed to frame **137** is a block **143**, mounted thereto by screws **144**. Block **143** carries on its rearward side an adjustable forward stop **146**.

Passage of compressed air to cylinder **140** extrudes rod **141** which drives block **142** and shaft **131** forwardly (to the left in FIG. 1). Mounted on shaft **141** is block **132** which carries forward therewith elongate bar **133**, those members forwardly attached thereto to be described and the tape strip **135**. Return of the piston rod **141** into the cylinder **140** brings back these members to the position seen in FIG. 1.

A pair of vertically extending side plates **147** and **148** (fixed by screws **147***a* and **148***a* to tracks **147** and **148**) are capped by a horizontal connecting top wall **149**. Wall **149** carries a hydraulic or pneumatic cylinder **150** driving shaft **151**. Shaft **151** has shoe **152** at the lower end thereof with tape engaging pads **153** and **154** on the underside thereof adapted to overlie and engage film or tape **120** between them and the upper horizontal portions of channels **133** and **133***a*.

Mounted on the front end of angles **133***a* and *b* by screws **160** is elongate flat plate **16** having vertical guides **162** and **163** at the sides thereof. Rearwardly of guide plates **162** and **163** is positioned a frame generally designated **164** which carries vertical pneumatic cylinder **165**. Brake shoe **166** is driven by the extrudable and retractable piston rod of pneumatic cylinder **165**. The end of member **161** is downwardly turned as at **167** to carry three members. Two of these (best seen in FIG. 2) are bolts **168** and **169** adapted to knock the banded packet of checks off the lower plate **19**, the other, **170**, being an air outlet to blow the end of the tape into the desired position with respect to the tension bar **101** and lower plate portion **19***c*.

Immediately in front of roller **123** which cooperates with brake shoe **124** of the back brake is positioned a film hold-down means. A pin **171** is seen in FIG. 1 riding along the outside of track **128**. This pin extends through lower block **172**, lower film carrier plate **173** and as a guide through upper clamping member **174**. A vertical pneumatic cylinder **175** has the extendable and retractable piston rod **176** thereof fixed to shoe **174**, whereby to move same toward or away from member **173** to clamp film or tape **120** therebetween. Block member **177** is mounted above and rigidly attached to shaft **131** at the upper surface of the latter, whereby the entire film hold-down assembly moves to the left and to the right in the view of FIG. 1 as shaft **131** is driven to the left and to the right by pneumatic cylinder **140**.

Particularly referring to FIGS. 2 and 4, behind cradle plate **64** and mounted thereon is a knife cut-off device. This (see FIG. 4) includes horizontal plate **180** fixed to the rear face of cradle plate **64**, same having vertical plate **181** fixed to one end thereof. Plate **181** carries in rigid mount pneumatic cylinder **182**. Same drives piston shaft **183** which carries a framework consisting of vertical plate **184**, horizontal bar **185** mounted thereon and a knife or razor edge blade **186** depending downwardly therefrom. Pressure furnished to cylinder **182** in FIG. 4 moves shaft **183** to the right in the view, moving blade **186** across the gap between plates **63** and **64** to sever the tape, when same is lifted upwardly by tension bar **101**.

THE PROCESS OF BANDING CHECKS OR OTHER MATERIALS

(1) The description starts with the ejection of a wrapped bundle of checks from the open jaws of the cradle (the wrapped bundle is resting on the lower most jaw or bottom plate **19**).

(2) The operator then places a new bundle of unwrapped checks in the cradle (straddling the lower plate), the apparatus having its jaws open in the configuration of FIG. 3, with the cradle rear walls themselves perpendicular (cradle plates **63** and **64**).

(3) The operator, in a preferred control system (not shown), simultaneously pushes two buttons (which insures that the operator's hands are free of the cradle).

(4) The sets of check stack engaging means, comprising the two separate upper arms **21** and **22**, and the one lower plate **19**, move simultaneously toward one another, driven through a rack and gear system by the pair of air cylinders **77** and **78**, one on each side of the cradle plates **64** and **63**. (This simultaneous movement of both check engaging members saves piston length.)

(5) The motion of the upper arms **21** and **22** and lower plate **19** toward one another stop when the p.s.i. pressure input (typically 90 p.s.i.) to the cylinders **77** and **78** is equalled by the back pressure from the engaging members on the check stack.

(6) The two cradle plates **63** and **64**, carrying both the upper arm **21** and **22** systems and the lower plate **19**, start rotation around spindles **79** and **80**, with the bottom of the cradle plates moving toward the observer in the view of FIG. 3.

