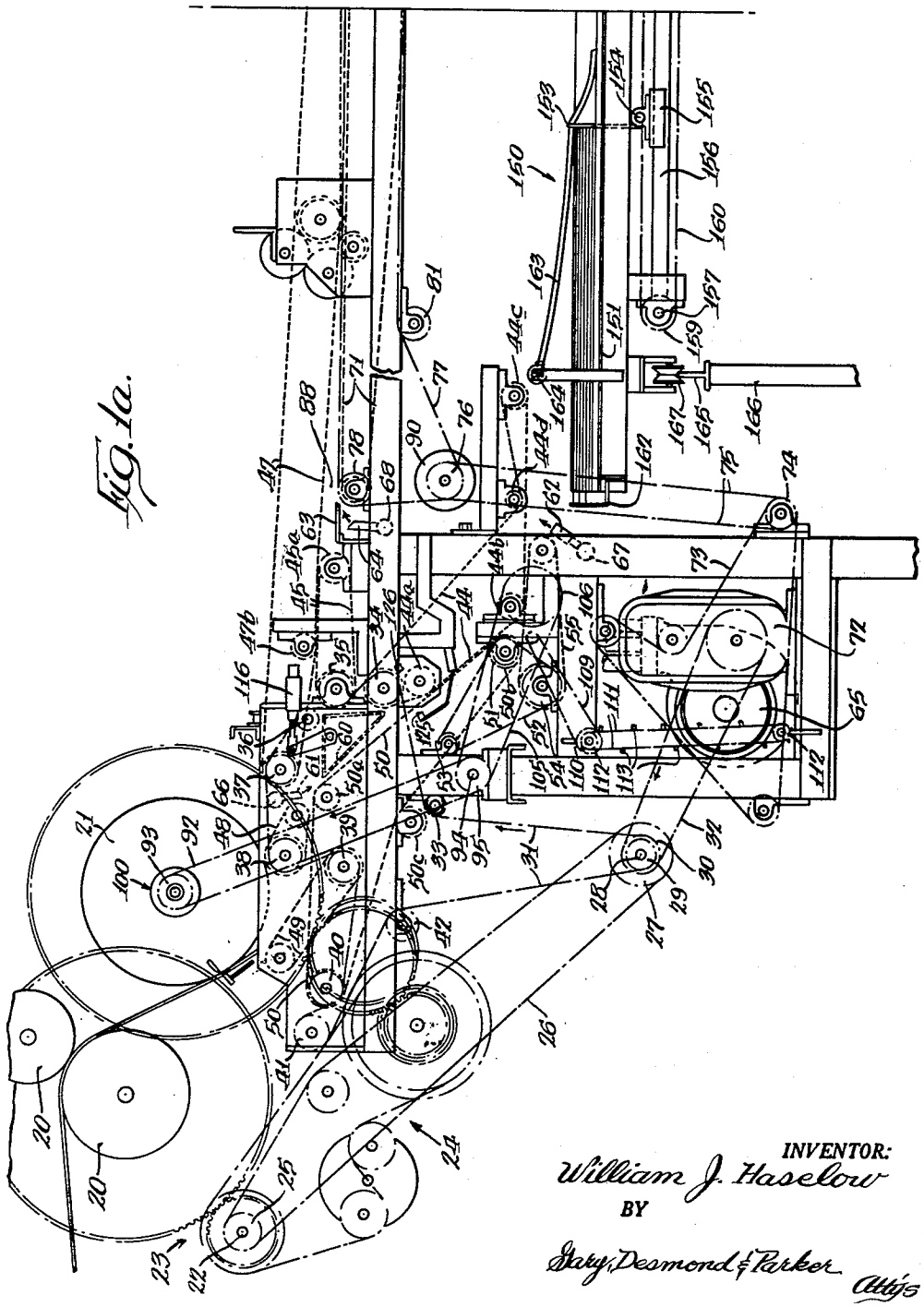
April 27, 1965 W. J. HASELOW 3,180,190

AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

Filed Feb. 15, 1961 6 Sheets-Sheet 1

Fig. 1a.



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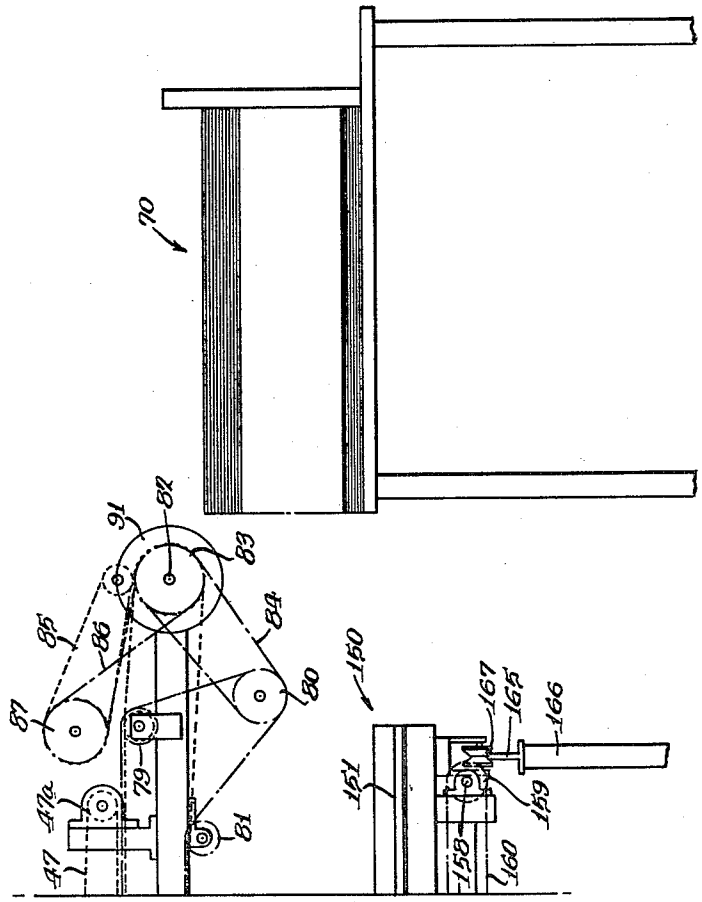
AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

Filed Feb. 15, 1961 6 Sheets-Sheet 2

Fig. 1b.



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AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

