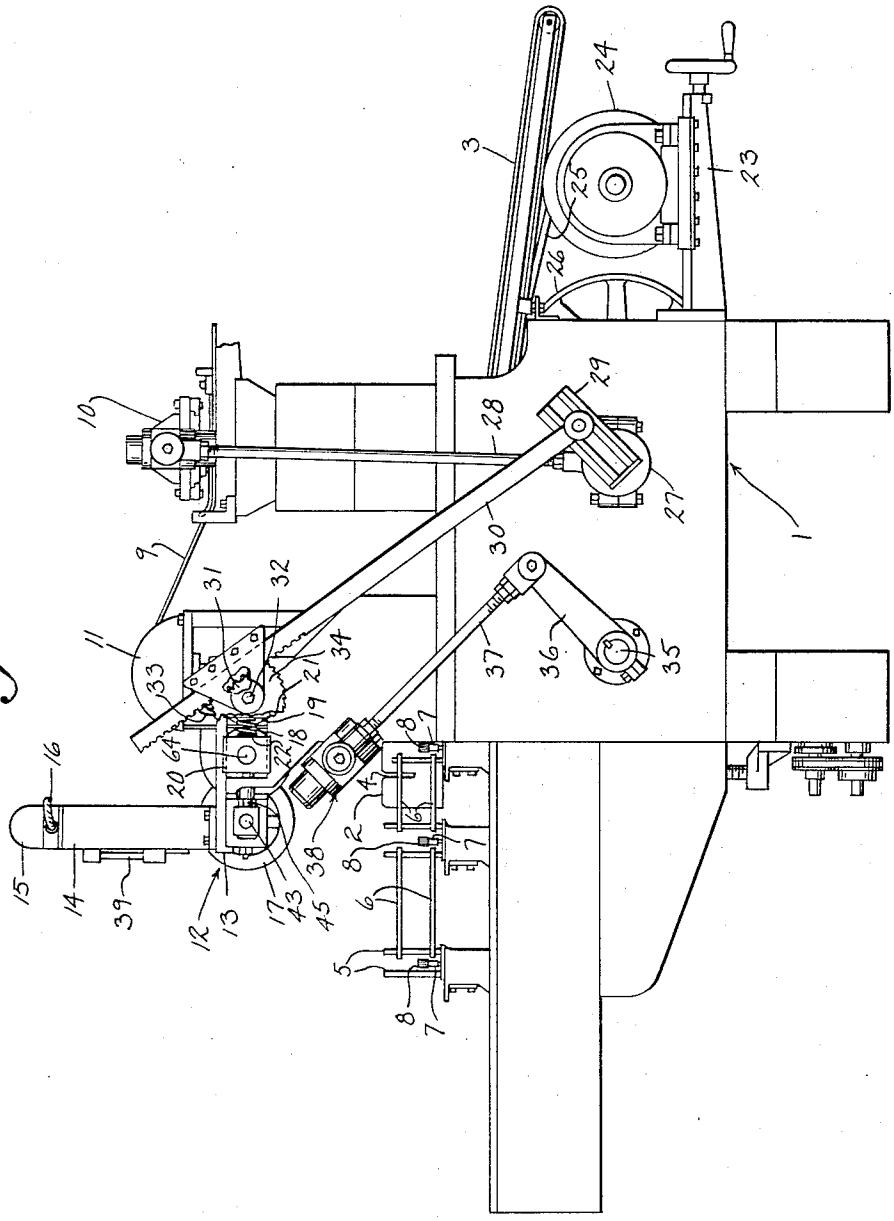
March 26, 1968 J. W. LAWRIE ET AL 3,374,716

