June 28, 1966 F. L. VATH ETAL 3,258,261

STRIP HANDLING

Filed April 13, 1964 3 Sheets-Sheet 1

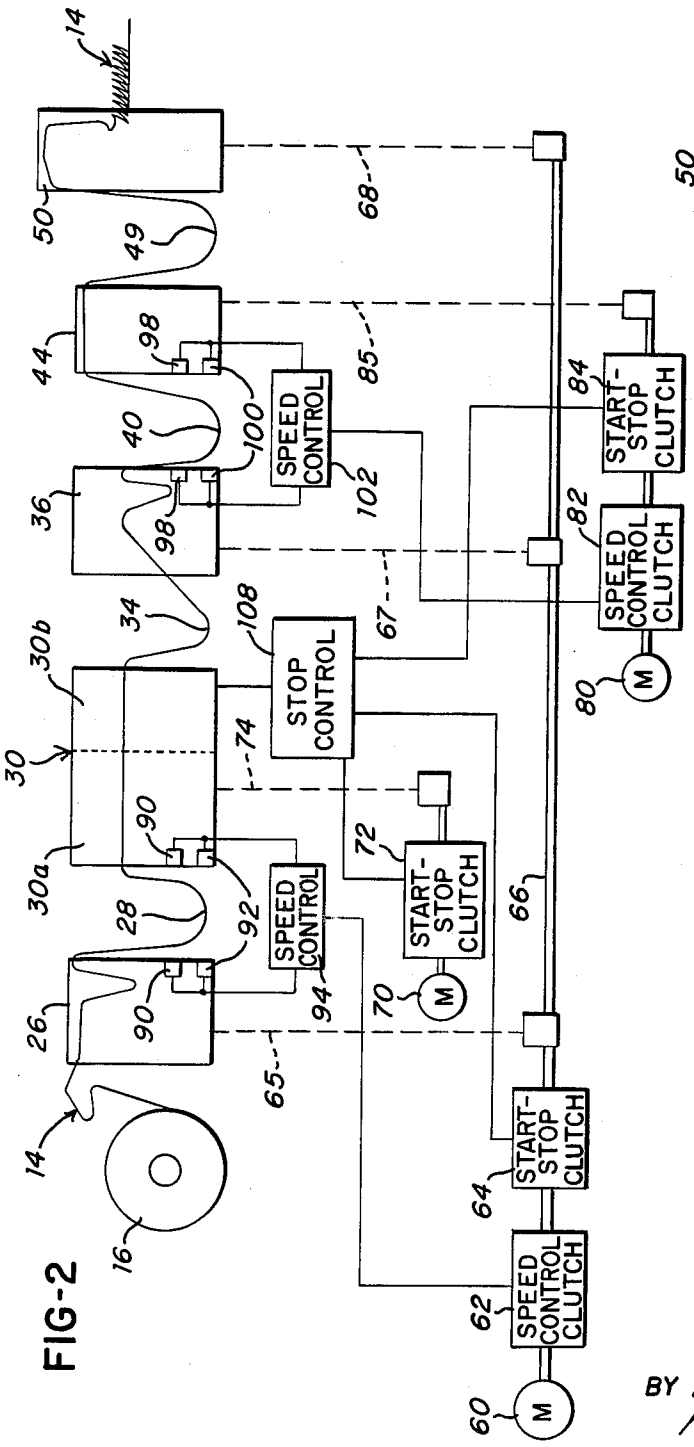


FIG-2

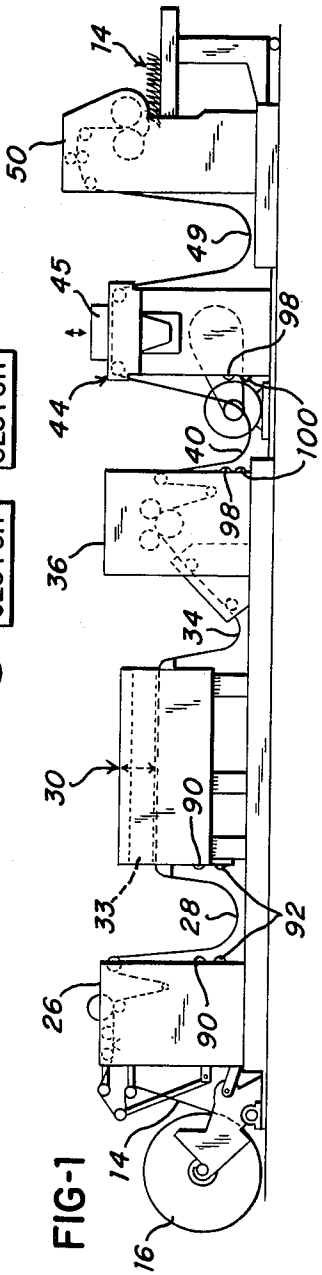


FIG-1