Filed Feb. 15, 1961 6 Sheets-Sheet 3

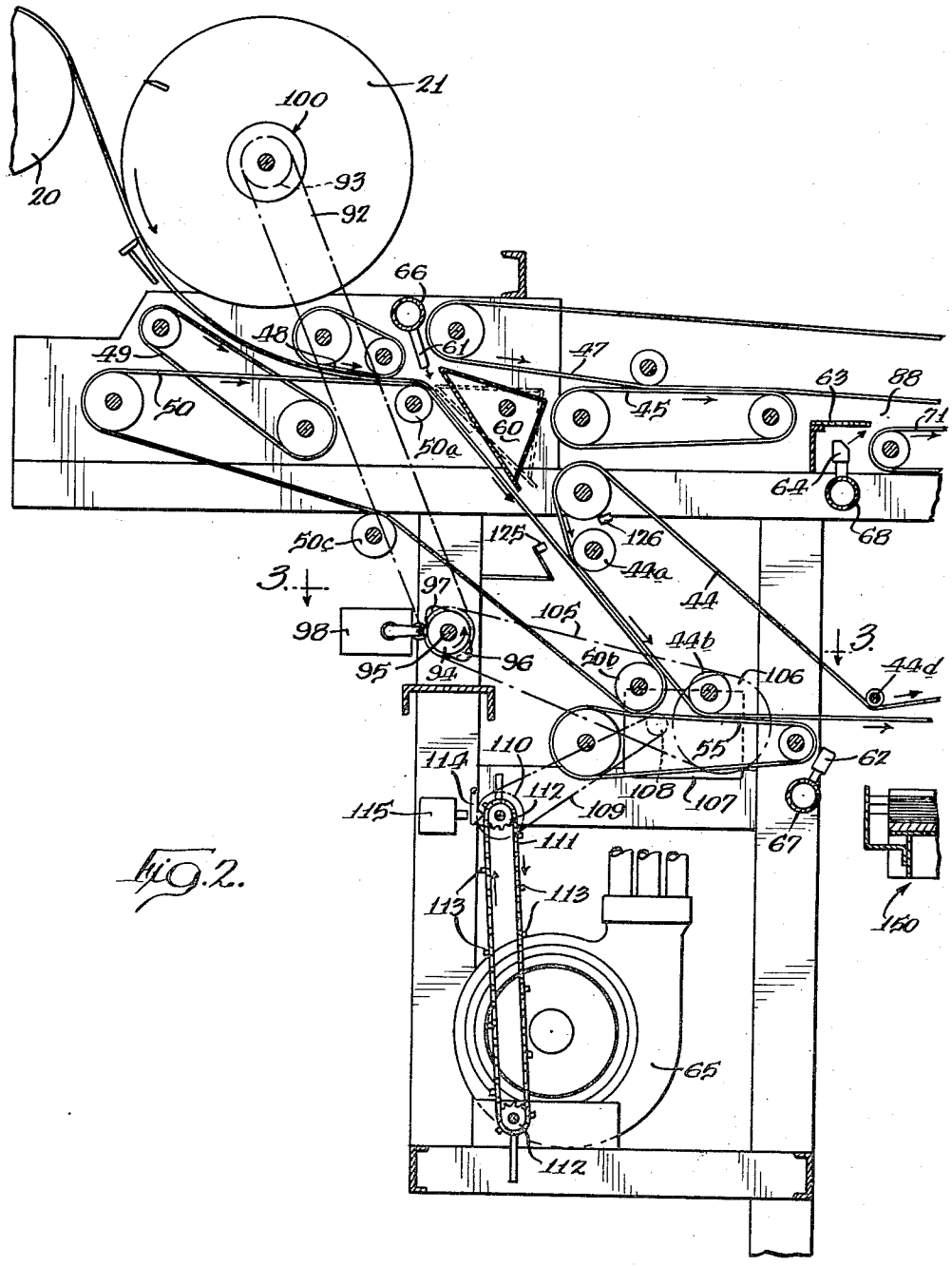

Fig. 2.

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AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

Filed Feb. 15, 1961 6 Sheets-Sheet 4

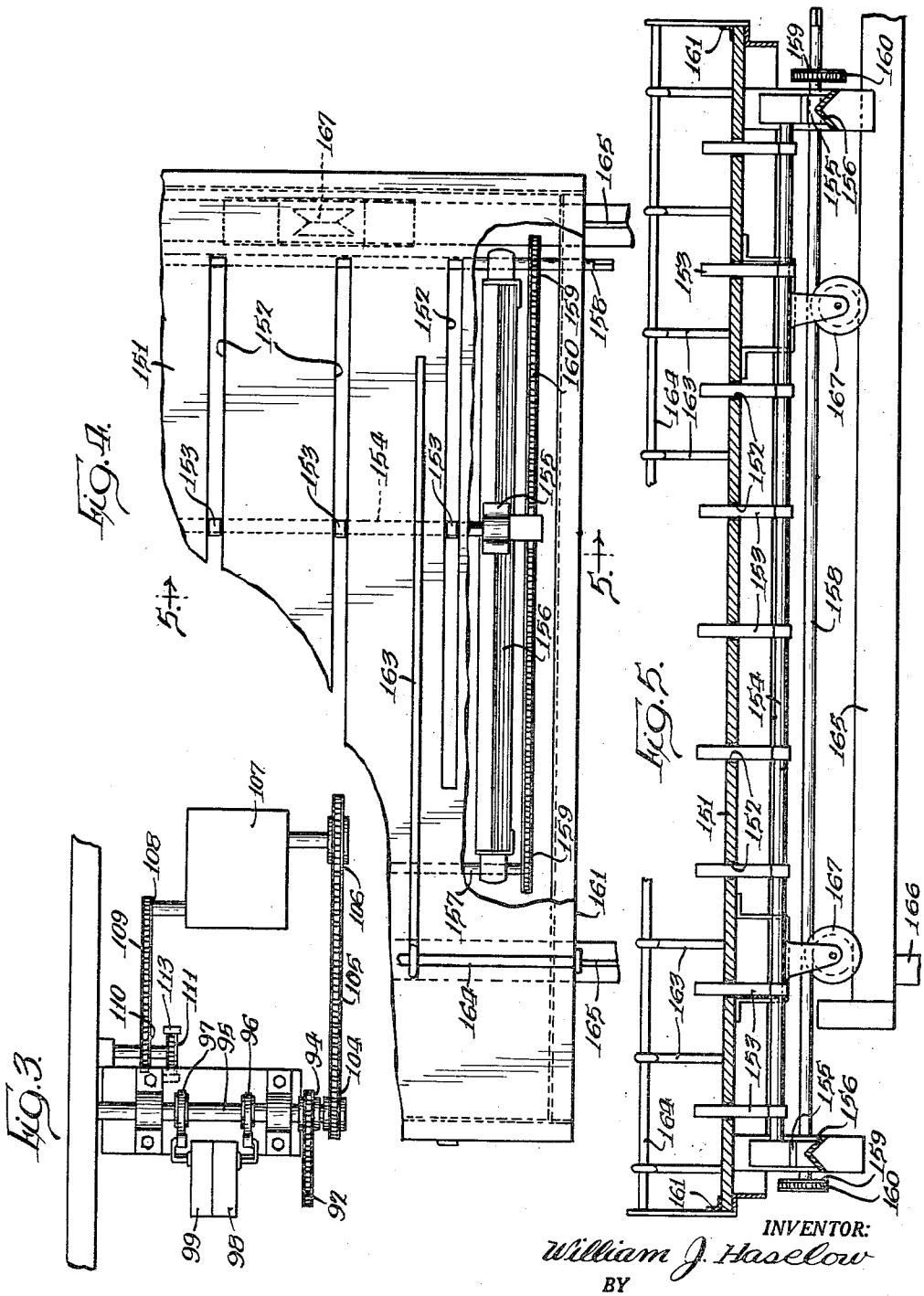

Fig. 3.

Fig. 4.

Fig. 5.

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AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

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Fig. 6.

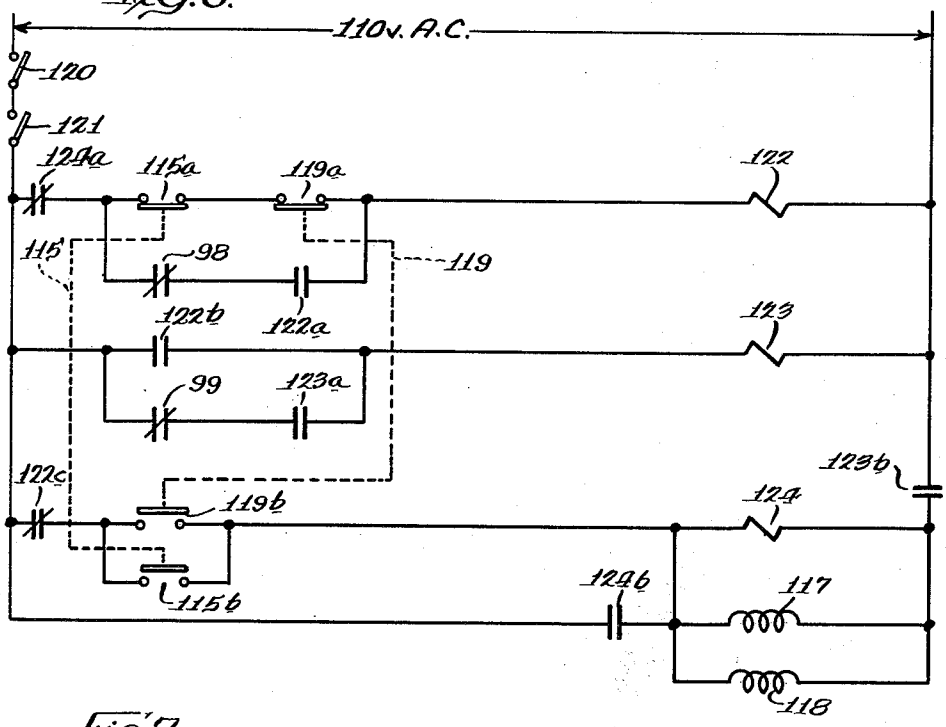

Fig. 7.