JAM-UP PREVENTION APPARATUS FOR A WEB FEEDING MECHANISM

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Fig. 1



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Fig. 2

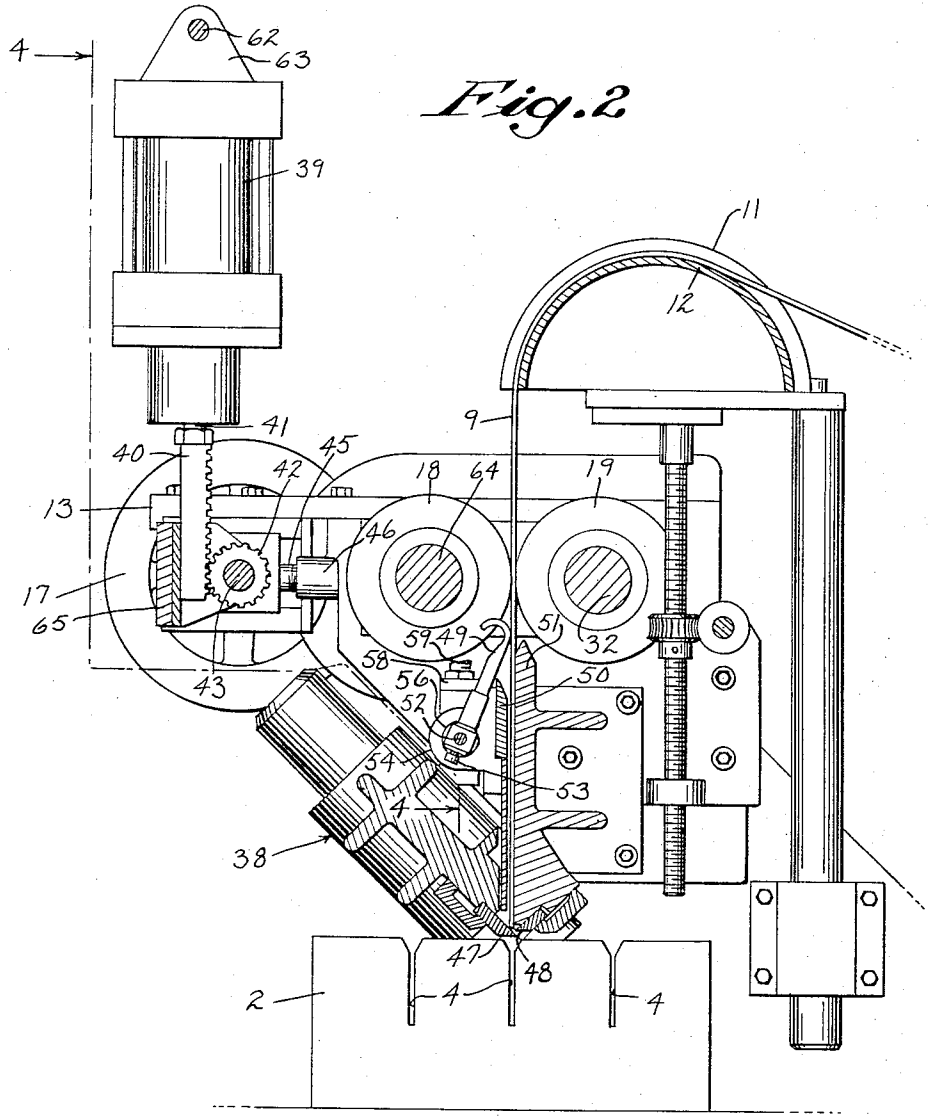
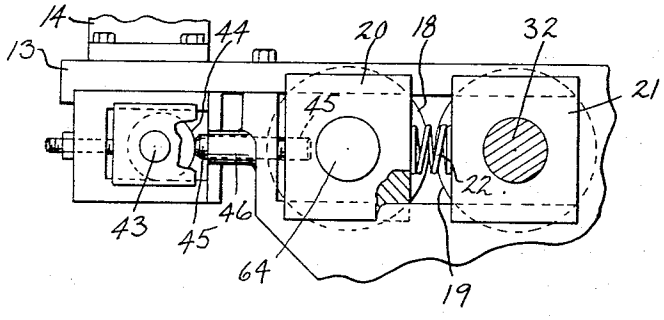


Fig. 3



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Filed Nov. 22, 1965 3 Sheets-Sheet 3