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STRIP HANDLING

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FIG-3

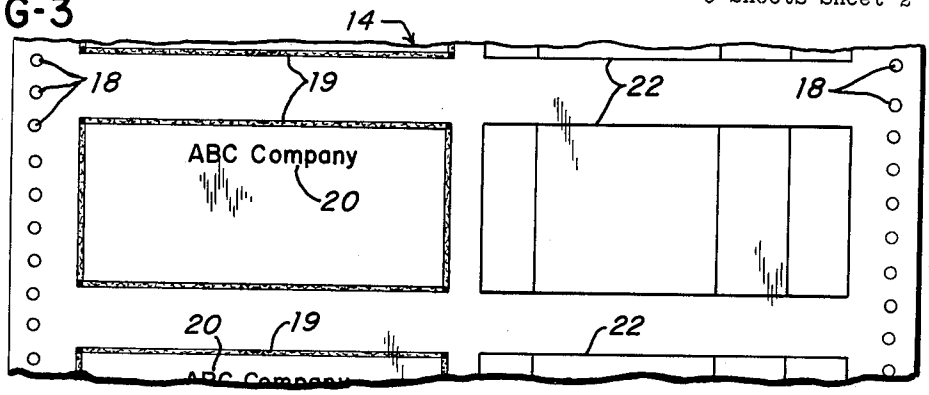


FIG-4

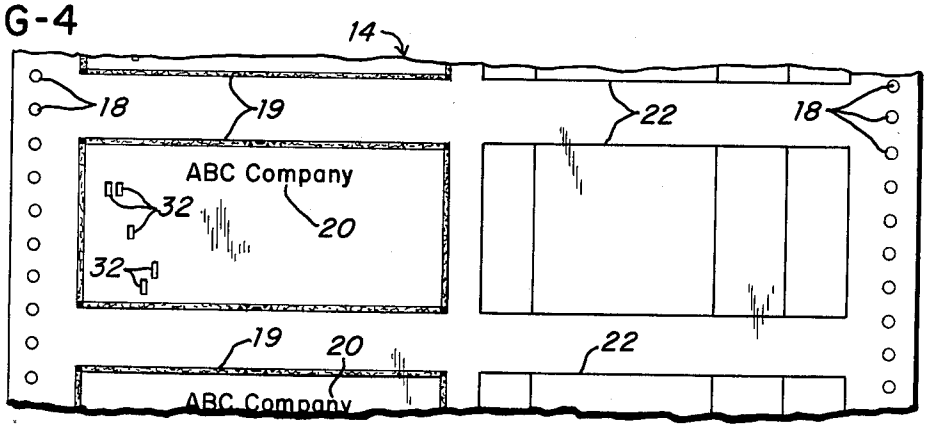
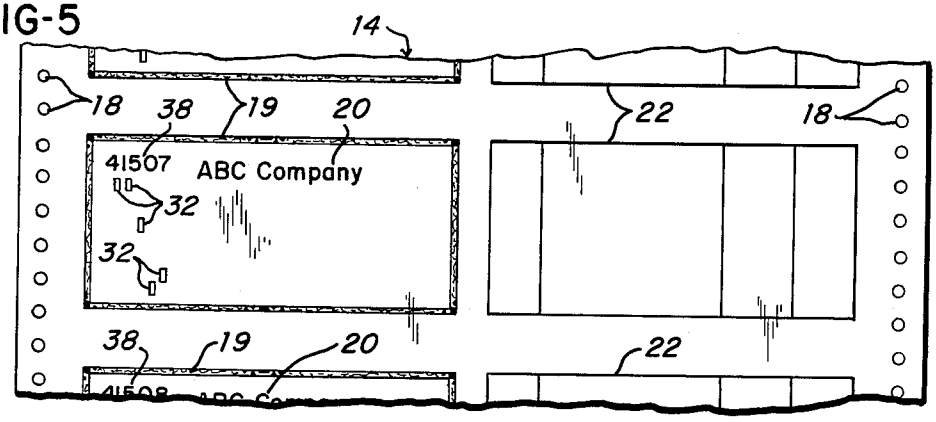