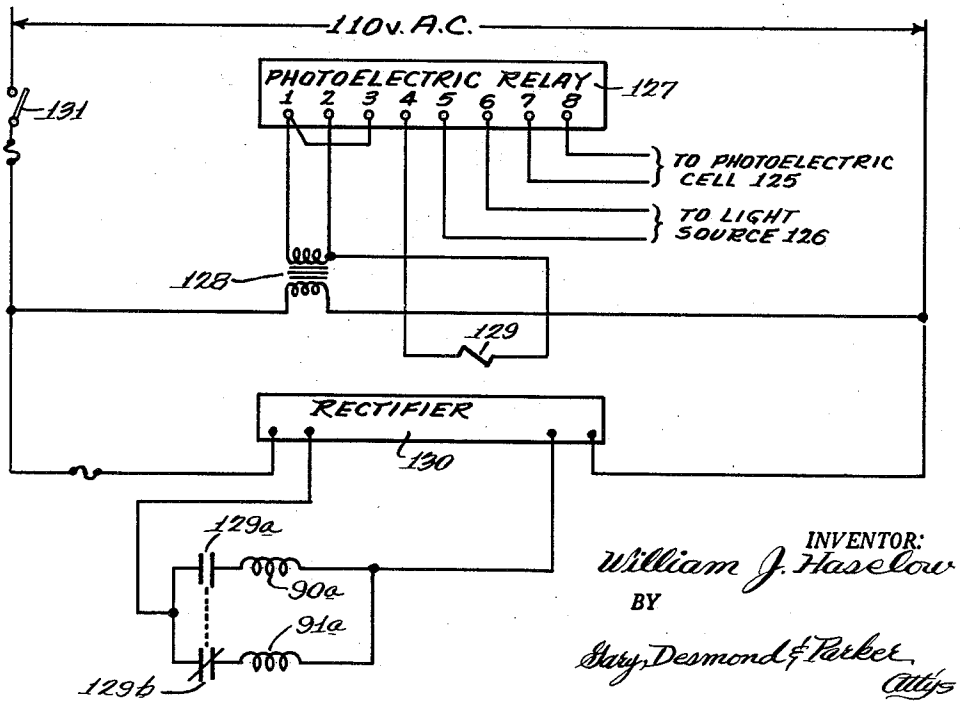

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Fig. 8.

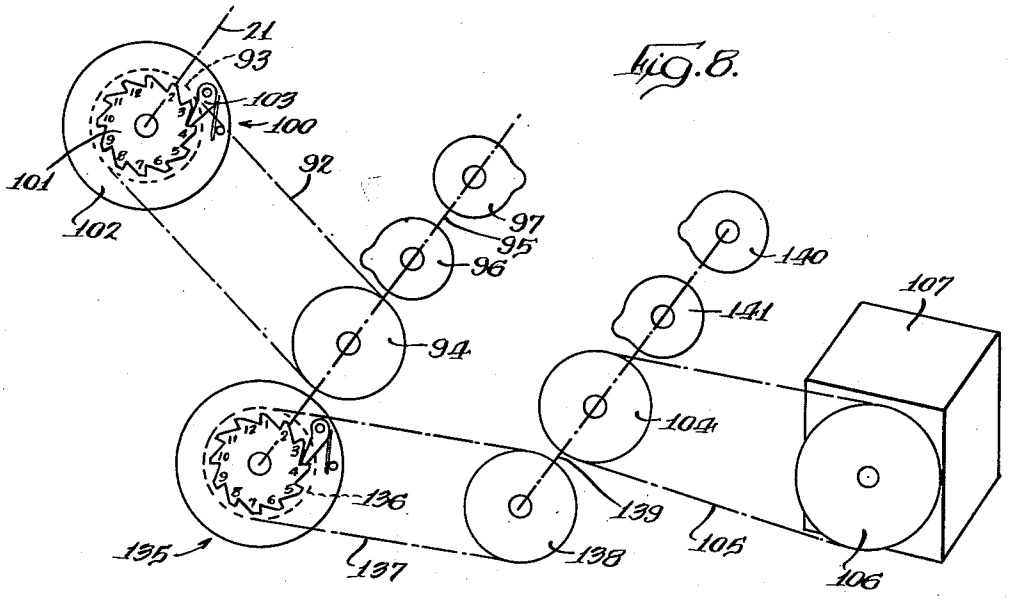
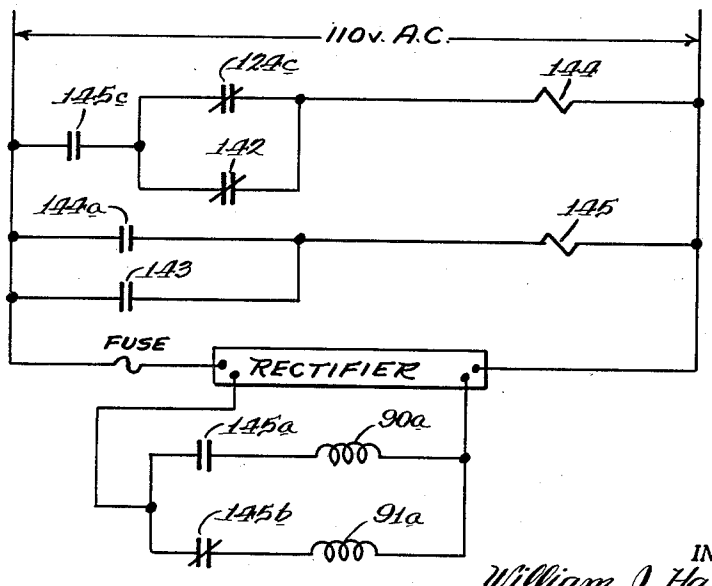


Fig. 9.



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United States Patent Office 3,180,190 Patented Apr. 27, 1965

3,180,190
AUTOMATIC SAMPLER FOR SHEET HANDLING APPARATUS

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Filed Feb. 15, 1961, Ser. No. 89,383
24 Claims. (Cl. 83—88)

The present invention relates to sheet handling apparatus, and particularly, to automatic statistical sampling of sheets moving over or through a sheet handling apparatus.

The invention is illustrated herein as applied, by way of example, to a machine for cutting rolls of flexible web material, specifically paper, into sheets. The machine includes conventional means for supporting rolls of paper and for feeding and guiding the paper web, an adjustable cutter for accommodating variation in the length of the sheets cut thereby, and means for stacking the sheets in reams containing a predetermined number of sheets.

At one time, the sheets were individually inspected after stacking. Recently, a statistical sampling plan has been proposed, whereby a number of representative samples are taken from each lot, the samples are inspected and/or tested sheet by sheet for defects, and based upon the number and type of defects found in the samples, the entire load of paper from which the samples were obtained is either accepted for trimming and shipment or rejected for further inspection and removal of defects. It has been estimated that this quality control inspection system will result in a 25% to 40% reduction in finishing inspection labor costs when the system is in complete operation.

Heretofore, the samples were removed manually, in either regular or random order. Obviously, the manual operation is inefficient and expensive; and based on actual experience, it has proven to be from 25% to 75% destructive due to crinkling and tearing of sheets that would otherwise have been marketable. Considering that several hundred samples, at present 400, may be taken from each lot, the loss over a period of time is substantial, and has delayed full commercial adoption of the statistical sampling system and appreciation of its economies.

A prime object of the present invention is to provide improved means for automatically removing representative sample sheets from the cutting machine without tearing or crinkling, whereby a representative sampling may be secured without destruction of sheets and whereby the samples may be marketed after statistical inspection.

In achieving its prime objective, the present invention also has as one of its objects improvement of sheet handling apparatus in general.