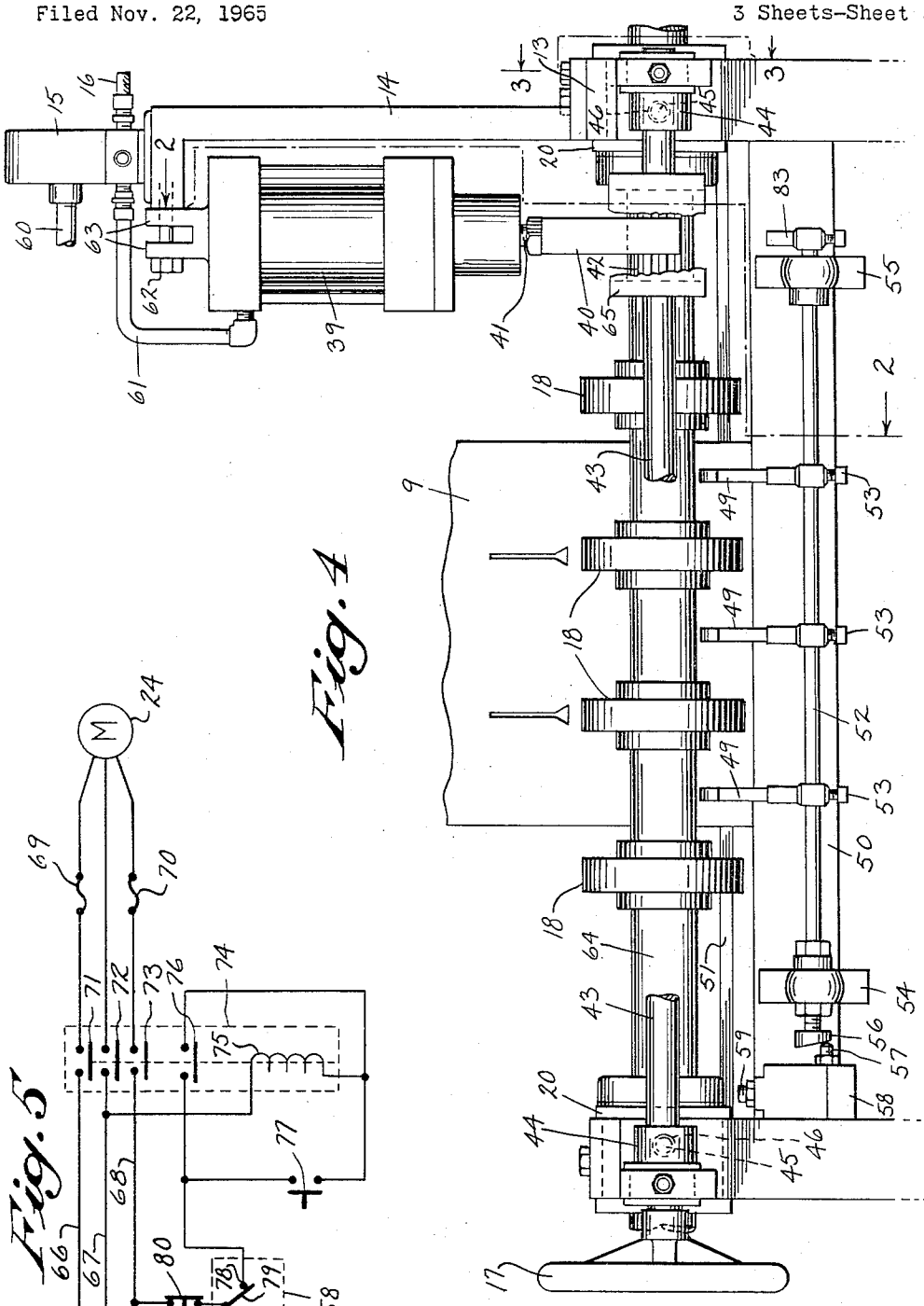


Fig. 4

Fig. 5

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JAM-UP PREVENTION APPARATUS FOR A WEB FEEDING MECHANISM

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5 Claims. (Cl. 93—37)

ABSTRACT OF THE DISCLOSURE

In a partition assembly machine, an idler feed roller is held in engagement with a driven feed roller by a pinion controlled cam. A rack to drive the pinion is fastened to the piston of a pneumatic cylinder. A finger rides on the partition web fed between the feed rollers to be moved by any deflection of the web. The finger is connected to actuate a switch by its movement, and the switch energizes a solenoid that operates an air valve to actuate the pneumatic cylinder to rotate the cam and release the idler feed roller.

The present invention relates to a jam-up prevention apparatus for a web feeding mechanism; and more particularly it resides in the combination of a feed roller mounted to normally engage a web to impel said web, a web buckling detector mounted to engage said web after said web leaves said feed roller and to be displaced by a deflection of said web, and means responsive to the displacement of said web buckling detector to drive said web out of engagement with said feed roller.

The orthogonal network of corrugated paper, cardboard, pressboard and other similar materials, which are commonly used in boxes for packaging jars, bottles and other breakable devices, are automatically made and assembled today on machines capable of producing 100 or more partition assemblies per minute. In these machines, partition strips are preformed in one part of the machine and fed on edge, with precut slots opening upward, to an assembly area, where cross partition strips are inserted in the upward opening slots to complete the partition assembly. The cross partition members are cut from a continuous preslotted web of partition material, immediately after assembly of each individual cross partition member. This is accomplished by feeding the preslotted web, or partition material vertically downward as the preformed partition strips pass horizontally beneath it, and severing the web material at the top of the preformed strips immediately upon assembly in the slots of the preformed partition strips. The preformed partition strips are moved intermittently horizontally beneath the web feeding mechanism, which is synchronized to operate intermittently to drive the web material downward into the slot of the preformed strips each time a slot passes beneath it.