FIG-5



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STRIP HANDLING

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FIG-6

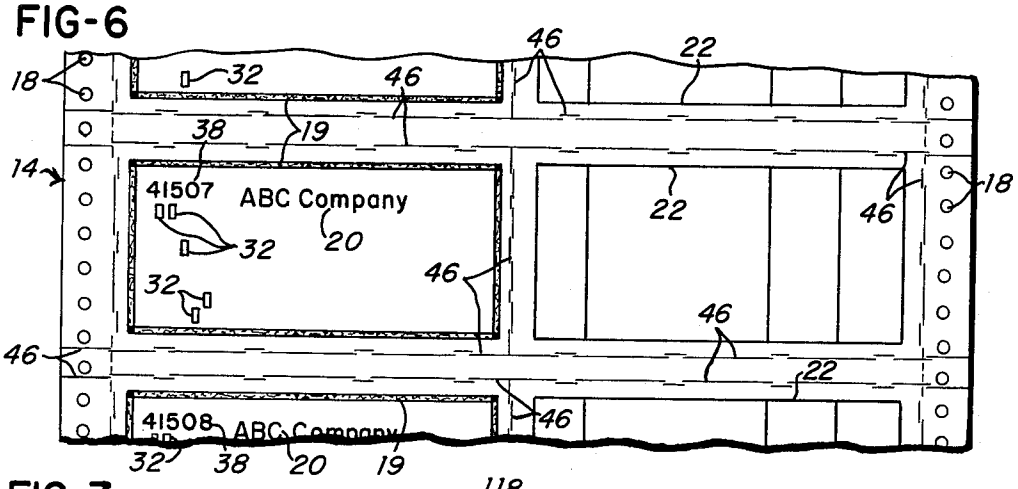
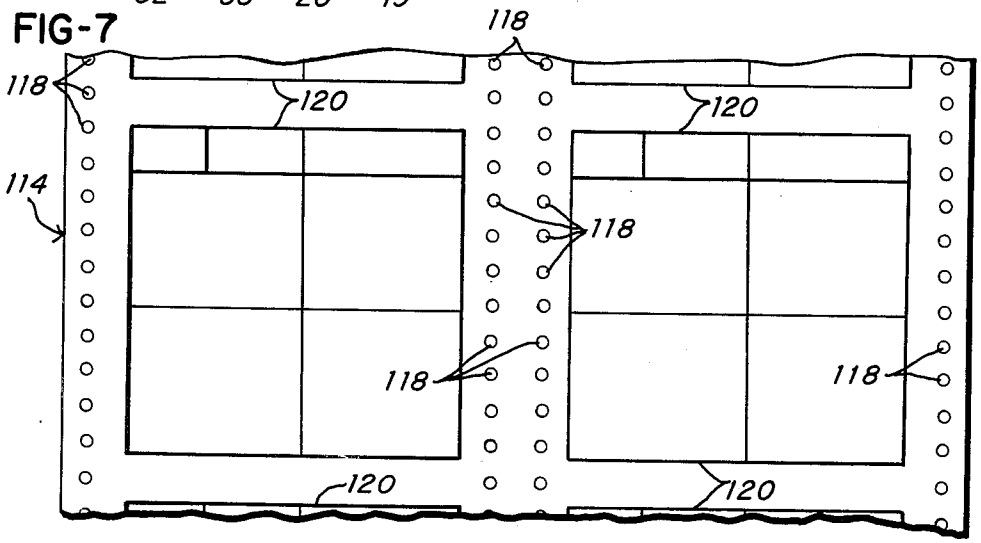


FIG-7



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United States Patent Office 3,258,261 Patented June 28, 1966

3,258,261

STRIP HANDLING

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Filed Apr. 13, 1964, Ser. No. 359,125
8 Claims. (Cl. 270—21)

This invention relates to strip handling.

The invention relates more particularly to apparatus and a method of handling strip material in the preparation of business forms and the like.

This invention pertains to production of business forms which are provided with printed information and which are also provided with coded information in the form of holes punched through the form in predetermined positions thereof. This invention relates still more particularly to business forms produced from a continuous strip of stock material.