It is in particular an object of this invention to provide in sheet handling apparatus sheet conveyor means additional to and divergent from the usual sheet conveyor means, and means forwardly of the conveyor means adjacent their point of divergence for directing sheets selectively to said conveyor means and for causing the sheets to adhere to the selected conveyor means to facilitate uninterrupted and non-interfering high speed movement of sheets over or through the sheet handling apparatus irrespective of the selected direction of the sheets.

Another object of the invention is the provision, as the means of the preceding paragraph, of air jet means operable in conjunction with a gate for directing sheets to and maintaining the same in close contact with conveyor means that diverges from a normal path of sheet movement, whereby sheets may be selectively diverted from

said normal path to a secondary path of movement, i.e., a separate path of movement for sample sheet.

A further object of the invention is the provision of improved sheet diverting means as above described in combination with control means therefor, the control means being correlated to the sheets in the normal path of sheet movement upstream from the point at which the second or sample path diverges from the normal path and operative to effect energization of the sheet diverting means at a time when one sheet is passing over said point of divergence, whereby to cause diversion of the succeeding sheet or sheets, and to deenergize the sheet diverting means when said succeeding sheet, or the last of said succeeding sheets, is passing over said point of divergence whereby the next following sheet or sheets will again move in the normal path. In this manner, the sheet diverting means is not dependent upon, nor does it impose limitations upon, the speed of sheet movement or the spacing of sheets in the stream. The invention thus affords an efficient, high speed sheet diverting function without in any way interfering with or hampering the mass production capabilities of modern sheet handling aparatus.

It is also an object of this invention to embody the improved sheet or sample diverting means above described in sheet handling and stacking apparatus of the type wherein the sheets moving in the normal path are overlapped prior to stacking at an overlap station provided in the conventional or main conveyor means, and to stop and start the main conveyor means in accurately timed relationship to the diversion of sample sheets from the normal path or main flow of sheets, whereby the overlapping of sheets on the main conveyor is not interrupted.

In connection with the immediately foregoing, it is an object of the present invention to incorporate a clutch and a brake in the main conveyor drive, to locate the same respectively adjacent the head and tail ends of the conveyor with the novel result that the conveyor may be started and stopped without backlash or lost motion, and to provide means for actuating the clutch and brake in coordinated relation to the cutter or sheet delivery means and the sheet diverting means to stop the main conveyor when the sheet preceding the diverted sheet or sample reaches its overlap position and to start the main conveyor when the sheet following the diverted sheet or sample reaches its overlap position relative to said preceding sheet.

According to the invention, coordination of the cutter, the sheet diverting means and the clutch and brake may be effected electrically by sheet sensing photoelectric cell means associated with the second or sample conveyor in correlation with the location of the overlap station in the main conveyor means, or may alternatively be effected mechanically or electro-mechanically by brake and clutch actuating cam means operated in timed relationship with the cutter and the sheet diverting means.

A further object of the invention is the provision in an automatic sheet sampler of means controlling the frequency and regularity of sample removal, said means comprising a control instrumentality having spaced control elements thereon for intermittently rendering the sheet diverting means operative, the elements being selectively arrangeable to provide for any pattern of sample removal from random to regular, and a variable speed drive for said instrumentality operative to drive the same in inverse ratio to the size of respective loads, lots or rolls of paper to cause a predetermined number of samples to be taken from each.

A still further object of the invention is the incorporation of all of the above defined features in a compact assembly whereby the sheet diverting means is intermittently rendered operative by said control means in

timed relation to the operation of the cutter, and thus to the leading edge of a sheet, to divert that sheet as a sample to the second conveyor means and a sample layboy, the main conveyor is stopped with the sheet preceding the sample in its overlapped position, the main conveyor is started when the sheet following the sample reaches overlap position, and the entire operation of the machine including sampling may be carried out fully automatically and at high speed without jamming, without damage to sheets and without danger of injury to personnel; and whereby a predetermined statistical sample may be taken from each roll at particular economy and without diminution of the market value of sheets temporarily used as samples.

Other objects and advantagse of the invention will become apparent in the following detailed description.

Now, in order to acquaint those skilled in the art with the manner of making and using my improvements in sheet handling apparatus and my improved automatic sampling means, I shall describe, in connection with the acompanying drawings, a preferred embodiment of my invention and the preferred manner of making and using the same.

In the drawings:

FIGURES 1*a* and 1*b* together comprise a side view of a paper cutting machine equipped with a preferred embodiment of the automatic sampling means of this invention, the sheet carrying tapes or conveyor means being shown in dotted lines and the chains or belts for driving the tapes or conveyors being shown in dot-dash lines.

FIGURE 2 is a fragmentary side view, partly in section and partly in elevation, illustrating particularly the divergent conveyor means, the movable gate, the sheet diverting air jet means, the gate actuating control means and the means for coordinating the operation of the several components;

FIGURE 3 is a fragmentary horizontal section, taken substantially on line 3—3 of FIGURE 2, showing the gate actuating control means;

FIGURE 4 is a fragmentary top view, partly in section and partly in plan, of my improved layboy;

FIGURE 5 is a vertical cross-section of the layboy taken substantially on line 5—5 of FIGURE 4;

FIGURE 6 is a schematic wiring diagram of the sample gate and air jet control means;

FIGURE 7 is a schematic wiring diagram of the photoelectric cell type of control means for stopping and starting the main conveyor means;

FIGURE 8 is a somewhat schematic perspective view of the primary mechanical components of a mechanical or electro-mechanical control for stopping and starting the main conveyor; and

FIGURE 9 is a schematic wiring diagram of an electromechanical control for the main conveyor employing the components shown in FIGURE 8.

Referring now to the drawings, and particularly to FIGURES 1*a* and 1*b*, I have shown the features of my invention embodied in and as constituting the combination of a paper cutting machine and an automatic sampler therefor. The cutting machine includes conventional roll supporting means (not shown) and paper web guide and feed means, the latter including a pair of squeeze rolls **20** for continuously feeding the web at constant speed to the cutting means, which is here comprised of a knife roll **21** having a single knife. A drive shaft **22** comprises the power input to the cutting machine and the same is coupled by conventional gearing **23** to one of the squeeze rolls **20** and by a conventional variable speed belt drive **24** to the knife roll **21**, so that the knife roll may be driven at various speeds relative to the rate of paper web feed, thereby to accommodate cutting of the web into sheets of variable, preselectable length. Conventionally, sheet length may vary from about 24 inches to about 60 inches when employing a single knife on the knife roll as herein shown.