Since there may be as many as six or more preformed partition strips moving parallel to one another to make up the assembly, it is evident that the slightest misalignment of the preformed partition strips, or the arrival of one or more of the preformed partition strips at the assembly area upside down so that its slot opens downward, would cause the rapidly moving web material to jam up, crushing both the web material and the preformed partition strips. Due to the high speed operation of the assembly machines, a serious jam-up is likely to occur in such circumstances before the machine can be stopped, and if that happens, the machine could be out of operation for many minutes while the tightly wadded partition material is removed from the assembly area, before normal operation is restored. Such a delay could reduce production by

hundreds of partitions and seriously upset production schedules.

The present invention solves that problem by instantly stopping the feed of partition material at the very moment when a malfunction, which would ultimately result in a jam-up, begins to occur. To accomplish this result, two things are needed: first, a detector to detect a potential jam-up condition; and second, means for instantaneously stopping the feeding of web material which is being driven at a high speed by heavy machinery. For a detector, the disclosed embodiment of the present invention provides a steel finger one end of which lightly engages the surface of the web material and the other end of which is fastened about a rotatably mounted shaft. The shaft has a plate cam device on it which engages an electrical switch. The plate cam operates the switch when the shaft rotates. Thus the switch will be actuated instantaneously any time the web is laterally deflected in its downward travel.

Since the web is driven by a pair of rollers, through the nip of which it passes, the feed of the web can be instantaneously stopped without having to overcome the inertia of the high speed machinery by drawing the rollers apart to release the web. The disclosed embodiment of the invention accomplishes this by spring biasing the rollers apart, but normally holding them together by means of a radial cam that is mounted on a shaft with a spur gear. The spur gear is engaged by a rack which is mounted on the end of a piston in a high speed pneumatic cylinder. The pneumatic cylinder is connected to an air pressure line through a solenoid valve that is energized when the switch is actuated by the detector finger. Thus, whenever the web is obstructed, its initial deflection displaces the detector, actuating the switch which energizes the solenoid valve so that the pneumatic piston will drive the rack rotating the radial cam shaft, which also rotates the radial cam that was holding the rollers together to release the rollers, which spring apart. As soon as the rollers release the web, the obstruction stops the movement of the web without causing a jam-up. When the switch energizes the solenoid valve, it simultaneously deenergizes the electric motor driving the assembly machine so that the machine can be halted to permit elimination of the obstruction and rapid resumption of normal operation.

Accordingly, the principal objects and advantages of the present invention may be summarized in the form of the list that follows:

To provide means for instantly detecting an obstruction to the normal feed of a web.

To provide means for instantaneously halting the feed of the web of a web feeding mechanism when an obstruction to the feed of the web occurs.

To provide means for instantaneously deenergizing the driving means of a web feeding mechanism when an obstruction to the web is detected.

To provide means in a web feeding mechanism for instantaneously detecting an obstruction to the web, instantaneously halting feed of the web and turning off the drive means for a web feeding mechanism.

To provide an economical and reliable apparatus for preventing jam-ups in a web feeding machine.

The foregoing and other objects and advantages of the present invention will appear from the following description of the embodiment of the invention shown in the accompanying drawings which form a part of this disclosure. This embodiment is described in sufficient detail to enable those skilled in the art to practice this invention, but structural changes may be made in the embodiment described, and other embodiments may be used, in practicing the present invention. Hence the following detailed description is not to be considered definitive of the scope of this

invention, which instead is particularly pointed out and distinctly claimed in claims to be found at the conclusion of this specification.

In the drawings:

FIG. 1 is a side elevation of a partition assembly machine utilizing the present invention,

FIG. 2 is an enlarged side elevation in section along the line 2—2 in FIG. 4 of the present invention as employed on the partition assembly machine shown in FIG. 1,

FIG. 3 is a side view in section taken along the line 3—3 in FIG. 4 showing the mounting of the feed rollers,

FIG. 4 is an end view in elevation of the embodiment of the present invention shown in FIG. 1, and

FIG. 5 is a schematic diagram showing the motor starter and other electrical operating circuitry employed in this embodiment of the present invention.

Referring now specifically to FIG. 1 of the drawings, a partition assembly machine is shown which is essentially a modified version of the partition fabricating machine disclosed in the Patent No. 2,163,923 issued to D. R. Vail et al. Although many improvements have been introduced into the various models of that machine since the patent issued, the patent may still be relied upon to disclose the basic assembly operation. Hence, it may be referred to wherever necessary or desirable as an adjunct to the following disclosure.