(7) At substantially 95° rotation of the cradle plates **63** and **64**, the back brake **124** goes on, whereby to apply tension to the heat sensitive film **120** being pulled from the roll **117**, same thereby thereafter permitted to slip through back brake **124** only under tension.

(8) The cradle plates **63** and **64** continue to rotate and finish 360° of rotation.

(9) The heat sealing means **100**, driven by its piston **97**, rises to the bottom of the wrapped checks, through the cut out portion **20** of the bottom plate **19** and effects a seal, tape to tape or film to film.

(10) After the heat sealing action, the heat seal **100** means drops, more slowly than the knife cut-off acts.

(11) Simultaneously with the heat seal means drop, the knife cut-off **186** (best seen in FIG. 4), driven by its piston **182**, extends laterally and cuts off the tape or film **25**.

(9*a*) Simultaneous with the rise of the heat seal **100** (step 9), the tension bar **101** rises under the same power as the heat seal means **100** thereby pulling the film or tape **25** to the maximum tension. The tension bar also holds the film high enough to be cut with the blade **186** of the knife cut-off.

(12) As the knife cut-off **186** retracts to the position of FIG. 4, the top pressure arms or engaging members **21** and **22** on the cradle plates retract laterally. This pulls them out from under the film or tape **25**. The top pressure members **21** and **22** immediately are returned inwardly back over the film, still holding the check stack in tight engagement.

(13) At this time, the front brake **166** and the rear film hold-down **174** go on. Thereafter, the feed rack shaft **131** then starts forwardly (toward the cradles **63** and **64**), powered by its drive piston **140** through the feed rack drive connection **142**. The film hold-down and the front brake **152** is stationary because it is not mounted on the feed rack shaft **131** (rather the guides **128** and **129**).

(14) After a quarter inch of travel of the feed rack shaft or bar **131**, and all means carried thereby, the back brake **124** goes off. The velocity of the feed mechanism of the film **120** from the tape roll **117** is such that

the dancing roll **121** is most preferred or required in order to eliminate take-up shock on the roll of film.

(15) The front end **167** of the feed rack operates to eject the bound stack of checks and moves forwardly over the heat seal means **100**.

(16) It should be noted that the extension of the film out from the front end of the feed rack is less than an inch after the action of the knife cut-off **186**.

(17) The feed rack bar **131** stops in its forward position. The front brake **166** and rear film hold-down **174** both release. The center stationary brake **152** goes on simultaneously therewith. (The film **120** was always fed over the center brake feed channels **133***a* and *b* and now the brake pads **153** and **144** grip the film thereagainst.)

(18) The feed rack **131** returns to the position of FIG. 1.

(19) As the feed rack retracts, exhaust air from the feed rack drive air cylinder is emitted through an orifice **170** in front of the feed rack push bar **167**. The purpose of this is to insure that the film will lie straight over the bottom plate **19** on the cradle plate **63** and **64** faces.

(20) The center stationary brake **152** (which is a fail-safe to insure that the film extends outwardly 100% of the time) remains on while the feed rack **131** is back in the position of FIG. 1. It is not put into off position until the feed rack **131** starts forwardly again.

(21) A new stack of checks are laid over the film and onto the bottom pressure plate or engaging means **19**.

(22) The operator again pushes both buttons to start the activation cycle.

(23) Once the cycle has started, there is effectively no tension on the film pull exerted by the center brake **152**.

Broadly speaking, the process may be described as follows:

(1) A band or strip **120** of banding material is advanced so that a lead portion of it is laid on the lower gripping means **19**.

(2) Checks are then laid on this lead portion of the band or strip and the lower gripping means in a stack.

(3) The check stack and the band portion are gripped by the upper (**21** and **22**) and lower (**19**) gripping means with the band received only partly in the grip.

(4) The cradle plates **63** and **64** are then spun so that the rest of the band length desired is pulled around the checks and over the upper gripping means **21** and **22** (here two laterally retractable arms).

(5) A sealing means **100** (here shown as a heat seal effected on a heat sealable film) effects a strip to strip or band to band seal.

(6) The upper gripping means **21** and **22** are laterally retracted from under the band **120** and then back over the band.

(7) In the instance shown, where a heat sealable film is utilized and a heat sealing device **100**, there is a knife **186** or other cut-off means and step to sever the continuous feed band from the band heat-sealed around the checks.

(8) The ejection operation takes place.