However, apparatus produced according to this invention and the method of this invention may be employed in the processing of strip material of various kinds, other than material for producing business forms.

In the past it has been customary to produce business forms from continuous strip material by using a machine which receives a continuous strip of stock material, prints on the material at predetermined locations, perforates the material at predetermined locations to provide business forms in the strip of stock material which is carried thereby. Then, such a machine folds the strip of stock material which carries the forms therein which are partially cut therefrom. Then it has been customary to take the folded stock material to a second machine which unfolds the strip, and applies numbering or other information to the forms formed in the strip. Such numbering or other information is applied by punching holes through the forms at certain predetermined positions and also by applying such information in the form of printed numbers or letters or other indicia. Some of the information applied to the forms may be applied by conventional ink or by magnetic ink or the like.

It has been found that a machine which performs such functions as partially cutting and folding, as well as printing, must, by necessity, operate more slowly than if the machine should do only printing. Also, if a machine is to perform printing, partial cutting, and folding, the amount of "set-up" time upon the machine is considerably greater than if the machine is to perform printing only. Furthermore, in a printing press type of machine which also performs perforation operations, replacement or proper adjustment of perforating blades is time consuming. Also, in the use of a printing press type of machine for perforation of the stock material as well as printing thereupon, the perforating is done by a blade or blades against a hard cylinder. This results in a crushing effect and causes curved edges of the forms produced. Of course, forms having curved edges are objectionable in that they present numerous problems in machine feeding thereof.

Also, when perforating of stock material is carried out in the same machine which performs printing thereupon, the paper dust produced in the perforating operation may cause trouble in the printing operation. Also, in the assembly of a machine which is to perform both printing and perforating operations, the necessary tolerances among the parts of the machine, such as gearing and the like, must be very small and are difficult and costly to obtain and maintain.

An object of this invention is to provide apparatus and a method for high speed production of business forms in a continuous strip of stock material.

Another object of this invention is to provide apparatus which performs unwinding of a rolled strip of stock material, applies information to the material in the form of properly positioned holes, prints information such as numbers or other indicia upon the material either by use of conventional types of inks and/or magnetic types of inks, perforates the material to create forms or the like in the material, the forms being partially severed from the stock material by the perforating operation.

Another object of this invention is to provide such apparatus which operates at a much higher rate of speed than any known apparatus which performs the same functions or operations.

Another object of this invention is to provide continuous strip handling apparatus having a plurality of units arranged in seriatim relationship in which some of the units operate upon the strip when the strip is stopped and in which some of the units operate upon the strip when the strip is in motion and in which all of the units operate together and perform sequential operations upon the strip.

Another object of this invention is to provide apparatus which produces partially severed forms in a continuous strip by use of a plurality of units operated in sequence in the production of each form.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawings:

FIGURE 1 is a diagrammatic view of apparatus of this invention.

FIGURE 2 is another diagrammatic view of apparatus of this invention, illustrating the control means thereof.

FIGURE 3 is a fragmentary plan view illustrating an example of strip material as it enters the first and second units of the apparatus of this invention.

FIGURE 4 is a fragmentary plan view showing the strip material of FIGURE 3 as it enters the third unit of the apparatus of this invention.

FIGURE 5 is a fragmentary plan view showing the strip material of FIGURES 3 and 4 as it enters the fourth unit of the apparatus of this invention.

FIGURE 6 is a fragmentary plan view showing the strip material of FIGURES 3, 4, and 5 as it enters the fifth unit of the apparatus of this invention.

FIGURE 7 is a fragmentary plan view showing another example of strip material as its enters the first and second units of the apparatus of this invention.

Referring to the drawings in detail, apparatus of this invention comprises a plurality of units shown in FIGURES 1 and 2, which sequentially perform operations upon a strip or web of material **14** as the strip **14** moves from a roll **16** thereof.

The strip material **14** may be card stock material or any other material used in producing business forms. Prior to being wound into the roll **16**, the strip material **14** is provided with pin feed holes **18**, which may appear, for example, in the manner shown in FIGURE 3. FIGURE 3 shows pin feed holes **18** in the two opposite edges of the strip **14**.