The assembly machine is supported on a base **1**. Performed partition strips **2** enter the machine from the front end and the completed partition assemblies (not shown) are carried out the back end of the machine on a conveyor belt **3**. The preformed partition strips **2** are supported on edge, with assembly slots **4** opening upward, by a succession of vertical posts **5** joined by elastic bands **6** wrapped around them. Between each pair of vertical posts **5** joined by elastic bands **6** is a driven spindle **7** which has an enlarged knurled head **8**. The spindles **7** although not completely shown in this drawing, operate in pairs with one on each side of the preformed partition strip **2** so that the knurled heads **8** of the spindles **7** grip the preformed partition strips **2** and drive them forward into the assembly area.

Meanwhile a web **9** of partition material is fed from a roll (not shown), on the back of the machine, beneath a punch head **10**, which forms assembly slots in the web. From the punch head **10**, the web **9** passes over a semi-cylindrical adjustable apron **11** and down toward the assembly area. The web is drawn forwardly over the adjustable apron **11** and driven downwardly into assembly with the preformed partition strips by means of a web feeding mechanism **12**, generally shown in FIG. 1 which will be described in greater detail in connection with the other figures of the drawings. Suffice it here to point out that a bearing block support frame **13** projects forwardly from a point just below the front of the adjustable apron **11**, and on its forward end the bearing block support frame **13** supports a vertically mounted pneumatic cylinder support bracket **14**, with a solenoid valve **15** mounted on top of it, and a segment of an air hose **16** is shown leading from the solenoid valve **15** to a compressor (not shown).

A hand wheel **17** is mounted on the far side of the front of the bearing block support frame **13** to permit manual engagement of the web between an idler roller **18** and a driven feed roller **19**, only segments of which are shown in FIG. 1. An idler shaft **64** has its ends journaled in slidable bearing blocks **20** and it supports the idler roller **18**, which serves to position the web **9** against the feed roller **19**. Stationary bearing blocks **21** have the ends of a driven shaft **32** journaled in them, and the shaft **32** mounts the feed roller **19**. A coil spring **22** is shown between the two bearing blocks **20** and **21** urging the slidable bearing block **20** away from the stationary bearing block **21**. As can be seen in FIG. 4, the idler roller **18** is actually a plurality of wheels mounted on a shaft **64** instead of a single cylinder, and the feed roller **19** is of the same construction although it is not so illustrated in the drawings.

The drive means for this partition assembly machine is shown in sufficient detail for the present purposes. On an adjustable rear platform **23** an electric motor **24** is mounted which drives the entire machine. A drive belt **25** from a pulley (not shown) on the far side of the motor drives a large pulley **26** on the machine. Within the base **1**, the rotational movement of the pulley is geared down and connected to rotate a cam member **27** on the outside of the base **1**, from which a connecting rod **28** extends to the punch head **10**, so that when the cam member **27** rotates the punch head **10** is vertically reciprocated. Rotating concentrically with the cam **27** is a guide block **29** to which an end of a drive rack **30** is adjustably fastened. The other end of the drive rack **30** has teeth meshed with a pinion **31** that is rotatably mounted on a shaft **32** of the feed roller **19**. The pinion **31** is connected by means not shown, to a pawl **33** that engages a ratchet wheel **34**, which, in turn, is fastened to the shaft **32** of the feed roller **19**. Hence, as the drive rack **30** is reciprocated, the pinion **31** is rotated in an oscillatory motion so that the pawl **33** moves the ratchet wheel **34** in intermitten fashion, and by this means stepwise rotation is imparted to the feed roller **19**. Also driven by the electric motor **24** through a transmission means (not shown) is a drive shaft **35** on the end of which a crank **36** is fastened. A link **37** connects the other end of the crank **36** to a knife head **38** which is thus caused to reciprocate as the drive shaft **35** rotates.

A pneumatic cylinder **39** can be seen in FIG. 2, with a rack **40** projecting downward from the end of a piston rod **41**, which reciprocates in the cylinder **39**. The rack **40** is meshed with a pinion **42** that is fastened on a cam shaft **43**, on which the hand wheel **17** is also mounted. Also mounted on the cam shaft **43**, as can be seen in FIG. 3, is a radial cam **44**, the surface of which is engaged by a pin **45** mounted for axial sliding movement in a sleeve **46**. The other end of the pin **45** bears against the slidable bearing block **20** of the idler roller **18**, so that when the cam **44** is in the position shown, the pin **45** drives the slidable bearing block **20** toward the stationary bearing block **21**, of the driven feed roller **19**, compressing the coil spring **22** which urges the bearing blocks **20** and **21** apart. Thus also the rollers **18** and **19** journaled in the bearing blocks **20** and **21** are urged toward and away from each other. Hence, by rotating the hand wheel **17**, or by moving the rack **40**, the cam **44** can be rotated, permitting the pin **45** to move forwardly under pressure from the compressed coil spring **22**, which thus drives the idler roller **18** away from the feed roller **19**. Thus the movable idler roller **18** serves as a web **9** positioning means to push the web **9** against the feed roller **19** to be impelled toward the assembly area, or to release the web **9** to move out of driving engagement with the feed roller **19** to stop the feed of the web **9**.