The drive shaft **22** also carries a sprocket **25** over which a roller chain **26** is reeved, the chain extending downwardly and forwardly and at its lower end being reeved over and drivingly engaging a sprocket **27** which is secured to a floor shaft **28**. The shaft **28** carries second and third sprockets **29** and **30**, the second one **29** of which receives a chain **31** for driving the high speed sheet conveyors or conveyor tapes of the apparatus, and the third one **30** of which receives a chain **32** for driving the low speed sheet conveyors or tapes. The high speed conveyor drive chain **31** extends, in its direction of movement, from the sprocket **29** upwardly and forwardly around an idler pulley **33**, forwardly and upwardly around a sprocket **34**, rearwardly and upwardly around a sprocket **35**, upwardly and rearwardly over an idler **36**, upwardly and rearwardly over a sprocket **37**, rearwardly and downwardly around a sprocket **38**, downwardly and rearwardly around a sprocket **39**, rearwardly and upwardly around a sprocket **40**, rearwardly and upwardly over an idler sprocket **41**, forwardly and downwardly over an idler pulley **42** and thence downwardly to the sprocket **29**. The chain is suitably a standard ASA–40 roller chain (as are all of the chains described herein), and the several sprockets are of conventional roller chain design. Preferably, all of the driven sprockets, i.e., the sprockets **34**, **35**, **37**, **38**, **39** and **40** have the same number of teeth, whereby all are driven at the same speed. Each of these sprockets is of course mounted on a conveyor supporting shaft which also carries suitable pulley means for drivingly supporting an endless conveyor or, as is customary in the paper industry, a plurality of spaced parallel endless conveyor tapes. Preferably, the pulleys are all of the same diameter, whereby all of the tapes will be driven at the same speed. These tapes are constituted and arranged to define two different paths of sheet flow or movement and comprise, respectively, a tape **44** which, in its direction of movement, passes rearwardly over the pulley means driven by the sprocket **34**, then downwardly and forwardly at a steep angle around a pulley **44***a*, downwardly and forwardly around a pulley **44***b*, horizontally forwardly and then upwardly around a pulley **44***c*, rearwardly and downwardly around a pulley **44***d* and then rearwardly upwardly back to the pulley means driven by the sprocket **34**. The sprocket **35** in turn drives a short horizontal feed tape **45** which is supported by the sprocket-driven pulley and a horizontally spaced idler pulley **45***a*. The sprocket **37** drives an overlay or sheet-confining tape **47** which extends essentially in a horizontal direction, the tape or tapes being reeved over the pulley means driven by the sprocket and a horizontally spaced guide pulley **47***a*, and being guided by a pulley **47***b* adjacent its head end (i.e., its left-hand end) to form a tapering inlet throat relative to the tape **45**. The sprocket **38** drives a short overlay or guide tape **48**, which has a slight downward inclination, thereby to define an inlet throat relative to the tape therebelow. The sprocket **39** drives a forwardly and downwardly inclined conveyor or tape **49**, which comprises the initial sheet receiving conveyor means of the cutting machine. The sprocket **40** in turn drives a long conveyor tape **50** which, in the direction of its movement, runs generally horizontally forwardly from the sprocket **40** and passes in interleaved relation through the conveyor tapes **49** and beneath the tapes **48**, then forwardly and downwardly over a pulley **50***a* at a downward and forward inclination to a pulley **50***b* during which movement it closely parallels the portion of the tape **44** between the pulleys **44***a* and **44***b*, the portion of the tape **44** between the sprocket **34** and the pulley **44***a* defining an entry throat relative to the tape **50**; the tape **50** then turning rearwardly around the pulley **50***b*, rearwardly and upwardly over the pulley **50***c* and thence back to the pulley driven by the sprocket **40**. In passing over the pulley **50***b*, the tapes **50** cause that pulley to drive a sprocket **51** over which an endless chain **52** is reeved, the chain also passing over a guide or idler pulley **53** and a driven sprocket **54**, the latter being

mounted on a shaft which carries a supporting and drive pulley for a short horizontally extending delivery tape 55 which extends beneath the lower end of the tape 50 and beneath part of the horizontal run of the tape 44.

As thus constituted and arranged, the tapes define two paths of sheet movement, namely, a first, normal or main path horizontally along the horizontal run of tape 50 and then horizontally forward and along the tape 45, and a second or sample path horizontally along the horizontal run of tape 50, then forwardly downward along the inclined run of the tape 50 and horizontally forward along the tape 55. To accommodate control of the direction of sheet movement, the tape 45 is spaced horizontally forward from the tail end of the horizontal run of the tape 50 and selectively operable sheet diverting means is provided at and within the space between the tapes. The sheet diverting means is comprised of a generally triangular sheet metal gate 60 extending horizontally across the machine and having an upper, generally horizontal surface generally alinable with the upper horizontal surfaces of the tapes 50 and 45, and a downwardly and forwardly inclined surface generally parallelling the inclined forward run of the tape 50; the two surfaces having a common apex or point closely adjacent the pulley 50*a*. The gate is pivotally mounted on the frame of the machine to accommodate selective positioning of the same in a first or normal position wherein its horizontal surface is generally alined with the sheet carrying sides of the tapes 50 and 45, and a second or sampling position wherein the surface parallelling the downwardly and forwardly extending run of the tape 50 intersects the horizontal path of sheet movement.

In use of the machine, the paper web is fed to the knife roll 21 at a preselected constant speed, and the knife roll is operated at a preselected constant speed to cut the web into sheets of predetermined length. As the knife approaches the paper to cut a sheet from the web, it is desirable to place the web under tension during cutting and then to remove the sheet relatively rapidly from the vicinity of the cutter. For these reasons, the tape 49 is disposed to receive the leading edge of the web prior to cutting of the sheet therefrom, and the tapes 49, 50, 48, 45, 47, 44 and 55 are all operated preferably at a constant equal speed that is greater than the speed of web feed and knife movement. While the tapes may operate at a speed only slightly in excess of the speed of web feed, the tapes 49 and 50 nevertheless serve to pull the web relatively taut, and as a sheet is cut from the web, to whisk the same forwardly away from the cutter. The sheet is thus propelled by the tapes 49 and 50 downwardly and forwardly, the tape 48 guiding the sheet and holding the same on the tape 50 as the sheet approaches the gate 60. The gate 60 (supplemented by air-jet means to be described) then causes the sheet to be fed, still at relatively high speed, selectively to the high speed conveyor means 47–45 or 44–50.

Due to the relatively rapid movement of the individual sheets away from the knife roll, a short gap is introduced between sheets, which facilitates the operation of the sheet diverting means to select the direction of sheet movement. Despite this gap, however, there can be no delay in sheet transfer at the gate because following sheets, due to the high speed operation of the machine as a whole, would then jam against or overlap or underlap the trailing edge of a preceding sheet with consequent damage to the sheets, jamming of the machine, and/or inability of the gate to separate one sheet from the path of travel of the preceding sheet. In the illustrated environment, this danger is inherent in attempts to divert one or more sheets downwardly around the corner of the tape 50, since the sheets would tend to move horizontally forward until engaged with the gate, then downwardly along the gate to the entry throat of the tape 44 and finally to the sheet carrying side of the tape 50, all of which would introduce delay in sheet movement and result in jamming of sheets at and adjacent the gate. This danger is mitigated according to the present invention by the provision of novel sheet diverting means comprised of a specially designated gate and sheet diverting air jet means.

As best shown in FIGURE 2, a plurality of transversely spaced air jets 61 are disposed above the guide roll 50*a* in the space between the conveyor tapes 47 and 48, and the jets are directed downwardly toward the sheet carrying side of the tapes 50 at substantially the point of divergence of the tapes from the normal horizontal path of sheet movement. Preferably, the jets emit a jet stream directed forwardly downward at a somewhat steeper angle than the forward inclined run of the tapes 50, thereby to have the proper influence on the leading edge portion of the sheet and to cause the air to have a path of flow downwardly over the face of the sheet for a significant distance as the sheet follows the tapes 50. With relatively thin flexible sheets, the result is that the sheet to be diverted along the tapes 50 is maintained in adhering relation to the sheet carrying side of the tapes and moves forwardly downward without any delay. With thicker sheets, the leading edge of the sheet may engage and be diverted downwardly by the gate 60, but the air flow produced by the jets then immediately causes the sheet to curve about the tapes at the pulley 50*a* and to conform to the tapes, whereby the sheet is caused to move forwardly downward without delay. To assist in this action, the forwardly and downwardly inclined sheet diverting surface of the gate is a plane surface and is formed to introduce a minimum gap between its upper end portion and the tapes 50 when the gate is moved to its sheet diverting position, and to dispose its lower end portions closely adjacent the tapes 50 whereby the gate holds the diverted sheet on the surface of the tapes despite dissipation of the force created by the air jets. Specifically, as the sheet turns the corner formed by the pulley 50*a*, the exposed surface of the sheet and the adjacent plane surface of the gate form a funnel confining the air from the air jets and causing the air to fill the funnel and thus press against the sheet and hold the sheet firmly against the inclined run of the tapes 50. Then, as the sheet approaches the lower end of the gate, the gate itself is sufficiently close to the conveyor tapes as to hold the sheet thereon. Thus, the sheet may be diverted from the course of normal flow and fed to the tapes 44 and 55 at essentially the speed of the tapes 50 and without relative shifting of the sheet with respect to tapes 50, whereby jamming of subsequent sheets is eliminated.