Also, prior to being wound into the roll **16**, the strip **14** may be printed thereupon. For example, if checks or the like are to be formed from the strip **14**, a decorative border or outline or frame **19** of a blank check may be printed on the strip **14** along with any other information or wording **20**, as illustrated in FIGURE 3, in the left hand portion thereof. Also, as shown in FIGURE 3, the right hand portion of the strip **14** may have a stub blank **22** printed thereon to receive information pertaining to a check prepared within the border **19** adjacent thereto.

Thus, FIGURE 3 shows an example of the appearance of the strip **14** of material as it moves from the roll **16** thereof.

Thus, the strip **14** moves from the roll **16** thereof and into an unwind unit **26**. The unwind unit **26** draws the strip **14** from the roll **16** thereof and operates upon the strip **14** in a manner to remove the tendency of the strip **14** to curl. The unwind unit **26** continuously moves the strip **14** therethrough during operation of the apparatus.

The strip **14** passes from the unwind unit **26** and forms a loop **28**. Then the strip **14** passes into a punch unit **30**. The punch unit **30** has a punching portion **30***a*, shown in FIGURE 2, within which holes or apertures **32** are formed in the strip **14** within the outline **19**, as shown in FIGURE 4. These holes **32** are so positioned and arranged that they provide certain information. For example, the punched holes **32** may provide a number for a check or provide other information.

The punch unit **30** also includes a verification portion **30***b*, shown in FIGURE 2. The verification portion **30***b* "reads" the information provided by the punched holes **32** and determines whether the information has been correctly applied by the punching portion **30***a*. The verification portion **30***b* may consist of any suitable "reader" or "checking" device.

The punch unit **30** draws a given length of the strip **14** thereinto. Then that portion of the strip **14** within the punch unit **30** is stopped. Then as that portion of the strip **14** is stopped, a linearly movable head element **33**, shown diagrammatically in FIGURE 1, moves downwardly toward the strip **14** and a punching element (not shown) carried by the head **33** punches holes **32** in the portion of the strip **14** which is within the punch portion **30***a*.

At the same instant of time that a punching operation occurs upon a portion of the strip **14** within the punching portion **30***a* of the punch unit **30**, the verification portion **30***b* "reads" the holes **32** which are in a portion of the strip **14** which is within the verification portion **30***b*. Of course, the holes **32** within the verification portion **30***b* at any given time are holes **32** which were punched into the strip **14** by the punch portion **30***a* immediately prior to movement of that portion of the strip **14** into the verification portion **30***b*.

Thus, the strip **14** moves through the punch unit **30** in a series of short movements which are separated by short intervals during which the strip **14** is at rest.

Then, the strip **14** passes from the punch unit **30** and forms a loop **34** between the punch unit **30** and a printer unit **36**. The strip **14** then passes into the printer unit **36**. Within the printer unit **36**, numbering or other information referred to by reference numeral **38** shown in FIGURE 5 is applied by a printing operation within each check blank outline **19**. The printed information **38** ordinarily may confirm or agree with the information applied to the strip **14** in the form of the punched holes **32**. The printer unit **36** may apply printed information to the strip **14** by use of magnetic inks or the like, and/or by conventional inks.

It is to be understood that all of the printing upon the strip **14** may occur within the printer unit **36**. In such event, there is no printing upon the strip **14** when it enters the apparatus of this invention.

The strip **14** moves continuously through the printer unit **36** and printing upon the strip **14** occurs while the strip **14** is in motion.

The strip **14** then passes from the printer unit **36** and forms a loop **40** between the printer unit **36** and a perforation unit **44**. The perforation unit **44** may be of any suitable mechanism and may be mechanism made according to the invention disclosed in application Serial No. 340,176, filed January 27, 1964, and owned by the assignees of this application.

The strip **14** moves through the perforation unit **44** in a series of short movements separated by very short intervals of no movement of the web **14**. During the periods in which the web **14** is stopped within the perforation unit **44**, the web **14** is operated upon by a linearly reciprocally movable head **45**, shown in FIGURE 1. The head **45** carries perforation elements (not shown) which perforate the strip **14** both transversely and longitudinally, as illustrated by perforations **46** in FIGURE 6. It is to be understood that the perforations **46** may be of any suitable shape or form. Thus, perforations **46** encompass both the check blank outline **19** and the stub **22** so that both the check blank within the outline **19** and the stub **22** are readily severable from the strip **14** but are carried by the strip **14**.