There is thus a stationary supply of banding film or strip material and a track for supplying same. There is further provided a moving feed means which reciprocates to and fro, whereby to move the banding tape, strip or the like so that the lead portion of it is placed on the lower gripping means so that the check stack can be laid thereon. The forward motion of the band feed carrier knocks out the banded bunch of checks. The front end of the band is moved out with the carrier, the carrier is then retracted, leaving the band on the lower gripping means. Once the checks are laid on the band and lower gripping means, the lower and upper gripping means forcefully grip therebetween the lead part of the band and the check stack or bundle. This gripped stack or group of checks is then rotated 360° while the remainder of the band is wrapped around the bundle or stack. The lateral retraction of the divided upper engaging members frees the band and the upper engaging members from the band, preparing for the vertical retraction of the gripping members from one another whereby to release the bundle of checks.

Tests for integrity of the band include dropping the banded checks to the floor or throwing them against a wall without breakage of the band. A tension test as to proper banding of a stack or group of checks would be to grasp any one of the bills, edge or center and shake the banded stack whereby to see if any of the bills pull out or the group disintegrates.

Base plate **19** (forward of portion **19***c*) permits the heat seal housing to come through (above the level of the base plate **19**) and touch the checks or rather the heat-sealable tape against the checks in its overlapped position. The heat seal is made at a position where the base plate portion **19***c* is not struck by the heat seal housing. The length of stroke of the heat seal is dependant on the height (thickness) of the stack of checks to be banded. That is, since the upper pressure plates **21** and **22** and the lower base plate **19** move toward one another on the double rack and gear system, the vertical movement of plate **19** depends on the height of the stack as well as the vertical movement of the upper members. A stop is provided on the under side of plate portion **19***c* to limit the travel of the heat seal.

The bottom plate is arcuate downwardly in side view, that is, the panel of the bottom plate which constitutes the portion **19***c* and the equivalent width on either side thereof is angled downward centrally of plate **19***c*, while an equivalent width on the outside of plate **19**, in the portions **19***a* and **19***b*, is angled upwardly. Since the checks are embossed centrally, they tend to be slightly spindle-form in side view. The arcuate nature of bottom plate **19** thus permits a firm grip on the stack of checks, without all the force concentrated at the center. Further, the rearward panel including portion **19***c* (to the left in the view of FIG. 2 and to the right in the view of FIG. 1) of the base plate is coated with a silicone rubber. The reason for this is that, when the upper and lower plates come together, the tape, overlying the portion **19***c*, tries to escape. The silicone rubber coating prevents such.

An additional reason for the double plate motion (both the upper and lower plates moving toward one another on the rack and gear system) is that it tends to make the spin of the gripped checks a circular orbit, rather than an elliptic orbit.

The back brake is provided for tension purposes only. There is preferably provided about a 90° arc grasp against its roller **123**. The two traveling brakes (the front brake and the tape hold down) are used to unwind the tape from the roll. The 90–95° travel of the cradles or cradle plates in rotation before the back tension brake goes on is to prevent the tape from pulling out from under the bundle.

There is preferably provided a front idler roller on the front of the feed rack in front of the front brake.

The ejection operation also brings forth a new tape length and deposits same on the base plate **19***c* portion. The feed rack then goes to the stand-by position shown on all the drawings.

The film is preferably a Mylar film coated with a heat sealing compound. Such a film has a memory in that, once it is stretched, it tends to return. This is an aid to tightness on a group of banded checks.

Adjustment of the back brake adjusts the tightness of the banded checks. The back brake stays on through the cutoff operation.

The tension bar **101** is of considerable significance, with respect to different heights or thicknesses of check bundles and the like. Thus, the angle of the tape to different heights of bundles will differ. The tension bar severely tensions the tape and tends to reduce this angle to a common denominator.

The heat control on the heat sealing means **100** is of considerable significance and must be adjusted for the particular tape being used. A typical heat would be 290° F. for a given tape.

The cradles remain closed on the bundle of checks until the heat seal retracts.

Once the cutoff means has translated and cut the tail of tape from the banded checks, the tail is left hanging on the banded bunch of checks. It does not interfere with stacking of the checks, nor with handling them. Then, when it is desired to break open the bundle again, one may grasp the tail back of the heat seal and pull the bundles open.

When the carriage is retracted, the center brake is on for the purpose of keeping the tape from coming back carried by static electricity.

In rotation of the cradle plates to band the checks, the lower ends thereof move to the left (clockwise) in FIG. 1 and toward the observer in FIG. 3.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the process and apparatus.