In the particular embodiment of the invention selected for illustration herein, the sheets diverted downwardly along the conveyor 50 are intended as samples of the roll of paper from which the sheets are cut, and to this end the sheets are discharged from the conveyor tapes 55 into a sample layboy, which will be described in detail hereinafter. To assist in the transfer of sample sheets to the layboy, upwardly directed air nozzles 62 are provided at the discharge end of the tape 55 to hold the sheets adjacent the tape 44 in their passage to the layboy.

When the gate 60 is in its normal position, sheets delivered to the gate by the tapes 49, 50 and 48 pass horizontally over the top of the plate onto the tape 45, the sheets being confined to the sheet carrying side of the tape 45 by the tape 47 and being delivered by both sets of tapes to a stationary plate or table 63. To assist the sheets in their passage over the table, a third set of air nozzles 64 is provided under the plate adjacent its tail end, the nozzles being directed upwardly and forwardly in the same manner as the nozzles 62.

The three sets of air nozzles or jets 61, 62 and 64 may be supplied with air in any suitable or customary manner. The nozzles 62 and 64 require a large volume of air at relatively low pressure, and the jets 61 require air at a relatively high pressure, such as 15 to 20 p.s.i. To this end, the jets 61 are supplied with air from a compressor (not shown) vai a header 66, while the nozzles

62 and 64 may be supplied from a common source in the form of an air blower 65 supplying the two sets of nozzles via conventional flexible conduits (not shown) and/or individual headers, such as the headers 67 and 68, respectively. The supply conduits and/or headers are provided with suitable valve (not shown) to regulate air flow, and if desired or necessary supplemental compressors or blowers may be provided. Each of the headers suitably comprises a pipe extending transversely across the machine and a plurality of smaller pipes or tubes welded to and extending radially out of the pipe. In the case of the sets 62 and 64, the outlet pipes are preferably provided with nozzles. The jets 61 are preferably comprised simply of small diameter pipes and are supplied with air at a pressure of about 15 to 20 p.s.i. At least the jets 61 are supplied with air in correspondence with the position of the gate 60. Specifically, air under pressure is supplied to the jets 61 when the gate 60 is moved to sample diverting position, and air supply is discontinued when the gate is in its normal position; a suitable valve (not shown) being provided for the purpose as will appear in greater detail hereinafter.

In the illustrated cutting machine, the objective is to cut rolls of paper into sheets of predetermined size and to stack the sheets in reams. To this end, a layboy 70 is provided at the tail end of the main or normal path of sheet movement, the sheets being delivered to the layboy by a main delivery conveyor or conveyor tapes 71 alined generally with the tapes 45 and the table or plate 63. To facilitate the stacking of the sheets, it is desirable to overlap succeeding sheets within the confines of the conveyor means, whereby sheets may flow in an uninterrupted stream from the conveyor 71 into the layboy 70. To achieve this result, a leading sheet is slowed relatively to the following sheet so that the following sheet may catch up to and commence to overlap the leading sheet, whereafter the two sheets may proceed together at the slower speed to the layboy. Slowing down of the sheets is accomplished in this machine by predetermined relatively slow speed drive of the tapes 71. Specifically, the chain 32 driven from the floor shaft 28 comprises the power input to a variable speed reducer 72, the output of which is transmitted via a chain 73 to a sprocket assembly 74. The sprocket assembly 74 in turn drives a chain 75 that is reaved over a second sprocket assembly 76 disposed adjacent the head end of the tapes 71. The sprocket assembly 76 drives a tape motivating chain 77 which, in its direction of travel, extends from the assembly 76 upwardly and forwardly over a sprocket 78, horizontally forwardly to a sprocket 79, thence downwardly and rearwardly around the sprocket 80 and returns to the assembly 76 over a pair of guide sprockets or pulleys 81. The sprocket 78 is secured to a shaft carrying the head end support pulley means for the conveyor 71, whereby the sprockets 76 and 78 and the chain 77 drive the conveyor from adjacent its head end. At its tail end, the conveyor 71 is provided with a support pulley 71*a* which is mounted on a cross shaft 82. The shaft 82 is equipped with a chain receiving sprocket 83 and a belt receiving pulley (not shown). The sprocket 83 via a chain 84 serves to couple the shaft 82 with the chain 77, and the pulley comprises drive means for overlay or upper delivery tapes 85 located above the tail end of the tapes 71 forwardly (i.e., to the right) of the tapes 47. Specifically, the pulley on the shaft 82 drives a belt 86 having a one-half twist therein, which belt is reaved over a pulley 87 secured to the head end shaft of the delivery tapes 85.

The speed reducer or change speed mechanism 72 in the illustrated embodiment of the invention is variable from substantially a one-to-one ratio to about a five-to-one ratio, whereby the slow speed tapes 71 and 85 may be driven at substantially any speed down to about one-fifth the speed of the high speed tapes, depending upon the degree of overlap desired. Thus, as sheets of paper are transferred at relatively high speed from the high speed delivery tapes 45 to the slow speed tapes 71, the sheets are slowed down by the tapes 71. Preferably, the arrangement of the tapes 45, 47 and 71 is such that the sheets may clear the tapes 45 at high speed into a relatively open or clear space 88, and then be slowed down by the tapes 71 with the trailing edge of the sheet in overlap position at the plate or table 63, whereby the table comprises an overlap station. As one sheet is slowed down by the tapes 71, the following sheet is delivered at high speed by the tapes 45, whereby the rapidly moving sheet consumes the gap that was created between the sheets at the knife roll and whereby the leading edge of the sheet commences to overlap the trailing edge of the immediately preceding sheet at the overlap station. Then, as the said following sheet leaves the tapes 45, it too slows down to the speed of the tapes 71, whereby the two sheets described are moved at the same speed in predetermined overlapped relation by the tapes 71, and the sheet following these two is overlapped on said following sheet to provide a continuous overlapping action and discharge of a continuous stream of sheets into the layboy 70. The overlap range of the sheets is preferably from about 30% to about 60%, and slow speed tape velocity is equal to high speed tape velocity less the overlap percentage. For example, if high speed tape velocity were 400 feet per minute, and a 40% overlap were desired, slow speed tape velocity would be 60% of high speed tape velocity or 240 feet per minute. High speed tape velocity may for example be about 1.015 times the speed of web feed, and at the present time may range up to about 800 feet per minute.

Due to the provision of the sheet overlap arrangement in the upper or main conveyor means, i.e., the conveyors 45, 47, 71 and 85, the present invention provides means for maintaining the overlap arrangement of sheets in the main path of flow despite the intermittent withdrawal or diversion of sample sheets from this path of flow. Specifically, I incorporate in the slow speed tape assembly clutch means for uncoupling the slow speed tapes from their drive, and brake means for stopping the slow speed tapes in predetermined relationship to sheet movement whenever a sample sheet is diverted along the tapes 50 to the tapes 55. It is important in such arrangement that there be no backlash of the chains 77 and 84 when stopping the same, and that there be no lost motion in starting the same, otherwise the intended operation of the machine would likely be defeated. To this end, I incorporate a clutch 90, preferably an electrically operated friction clutch, in the sprocket assembly 76, and operatively associate a brake 91, preferably an electrically operated friction brake, with the shaft 82 of the tail end pulley 71*a* of the slow speed tapes 71. Comparing the tape driving conditions with the tape stopping conditions, it will be appreciated that this particular arrangement of drive, clutch and brake elements attains the novel result that the tapes and chains may be stopped without backlash and started without lost motion. Specifically, when the sprocket assembly 76 is drivingly coupled to the chain 77, the chains 75, 77 and 84 are pulled taut on their return sides, i.e., the forwardly disposed downward run of chain 75 and the lower runs of chains 77 and 84, while the opposite runs, i.e., the upward run of chain 75 and the upper runs of the chains 77 and 84, are relatively loose or slack. The clutch 90 and the brake 91 are actuated substantially simultaneously to release the clutch and apply the brake, and as the brake is applied it exerts a tension load on the lower runs of chains 77 and 84, whereby the same remain taut and whereby the upper runs of these chains are permitted to remain relatively loose or slack, with the result that there is no backlash. At the same time, the shaft 28, chain 32, speed reducer 72, chain 73 and chain 75 continue to drive the input sprocket of the assembly 76, whereby this entire drive assembly maintains its tape driving conditions. Consequently, when the brake is released and the clutch is engaged, again substantially simultaneously, tape drive commences immediately

where it left off without lost motion. Because of this novel result, the sheet preceding a sample sheet may be stopped exactly at the overlap station and may be started in predetermined relation to the arrival at said station of the sheet following the sample sheet or sheets, irrespective of frequency of sample diversion.