Then the strip **14** passes from the perforation unit **44** and forms a loop **49** between the perforation unit **44** and a folder unit **50**. The strip **14** moves continuously through the folder unit **50** without stopping during operation of the strip handling apparatus of this invention. The folder unit **50** may be any suitable type of folder device and may comprise the folder apparatus disclosed in application Serial No. 323,962, filed November 15, 1963, and owned by the assignee of this application. The continuous strip **14** issues from the folder unit **50** in a folded condition, as illustrated diagrammatically in FIGURES 1 and 2.

As stated above, the unwind unit **26**, the printer unit **36**, and the folder unit **50** move the strip **14** continuously and without stopping the strip **14** during operation of the apparatus. However, the strip **14** moves through the punch unit **30** and through the perforation unit **44** in a series of short movements which are separated by short periods of no movement of the strip **14**. The strip **14** is thus operated upon in the punch unit **30** and in the perforation unit **44** when there is no movement of the strip **14** and the strip **14** is operated upon in the other units while the strip **14** is in movement.

Thus, it is understood that strip handling apparatus of this invention includes a series of units which operate together upon the continuous strip **14** as the strip **14** moves from each unit to the next succeeding unit.

Motor means

As illustrated in FIGURE 2, a main drive motor **60** has attached thereto any suitable speed control clutch **62**, which may, for example, be an eddy current clutch or the like. An electric motor and eddy current speed control clutch produced as a unit by Eaton Mfg. Company as Model ACM has been found to serve very satisfactorily as the motor **60** and speed control clutch **62**. Connected to the speed control clutch **62** is any suitable start-stop clutch **64**, which may, for example, be a fluid operated clutch or the like. An electrically operated friction clutch brake sold by Eaton Mfg. Company and referred to as "Dynator" has been found to serve satisfactorily as the start-stop clutch **64**.

Connected to the start-stop clutch **64** is a line shaft **66**. Any suitable connector means, illustrated by reference numeral **65**, which may be a belt, or chain, or gears, or the like, joins the line shaft **66** to the unwind unit **26**. Similar connector means **67** join the line shaft **66** to the printer unit **36**, and similar connector means **68** join the line shaft **66** to the folder unit **50**. Thus, these units **26**, **36**, and **50** are operated by the line shaft **66**, as illustrated in FIGURE 2.

A drive motor **70** is used to operate the punch unit **30**. The drive motor **70** is connected to the punch unit **30** through a start-stop clutch **72** and suitable connector means **74**. The start-stop clutch **72** is preferably similar to the start-stop clutch **64**, discussed above.

A drive motor **80** drives the perforation unit **44** through a speed control clutch **82**, and a start-stop clutch **84**, and suitable connector means **85**. The motor **80** and the clutches **82** and **84** may be similar to the motor **60** and the clutches **62** and **64**, respectively, discussed above.

It is to be understood that within the purview of this invention either of the speed control clutches **62** or **82**

may be combined with its respective start-stop clutch **64** or **84**. Also, within the purview of this invention various types of drive means, clutch means, and connector means may be employed.

Speed control

It is to be understood that as the punch unit **30** alternately moves and stops the strip **14**, the average rate of movement of the strip **14** through the punch unit **30** should be substantially equal to the rate of continuous movement of the strip **14** through the unwind unit **26**. During operation of the strip handling apparatus of this invention as shown in FIGURES 1 and 2, all of the units are operated at a given normal rate but may be operated at rates other than normal.

As stated above, the strip **14** forms a loop **28** between the unwind unit **26** and the punch unit **30**. A plurality of photocell members **90** and **92** are used to sense changes in the length of the loop **28** so that the length of the loop **28** is maintained between a predetermined minimum length and a predetermined maximum length. Of course, the length of the loop **28** is dependent upon the rate of operation of the unwind unit **26** with respect to the rate of operation of the punch unit **30**. The photocells **90** and **92** are electrically connected to a speed control unit **94** which, in turn, is joined to the speed control clutch **62**. The speed control unit **94** may comprise suitable electrical relays and/or electronic valve means which are joined to a source of electrical energy (not shown) and which are also joined to the speed control clutch **62** and which control the amount of electrical current flowing to the speed control clutch **62**, which, preferably, as stated above, may be an eddy current clutch which transmits rotational energy in accordance with the amount of electric current flow therein.