Having thus described my invention, I claim:

1. A process of banding packs of stacked materials, comprising,

laying a portion of a continuous strip of heat-sealable banding material drawn from a source thereof onto a base plate,

laying a stack of the materials to be banded on said base plate over said portion of the strip,

gripping the other side of the stack with a pair of pressure plates thereby to compress the stack against the base plate and portion,

wrapping an additional portion of said strip of banding material around the gripped assembly of base plate, band material portion, stack and pressure plates while drawing said additional portion from said source,

adhering one portion of the band to another in heat-sealing fashion whereby to effect a complete continuous circular band therearound including a portion of each of said plates,

applying tension to said strip adjacent to said banded stack,

severing said strip while same is under tension adjacent said banded stack,

and retracting said plates from under said band and releasing pressure on said banded stack whereby to free the banded stack for removal from said base plate.

2. A process of banding packs of stacked materials, comprising:

laying a length of a continuous strip of heat-sealable banding material drawn from a source thereof on a base plate,

laying a pack of stacked materials to be banded on said base plate over a portion of said length,

gripping the other side of the pack from said base plate and length with a pair of pressure plates whereby to compress the pack against the base plate and length,

rotating the gripped assembly of base plate, length, pack and pressure plates whereby to wrap the length and an additional portion of the strip of banding material drawn from said source around the pack and pressure plates,

adhering one portion of the strip to another in heat-sealing fashion whereby to effect a continuous circular band around the pack and portions of the pressure plates,

applying tension to said strip adjacent to said banded pack,

severing said strip while same is under tension adjacent said banded pack,

and thereafter withdrawing the pressure plates from under said band and releasing pressure therefrom on the pack whereby to permit removal of the banded pack from the base plate.

3. A process as in claim **2** including drawing a second length of said strip from said source and laying it on said base plate,

and retaining said second length on said base plate whereby to receive the next pack of materials thereover.

4. A process as in claim **1** including drawing a second portion of said continuous strip from said source thereof and laying it on said base plate,

and retaining said second portion on said plate whereby to receive thereover the next stack.

5. An apparatus for use in banding packs of materials, comprising:

a supporting frame,

a source of heat-sealable banding material in continuous strip form,

means rotatably mounted on said frame for holding one of said packs of materials to be banded and a length of a continuous elongate strip of heat-sealable (to itself) banding material,

said strip length held by said holding means in a position abutting one of the surfaces of said pack,

means operatively connected to said holding means for rotating said holding means about an axis generally transverse to said strip whereby to rotate said pack held by said holding means and wrap more of the strip around said pack, drawing same from said source,

means on said frame for heat-sealing one portion of said strip to another after same is wrapped around said pack,

means for tensioning a portion of said strip adjacent said pack after heat-sealing,

means for severing the heat-sealed band from the rest of the strip and said source adjacent said pack while the strip is under tension,

and means for drawing another one of said lengths from said source and laying it on said base plate.

6. An apparatus as in claim **5** including means for applying tension to said strip as it is drawn from said source as said pack is rotated.

7. An apparatus for feeding banding material in continuous strip form to a material stack band-wrapping assembly and banding said stack comprising:

a source of heat-sealable (to itself) banding material in continuous strip form,

a supporting frame,

means operatively associated with said frame for supplying lengths of banding material in continuous strip form from said source,

said last means including a mobile carriage assembly on said frame for gripping, carrying and guiding banding material in continuous strip form from said source to said band-wrapping assembly in a discontinuous manner,

means on said frame and connected to said carriage assembly for driving said carriage assembly to and from said band-wrapping assembly,

means for retaining a length of said strip at said band-wrapping assembly after the carriage assembly takes it there,

means at said band-wrapping assembly for wrapping said length and more of the strip of banding material circumferentially about a stack of material and operatively associated with said carriage assembly for receiving said limited length of said continuous strip,

said band wrapping means including a second supporting frame,

means rotatably mounted on said second frame for holding said pack and said length of said strip, said

length held by said holding means abutting one of the surfaces of said pack,

means operatively connected to said holding means for rotating said holding means about an axis generally transverse to said length and strip to rotate said stack and wrap more of the strip around the pack drawing same from said source,

means on one of said frames for heat-sealing one portion of said strip to another after same is wrapped around said pack,

means for tensioning a portion of said strip adjacent said pack after heat-sealing,

and means for severing the heat-sealed band from the rest of the strip and said source adjacent said pack while the strip is under tension.

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