The knife head **38**, as shown in FIG. 2, has a knife blade **47** clamped in its lower end to cooperate with a stationary blade **48** behind it so that as it moves down from the front to the rear it shears the web **9**. Just above the knife head **38** is a web buckling detector member in the form of a rearward slanting steel finger **49** which has its upper end curved forwardly to bear lightly against the web **9** with its convex side just before the web **9** enters between a pair of stationary guide plates **50** and **51**. The other end of the steel finger **49** is fastened to a shaft **52** by a set screw **53**.

In FIG. 4 it will be seen that there are actually three steel detector fingers **49** mounted on the shaft **52** between the individual wheels or segments that make up the idler roller **18**. The shaft **52** has its ends journaled in bearings **54** and **55** that are mounted on the guide plate **50**. On one end of the shaft **52**, a plate cam **56** is mounted, and a stop gauge **83** is mounted on the opposite end of the shaft **52**. The end of the stop gauge **83** will strike the back surface of the front guide plate **50** to limit rotation of the shaft **52**. An actuator **57** of an electric switch **58** bears against the face of the plate cam **56** so that the electric

switch 58 will be actuated in response to rotation of the plate cam 56. A stub of an electrical conduit 59 is shown projecting from the top of the electric switch 58. Some of the conductors in the electrical conduit 59 are connected by circuitry not shown in FIG. 4 to control the solenoid valve 15, the circuitry entering the solenoid valve 15 through the stub of a conduit 60.

The solenoid valve 15 controls the flow of compressed air from the air hose 16 to the air tube 61 which joins the solenoid valve 15 with the top of the pneumatic cylinder 39. The mounting of the pneumatic cylinder 39 is shown most clearly in FIG. 4, where the pneumatic cylinder support bracket 14 can be seen to have a base bolted to the bearing block support frame 13 and an L-shaped upper portion, which receives a mounting bolt 62 that passes through a bifurcated mounting eye 63 bolted to the top of the pneumatic cylinder 39. A rack guide 65 fits around the pinion 42 and the rack 40 with the cam shaft 43 journaled through its ends, so that the rack 40 is held in mesh with the pinion 42 by a sliding bearing pad on the inside of the back of the guide 65.

Turning now to FIG. 5 which is a schematic diagram of the electrical circuitry employed in the present invention, the electric motor 24 is shown to be connected across power lines 66, 67 and 68 of a three phase system, through fuses 69 and 70 and line contacts 71, 72 and 73 of a magnet switch 74. The entire control system is connected across one phase of the three phase system between the middle line 67 and the bottom line 68 shown in the drawing. An operating coil 75 of the magnet switch 74 has one end connected to the middle power line 67 and the other end connected to a holding contact 76, which is also a part of the magnet switch 74 and is operated by the operating coil 75, and through a normally open start switch 77 which is in parallel with the holding contact 76. The parallel connected start switch 77 and holding contact 76 are connected to one stationary terminal 78 of the single pole double throw precision limit switch 58, which has its common contact 79 connected through a normally closed stop switch 80 to the bottom power line 68. The solenoid valve 15 has its operating coil 81 connected between the middle power line 67 and another stationary contact 82 of the single pole double throw precision limit switch 58.

The operation of the electrical circuitry shown in FIG. 5 is best briefly set forth before discussing the operation of the over-all machine. The single pole double throw precision limit switch 58 is shown in its normal position in FIG. 5 so that if the normally open start switch 77 is closed, the operating coil 75 of the magnet switch 74 will be energized through the normally closed stop switch 80 and the precision limit switch 58. As soon as the magnet switch 74 is actuated, closing the line contacts 71, 72 and 73 and the holding contact 76, the start switch 77 may be released and the parallel connected holding contact 76 will hold the operating coil 75 of the magnet switch 74 across one phase of the power lines 67, 68. If the precision switch 58 is actuated to the alternate stable condition, the energizing circuit for the operating coil 75 or the magnet switch 74 will be opened, and the operating coil 81 of the solenoid valve 15 will be connected across the one phase of the power lines 67 and 68 through the precision limit switch 58. When the operating coil 75 of the magnet switch 74 is thus deenergized, the line contacts 71, 72 and 73 and the holding contact 76 will drop out, deenergizing the motor 24.