The photocells **90** provide a signal to the speed control unit **94** if the loop **28** becomes less than a desired predetermined length. When the speed control unit **94** receives such a signal from the photocells **90**, the speed control unit **94** causes the speed control clutch **62** to operate the line shaft **66** at a higher rate of speed. Thus, the unwind unit **26** is operated at a higher rate of speed. Thus, the unwind unit **26** operates at a higher rate with respect to the rate of operation of the punch unit **30** so that the relative rates of operation tend to lengthen the loop **28** between the unwind unit **26** and the punch unit **30**.

If the length of the loop **28** between the unwind unit **26** and the punch unit **30** becomes greater than a given desired length, the photocells **92** sense the condition and provide a signal to the speed control unit **94**. When this occurs, the speed control unit **94** causes the speed control clutch **62** to decrease the rate of operation of the line shaft **66**. Therefore, the rate of operation of the unwind unit **26** with respect to the punch unit **30** changes to tend to shorten the loop **28** between the unwind unit **26** and the punch unit **30**.

Changes in the length of the loop **40** between the printer unit **36** and the perforation unit **44** are sensed by photocells **98** and **100**. Of course, the length of the loop **40** is determined by the rate of operation of the printer unit **36** with respect to the perforation unit **44**. When the length of the loop **40** is less than a desired predetermined value, this condition is sensed by the photocells **98**, which provide a signal to the speed control unit **102**. This signal causes the speed control clutch **82** to decrease the rate of operation of the perforation unit **44**.

When the length of the loop **40** is greater than a given desired length, this condition is sensed by the photocells **100**, which provide a signal to the speed control unit **102**. The speed control unit **102** is, preferably, similar to the speed control unit **94**, discussed above. This signal causes the speed control clutch **82** to increase the rate of operation of the perforation unit **44**. Thus, the photocells **98** and **100** through the speed control unit **102** govern the rate of oepration of the perforation unit **44** with respect to the printer unit **36**.

Thus, it is understood that all of the units **26**, **30**, **36**, **44**, and **50** operate together sequentially upon the continuous strip **14** to produce partially severed business forms carried in the strip **14** of business form material. Even though some of the units of the apparatus of this invention operate upon portions of the continuous strip **14** while portions of the strip **14** are at rest and some of the units of this apparatus operate upon portions of the strip **14** while those portions are in continuous motion, the units are so coordinated and controlled that they all operate together at a high rate of speed and perform successive operations upon the strip **14**.

Stop control

The verification portion **30***b* of the punch unit **30** has connected thereto a stop control unit **108**. The stop control unit **103** is connected to the start-stop clutch **64**, and to the start-stop clutch **72** and to the start-stop clutch **84**. The stop control unit **108**, preferably, comprises electrical relays and/or contactors and/or electronic valve means which normally maintain closed electric circuits between a source of electrical energy and the start-stop clutches **64**, **72**, and **84**. However, upon proper signal from the verification portion **30***b* of the punch unit **30** the stop control unit **108** opens the electrical circuits to the start-stop clutches **64**, **72**, and **84**. If, the verification portion **30***b* of the punch unit **30** finds that any of the punched holes **32** punched by the portion **30***a* is not entirely correct, the stop control unit **108** receives a stop signal from the verification portion **30***b* of the punch unit **30**. When such a signal occurs, the stop control unit **108** causes the start-stop clutches **64**, **72**, and **84** to immediately stop the entire apparatus. Thus, the strip handling apparatus of this invention is operated only when the punching operation in the punch unit **30** is correct.

FIGURE 7 illustrates another example of a continuous strip or web **114** as it appears as it is removed from a roll, such as the roll **16**. The strip **114** is provided with strip feed holes **118** which, are disposed at the edges of the strip **114** and some of the strip feed holes **118** are disposed at the central portion of the strip **114**.