With respect to sample frequency and the pattern of sample diversion or extraction, it is an object of this invention to provide automatic sample frequency control means; and to combine therewith means for coordinating operation of the sheet diverting means, and actuation of the slow speed tape clutch and brake means, with the sheet delivery means (i.e., the cutter or knife roll in the illustrated machine). As best shown in FIGURES 2 and 3, a preferred embodiment of the combined control means is coordinated with the knife roll, and thus with the position of the knife and consequently with the position of sheets of paper, by virtue of a one-to-one chain drive consisting of a chain 92 reeved over a sprocket 93 mounted on and driven by the knife roll shaft and a sprocket 94 connected to a cam shaft 95. The shaft 95 is journalled on the machine frame beneath the conveyor tapes 50 and carries a pair of cams 96 and 97, which serve respectively to effect energization and deenergization of the sheet diverting means. In the illustrated embodiment of the invention, wherein the knife roll carries a single knife and a one-to-one drive is provided between the knife roll and the cam shaft, one rotation of the cam shaft is equal in time duration to the passage of one sheet, so that the cams 96 and 97 may be set to energize and deenergize the sheet diverting means at preselected times relative to sheet movement. At present, I prefer to energize said means when the sheet preceding a sample sheet is approximately three-quarters past the gate 60, and to deenergize said means when the sample is approximately one-quarter past the gate. Thus, the cams are set with their lobes approximately 180 degrees apart and are disposed to actuate respective switches 98 and 99 mounted on the machine frame.

To time the actuation of the switches 98 and 99 by the cams 96 and 97 relative to sheets of paper and in conformity with the preselected sheet length, a timing device 100 is provided between the knife roll and the sprocket 93. The timing device, as shown in detail in FIGURE 8, is comprised of a toothed ratchet wheel 101 keyed or otherwise secured to the knife roll shaft, a wheel 102 secured to the sprocket 93 and rotatably mounted therewith on the shaft, and a pawl 103 pivotally mounted on the wheel 102 for selective engagement with the teeth on the ratchet wheel 101. The ratchet teeth may be suitably numbered, as shown for example, and the numbering may be correlated in known manner on a graph or chart to respective sheet lengths, so that the timing wheel and the sprocket 93, and thus the cams 96 and 97, may be appropriately set relative to the knife and consequently relative to the sheets of paper.

Referring again to the embodiment of the control means shown in FIGURES 2 and 3, the shaft 95 also carries a sprocket 104 meshed with a chain 105 which drivingly engages the input sprocket 106 of a variable speed transmission unit 107 mounted on the machine frame outwardly of the conveyor tapes. The output sprocket 108 of the unit 107 is meshed with a chain 109 which drivingly engages a drive sprocket 110 for a sample frequency control device in the form of an endless belt 111 reeved over a pair of pulleys 112 and carrying a plurality of selectively positionable buttons 113. Buttons 113 may be added to and removed from the belt and may be positioned thereon as desired for the purpose of controlling the frequency and the pattern of sample sheet selection. As to pattern, the buttons may be evenly spaced or randomly spaced, may be positioned in predetermined reoccurring patterns, etc. As the belt is moved by the variable speed unit 107, the buttons 113 sequentially engage a cam 114, which in turn actuates a control switch 115.

The purpose of the switches 98, 99 and 115 is to effect control over the sample gate 60 and the sheet diverting air jets 61. In the illustrated embodiment of the invention, the gate may be actuated by a pneumatic piston and cylinder assembly 116 (FIGURE 1*a*), and this assembly and the air jets 61 may be under the control of individual solenoid operated valves (not shown). A preferred control circuit is shown in FIGURE 6, wherein the switches 98, 99 and 115 are illustrated in circuit with the coils 117 and 118 of the gate and air jet control valves. As shown, the switches 98 and 99 are normally closed and the switch 115 is preferably a double pole-double throw switch including contact sets 115*a* and 115*b*, the contacts 115*a* being connected in series with a first contact set 119*a*, and the contacts 115*b* being connected in parallel with a second contact set 119*b*, of a manually operated push button switch 119. Two on-off switches 120 and 121 under the control of the machine operator are also provided, as are three relays, 122, 123 and 124, the relay 122 having two normally open contact sets 122*a* and 122*b* and a normally closed contact set 122*c*, the relay 123 having two normally open contact sets 123*a* and 123*b* and the relay 124 having a normally open contact set 124*a* and a normally closed contact set 124*b*. The on-off switches 120 and 121 are disposed in series in the power supply. The normally closed contact sets 124*a*, 115*a* and 119*a* are disposed across the line in series with one another and the coil of relay 122, and the contact sets 98 and 122*a* are included in this circuit in parallel with the contacts 115*a* and 119*a*. The normally open contacts 122*b* and the coil of relay 123 are similarly connected in series across the line, and the contacts 99 and 123*a* are included in this circuit in parallel with the contacts 122*b* and in series with the relay coil 123. The contacts 122*c* and 119*b* are connected in series with a parallel array of the relay coil 124 and the solenoid coils 117 and 118, all of which are connected in series with the contacts 123*b* to the line. The contacts 115*b* are included in this circuit in parallel with the contacts 119*b*. In addition, the series connection of the contacts 122*c* with the parallel array of the contacts 115*b* and 119*b* is by-passed by a circuit including the contacts 124*b*.

In use of the machine, the relay 122 is normally energized via the normally closed contacts 115*a*, 119*a* and 124*a*, whereby the by-pass circuit comprised of the contacts 98 and 122*a* is also conditioned for normally energizing the relay 122. Energization of the relay 122 also results in closing the contacts 122*b*, whereby the relay 123 is energized to close the contacts 123*a*, whereby both the direct and by-pass circuits to the relay 123 are closed. While the contacts 123*b* also then close, the contacts 122*c* are opened to prevent energization of the relay 124, whereby the relay 124 and the coils 117 and 118 remain un-energized. Upon actuation of either the frequency control switch 115 or the push button switch 119, there is no immediate change in the energization of the circuit, except that relay 122 remains energized by way of the contacts 98 and 122*a*. Should cam 97 actuate switch 99 at this time, nothing would happen since the circuit to relay 123 is closed via the contacts 122*b*. However, when cam 96 actuates the switch 98, the circuit of relay 122 is broken thereby opening contacts 122*a* and 122*b*, and closing contacts 122*c*. Relay 123 then remains energized via the contacts 99 and 123*a*, and the relay 124 is energized via the contacts 122*c*, the contacts 115*b* or 119*b* of the actuated control switch, and the contacts 123*b*. At this time, the contacts 124*b* close to close the by-pass to the relay 124 and the coils 117 and 118, whereby the gate 60 is opened and the air jets 61 are supplied with air under pressure. Since the by-pass circuit via the contacts 124*b* is now closed, and the circuit of relay 122 is opened by the contacts 124*a*, the switch 115 or 119 may be returned to initial condition without affecting continued

operation of the coils 117 and 118. Due to the timed operation of the cam 96 relative to the knife roll, the coils 117 and 118 operate to open the gate and commerce operation of the air jets well in advance of the leading edge of the sample sheet, whereby one sheet may be diverted along the conveyor tapes 50 as previously described. After approximately one-quarter of the sample sheet has passed the gate, the cam 97 opens the contacts 99, thereby breaking the circuit to relay 123, whereupon the contacts 123*b* open to de-energize the relay 124 and the coils 117 and 118. The gate 60 then closes and air supply to the jets 61 is discontinued, and the circuit returns to its initial condition awaiting further signals from the frequency control switch 115 or the push button switch 119.