In the operation of the partition assembly machine, preformed partition strips 2 are fed into the front end of the assembly machine from an automatic partition strip feeding mechanism, such as that disclosed in the Patent No. 2,657,770 to S. E. Schroeder, the operation of which is synchronized with the assembly machine. Meanwhile a web 9 of partition material is fed into the assembly machine from the rear and passes beneath the punch head 10, which forms assembly slots in it. The web 9 is drawn forward over the adjustable apron 11 by the feed roller 19, against which it is held by the idler roller 18 under the force of the cam 44. Being gripped in the nip between the idler roller 18 and the feed roller 19, the web 9 is driven downward by the intermittent rotation of the feed roller 19. Since the feed roller 19 drives the web 9 intermittently, as a result of the motion by the rack 30 operating the ratchet wheel 34 and the pawl 33 to rotate the feed roller 19, the punch head 10 is synchronized to form the assembly slots in the web 9 during the intervals when it is stationary, and at the same time the knife head 38 is drawn rearward by its link 37, which is connected to the crank 36, to sever the web 9 at the end of each of the intermittent movements of the web 9.

If it is desired to stop the feed of the web 9 manually, the hand wheel 17 can be turned so that the cam 44 releases the pin 45, permitting the idler roller 18 to be sprung away from the feed roller 19 so that the web 9 is no longer gripped. The machine is stopped by depressing the stop switch 80 to deenergize the magnet switch 74 and disconnect the motor 24. The assembly machine is fitted with the various adjusting devices so that its operation can be adapted for a partition web material 9 of any size, and so that it can be synchronized to assemble partitions with any of the wide variety of sizes and shapes of preformed partition strips 2. The foregoing is the normal operation of the partition assembly machine, in which the present invention plays no part.

In setting up the machine for a production run, the detector fingers 49 must be adjusted to an optimum position relative to the web 9. Some webs 9 normally run with a slight, fluctuating bow or fluttering deflection, whereas others run straight, depending on the weight and stiffness of the material from which the web 9 is made. Inasmuch as the partitions assembled on this machine may be used in most any package—such as, beer cartons. or cookie boxes, for examples—the differences between the various webs 9 may be quite extreme. Hence, depending on the nature of the web 9, the stop gauge 83 is adjusted on the shaft 52 so that the fingers 49 are either bearing against or spaced from the surface of the web 9, when the end of the stop gauge 83 rests against the guide plate 50. By this means, the detector fingers 49 are positioned relative to the web 9 so as to detect an abnormal buckle of the web 9 that signals an impending jam-up before it occurs.

If the preformed partition strips 2 are fed out of synchronization with the assembly machine, or if one or more of the preformed partition strips 2 lack assembly slots 4, or if one is fed upside down so that its assembly slots 4 open downward, the web 9 will be obstructed in its intermittent motion by collision with the preformed partition strips 2. As soon as the web 9 strikes the partition strips 2. the web 9 begins to buckle, and inasmuch as it is laterally supported by idler roller 18 and the feed roller 19 and by the guide plates 50 and 51, the buckling will occur adjacent to the buckle detector fingers 49. The initial deflection of the buckling web 9 will displace the arcuate end of the detector fingers 49 to rotate the shaft 52 on which the detector finger 49 is mounted. The rotation of the shaft 52 will also rotate the plate cam 56 on the end of the shaft 52 to depress the actuator 57 of the single pole double throw precision limit switch 58 and actuate the limit switch 58. When the limit switch 58 is actuated, its common contact 79 is moved from the stationary terminal 78, which is connected to the operating coil 75 of the magnet switch 74, over to the stationary contact 82, which is connected to the operating coil 81 of the solenoid valve 15. Thus the magnet switch 74 is deenergized, opening the line contacts 71, 72 and 73 to the motor 24 to turn off the motor 24, and simultaneously the operating coil 81 of the solenoid valve 15 is energized opening the solenoid valve 15.

When the solenoid valve 15 is open, the pneumatic cylinder 39 is charged with compressed air from the hose

16 through the tube 61. which drives the piston rod 41 with the rack 40 on its end downward. The movement of the rack 40 rotates the pinion 42, with which it is meshed, on the cam shaft 43 so that the narrow part of the cam 44 is presented to the pin 45. The rotation of the cam 44 releases the pin 45 to move outward as the coil spring 22 expands, driving the idler roller 18 away from the feed roller 19. When the rollers 18 and 19 are separated, they release the web 9, which, since it has met obstruction, stops immediately. Meanwhile, the entire assembly machine is coasting to a halt.