Business forms such as the forms **120** are printed on either side of the central holes **118**. The strip or web **114** may be severed longitudinally at the center thereof during operation thereupon by the apparatus shown in FIGURES 1 and 2. Preferably, the web **114** is longitudinally severed at the center thereof in the folder unit **50**. Prior to reaching the folder unit **50**, the strip **114** is operated upon by the units **26**, **30**, **36**, and **44**, in the manner discussed above with respect to the strip **14**.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

The invention having thus been described, the following is claimed:

1. Strip handling apparatus comprising:

first operator means for operating intermittently upon a strip,

first drive means to drive said first operator means at a substantially constant rate,

second operator means for operating intermittently upon the strip,

second drive means to drive the second operator means at a variable rate and including speed control means,

third and forth operator means for operating continuously upon the strip, said third operator means preceding said first operator means, said forth operator means following said first operator means,

third drive means for continuously driving said third and fourth operator means at a variable rate and including speed control means,

means responsive to variations in the rate of the third drive means with respect to the rate of the first drive means for controlling the third drive means to maintain said variations within predetermined limits,

means responsive to variations in the rate of the second drive means with respect to the rate of the third drive means for controlling the second drive means to maintain the variations within predetermined limits.

2. The apparatus of claim 1 in which the first operator means comprises punching mechanism.

3. The apparatus of claim 1 in which the third operator means comprises unwind mechanism and the fourth operator means comprises printing mechanism.

4. The apparatus of claim 1 in which the second operator means comprises perforating mechanism.

5. Strip handling apparatus comprising:

punch means,

first drive means to drive the punch means at a substantially constant rate,

perforation means,

second drive means to drive the perforation means at a variable rate and including speed control means,

unwind means and printing means and folding means,

the unwind means preceding the punch means, the printing means following the punch means and preceding the perforation means, the folding means following the perforation means,

third drive means to continuously drive the unwind means and the printing means and the folding means at the same rate and including speed control means for adjusting said rate,

means responsive to variations in the rate of the third drive means with respect to the rate of the first drive means for controlling the third drive means to maintain said variations within predetermined limits,

means responsive to variations in the rate of the second drive means with respect to the rate of the third drive means for controlling the second drive means to maintain the variations within predetermined limits.

6. Strip handling apparatus comprising:

first operator means for operating intermittently upon a strip,

first drive means to drive said first operator means at a substantially constant rate, the first drive means including a start-stop clutch,

second operator means for operating intermittently upon the strip,

second drive means to drive the second operator means at a variable rate and including speed control means, the second drive means also including a start-stop clutch,

third and fourth operator means for operating continuously upon the strip, said third operator means preceding said first operator means, said fourth operator means following said first operator means,

third drive means for driving said third and fourth operator means at a variable rate and including speed control means, the third drive means also including a start-stop clutch,

means responsive to variations in the rate of the first drive means with respect to the rate of the third drive means for controlling the third drive means to maintain said variations within predetermined limits,

means responsive to variations in the rate of the second drive means with respect to the rate of the third drive means for controlling the second drive means to maintain the variations within predetermined limits,

means responsive to operation of the first operator means for simultaneously operating all of the start-stop clutches for stopping all of the operator mean.

7. Strip handling apparatus comprising:

first operator means for operating intermittently upon a strip,

first drive means to drive said first operator means at a substantially constant rate,

second operator means for operating intermittently upon the strip,

second drive means to drive the second operator means at a variable rate and including speed control means,

third and fourth operator means for operating continuously upon the strip, said third operator means preceding said first operator means, said fourth operator means following said first operator means,

third drive means for continuously driving said third and fourth operator means at a variable rate and including speed control means,

means responsive to variations in the rate of the third drive means with respect to the rate of the first drive means for controlling the third drive means to maintain said variations within predetermined limits,

means responsive to variations in the rate of the second drive means with respect to the rate of the third drive means for controlling the second drive means to maintain the variations within predetermined limits,

means responsive to the operation of the first operator means for stopping all of said drive means.

8. Strip handling apparatus comprising:

first operator means for operating intermittently upon a strip,

first drive means to drive said first operator means at a substantially constant rate,

second operator means for operating intermittently upon the strip,

second drive means to drive the second operator means at a varibale rate and including speed control means,

third and fourth operator means for operating continuously upon the strip, said third operator means preceding said first operator means, said fourth operator means following said first operator means,

third drive means for continuously driving said third and fourth operator means at a variable rate and including speed control means,

first control means, the first control means being responsive to variations in the rate of the third drive means with respect to the rate of the first drive means for controlling the third drive means to maintain said variations within predetermined limits, the first control means including means for sensing the length of a loop in the strip between the first operator means and the second operator means,

second control means, the second control means being responsive to variations in the rate of the second drive means with respect to the rate of the the third drive means for controlling the second drive means to maintain the variations within predetermined limits, the second control means including means for sensing the length of a loop in the strip between the fourth operator means and the second operator means.

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