The operator will then correct the condition which caused the obstruction to the web 9, and he will prepare the web 9 and the preformed partition strips 2 for a resumption of normal operation. The detector finger 49 will be returned to its normal position, restoring the precision limit switch 58 to its normal condition, where its common contact 79 is in contact with the stationary terminal 78 resetting the condition where the power may be applied through starting switch 77 to the operating coil 75 of the magnet switch 74. Meanwhile, the restoring of the limit switch 58 to its normal condition has deenergized the coil 81 of the solenoid valve 15, permitting the valve 15 to close and the compressed air charge in the pneumatic cylinder 39 to be exhausted. By turning the hand wheel 17, the operator can rotate the cam shaft 43 and the cam 44 mounted on it, to reengage the web 9 between the idler roller 18 and the feed roller 19. Thus, the machine is ready to resume operation, and the operator can start it by closing the start switch 77.

Since a jam-up of the preformed partition strips 2 and a web 9 has thus been avoided, the resumption of normal operation can be accomplished in a short period of time, reducing lost production and down time to an absolute minimum. While the invention has great value in the partition making industry, it is not limited thereto. Instead the invention may be applicable in many different types of machines employing similar web feeding mechanisms, and a vast number of variations in the embodiment shown may be introduced to adapt the invention to the machine with which it is used or to satisfy the desires of those seeking to practice the invention. For example, the air cylinder 39 could be replaced by a large solenoid, or the rack 40 and the pinion 42 on the cam shaft 43 could be replaced by a lever arm, or any form of movable detector could be substituted for the detector fingers 49 shown. Nor does that list of alternatives begin to exhaust the equivalent devices that will be obvious to one skilled in the art. Hence, the subject matter of the invention is not the embodiment shown but rather as set forth in the claims to follow.

We claim:

1. A jam-up prevention apparatus for a web feeding mechanism of a partition assembly machine comprising the combination of

at least one feed roller rotatably mounted and driven;

a web of partition material positioned to be normally in continuous driving engagement with said feed roller to be impelled by the rotation of said feed roller;

web positioning means normally forcing said feed roller into continuous driving engagement with said web, and adapted to be actuated to abruptly cause said web to be released from driving engagement with said feed roller to instantaneously stop said web from being impelled to prevent a jam-up of said web;

a web buckling detector mounted to be adjacent to said web after said web has passed said feed roller adapted to be displaced by deflection of said web caused by a malfunction in feeding said web before a jam-up of said web due to said malfunction;

and switch means connected to be operated by displacement of said web buckling detector to actuate said web positioning means to cause said web to be released by said feed roller.

2. A jam-up prevention apparatus for a web feeding mechanism as set forth in claim 1 wherein

said web positioning means is a rotatable idler roller mounted for movement toward and away from said feed roller and having means for driving said idler roller toward and away from said feed roller;

and said web passes between said idler roller and said feed roller to be pushed into engagement with said feed roller when said idler roller is moved toward said feed roller.

3. A jam-up prevention apparatus for a web feeding mechanism as set forth in claim 1 wherein

said web positioning means includes a rotatable idler roller parallel to said feed roller and movable toward and away from said feed roller, a compression spring mounted between adjacent ends of said feed roller and said idler roller to urge said idler roller away from said feed roller, rotatable cam means bearing against an end of said idler roller to normally force said idler roller toward engagement with said feed roller and to compress said spring, a rack and pinion gear mounted to rotate said cam means when said rack is moved relative to said pinion, a pneumatic cylinder and piston connected to move said rack under pressure from a pneumatic line to rotate said cam means to release said idler roller to be driven away from said feed roller by said spring, and a solenoid valve means connected to be energized through said switch means to open a compressed air conduit to said pneumatic cylinder.

4. A jam-up prevention apparatus for a web feeding mechanism as set forth in claim 1 wherein

said web buckling detector is a metal finger having one end fastened to a shaft mounted to pivot about its axis and its other end positioned to be displaced by that deflection of said web to rotate said shaft, said shaft having cam means mounted thereon to actuate said switch means.

5. A jam-up prevention apparatus for a web feeding mechanism as set forth in claim 1 wherein

said web feeding mechanism is part of a partition assembly machine;

an electric motor drives said partition assembly machine including said web feeding mechanism;

said web is a web of preslotted partition board being impelled by said feed roller into orthogonal assembly with at least one preformed partition strip and being subject to buckling and jamming from improper positioning with respect to said preformed partition strip;

a synchronized power driven knife means reciprocably mounted to sever said web into partition strips after said web passes said web buckling detector and is assembled with said preformed partition strip;

and said switch means also turns off said electric motor when it is operated.

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