As a sample sheet is diverted by the gate 60 and air jets 61 from the normal or main path of sheet movement along the path of sample sheet movement, i.e., along the tapes 50, the slow speed tapes 71 are stopped with the sheet preceeding the sample in overlap position. In one embodiment of the invention, as shown in FIGURES 1 and 2, this result is attained by coordinating means in the form of a photoelectric cell 125 disposed adjacent the path of sample sheet movement. Specifically, the cell 125 is disposed rearwardly and below the conveyor 50 in a position between adjacent tapes and at a location spaced from the pulley 50*a* (i.e., from the point of divergence of the two paths of sheet movement) by a distance correlated to the distance of the overlap table 63 from said point of divergence, the control circuitry of the photoelectric cell, the clutch 90 and the brake 91, and the stopping distance of the tapes 71. Since the high speed conveyor 45 continues to operate, the sheet preceding the sample must clear this tape before the tapes 71 are stopped; yet the tapes 71 must be stopped with the sheet in overlap position. Thus, coordination of the stopping and starting of the tapes is relatively critical. By locating the photoelectric cell 125 in the path of sample sheet movement, where it will sense the passage of the leading edge of the sample which moves in predetermined correlation to the preceding sheet, control of the stopping and starting of the slow speed tapes can be exactly correlated to the cutter knife and to sheet movement. In the present embodiment of the invention, the cell is disposed approximately one-half the distance of the table 63 from the point of path divergence. A light source 126 for the cell is located to the side of the tapes 50 and 44 opposite the cell, whereby the cell is adaped to sense the presence of a sample sheet on the sample conveyor means.

With reference now to FIGURE 7, the photoelectric cell 125 and its light source 126 are coupled to a photoelectric relay 127 which is powered from line via an isolating transformer 128 and the output of which governs a relay 129. A rectifier 130 is also disposed across the line and is controlled and protected by an on-off switch 131 and suitable fuses. The output of the rectifier is connected in series with a parallel array of the electric coils 90*a* and 91*a* of the clutch 90 and the brake 91, respectively. The relay 129 includes a normally open contact set 129*a* in series with the clutch coil 90*a* and a normally closed contact set 129*b* in series with the brake coil 91*a*. Normally, when the light beam emitted from the source 126 shines on the cell 125, the photoelectric relay 127 is controlled to cause energization of the relay 129, thereby closing the circuit to the clutch coil 90*a* via the contacts 129*a* to apply the clutch and breaking the circuit to the brake coil 91*a* via the contacts 129*b* to release the brake. When the leading edge of a sample sheet intersects the light beam from the source, the photoelectric cell triggers the relay 127 to cause energization of the relay 129, whereupon the clutch coil 90*a* is de-energized and the brake coil 91*a* is energized thereby to release the clutch and apply the brake. The brake remains on and the clutch remains released so long as a sample sheet intersects the beam of light from the source 126, but as soon as the trailing edge of the sample sheet clears the beam, the relay 129 is re-energized, the brake is released and the clutch is applied in timed or coordinated relation to the sheet following the sample so that the conveyor 71 is started when the sheet following the sample commences to overlap the sheet preceding the sample.

As an alternative to the photoelectric cell arrangement of FIGURES 1, 2 and 7, the slow speed tape clutch and brake means may be actuated mechanically or electromechanically. For example, as shown in FIGURE 8, the cam shaft 95 may carry a timing wheel 135 identical to the timing wheel 100, the wheel 135 being coupled to a sprocket 136 which, by means of a chain 137 and a sprocket 138, drives a cam shaft 139 at a ratio of one-to-one relative to the cam shaft 95 and thus the knife roll 21. The cam shaft 139 carries a pair of cams 140 and 141 similar to the cams 96 and 97, except that the lobes of the cams are spaced only a few degrees apart. As in FIGURES 1 to 7, the one-to-one drive from the knife roll is utilized to drive the sprocket 104 and the chain 105, thereby to drive the variable speed unit 107 and the sample frequency control belt.

While the cams 96, 97, 140 and 141 could be employed to effect mechanical operation of a gate, an air jet control valve, a clutch and a brake, I prefer electro-mechanical actuation of the enumerated elements and therefore provide the control circuit illustrated in FIGURE 9. This circuit can be added to the circuit of FIGURE 6 and includes a normally closed switch 142 operated by the cam 140, a normally open switch 143 operated by the cam 141, a normally closed contact set 124*c* incorporated in the relay 124 and disposed in parallel with the switch 142, a relay 144 connected in series across the line with the parallel array of the switch 142 and the contact set 124*c* and having a normally open contact set 144*a* connected in parallel with the switch 143, and a relay 145 connected in series across the line with the parallel array of the switch 143 and the contacts 144*a*, the relay 145 having a normally open contact set 145*a* in series with the coil 90*a* of the clutch 90, a normally closed contact set 145*b* in series with the coil 91*a* of the brake 91 and a contact set 145*c* in series with the relay 144.

When the machine is started, the on-off switches 120 and 121 are closed, the cam 141 will close the switch 143, thereby to close the circuit to the relay 145. As this occurs, the contact set 145*c* is closed to energize the relay 144 through the contact set 124*c*, whereupon the contact set 144*a* is closed to maintain the relay 145, and thus the relay 144, energized pending the events described below. Energization of the relay 145 also results in closing the contact set 145*a* and opening the contact set 145*b*, whereby the clutch is applied and the brake is released. Operation of the machine may then proceed as previously described. When the frequency control switch 115 or the push button switch 119 is actuated, the sequence of events described in conjunction with FIGURE 6 commences. When the cam 95 opens the switch 98, the relay 124 is energized, thereby opening the contacts 124*c*. Subsequently, the cam 140 opens the switch 142 (prior to closing of the gate 60) whereupon the relay 144 is de-energized and the contacts 144*a* are opened, which results in de-energization of the relay 145, opening of the contact sets 145*a* and 145*c* and closing of the contact set 145*b*. Consequently, the clutch 90 is released and the brake 91 is applied to stop the slow speed tapes until such time as the cam 141 again closes the switch 143. Since the cams are driven at a one-to-one ration relative to the cutter, one revolution of the shaft 139 is equal in time duration to the passage of one sheet, so that by spacing the cam 141 approximately 360 degrees from the cam 140, the cam 141 will actuate the switch 143 and cause release of the brake and application of the clutch at the time when the sheet following the sample attains overlap position relative to the sheet preceding the sample.

The purpose of the timing wheel 135 is to accommodate adjustable setting of the cams 140 and 141 relative to

the knife roll 21 and the cams 96 and 97 in conformity with sheet length, thereby to assure stopping and starting of the slow speed tapes in predetermined coordinated relation to sheet delivery and movement. This relationship of elements may require a circumferential spacing between the cams 96 and 97 greater than 180 degrees, but still less than 360 degrees, so that the cam 140 may actuate the switch 142 before the gate is closed by the cam 97 and its switch 98.

Irrespective of the control arrangement for stopping and starting the slow speed tapes, the entire sampling operation is under the primary control of the sample frequency control elements consisting essentially of the variable speed transmission 107, the belt 111 and the selectively positionable buttons 113. As above indicated, the buttons are adjustable on the belt to determine the basic frequency and pattern of sample selection. The particular purpose of the transmission unit 107 is to facilitate operation of the belt 111 at such speed as to secure a predetermined number of samples from each roll, or more exactly each load, of paper cut into sheets. Particularly, in keeping with the statistical quality control system described in the introductory of this application, it is desired to take a predetermined number of samples, say 400 samples, from each load (or from each roll) of paper irrespective of the size of the load. To this end, the speed of the sample frequency control belt is made inversely proportional to the size of the load in conformity with the speed of the cutting machine, thereby to facilitate extraction or diversion of the preselected number of samples in the preselected pattern.

The sheets thus diverted from the main or upper path of sheet flow are intended for statistical inspection and/or testing. To facilitate accumulation of the sample sheets without damage thereto, and also to facilitate removal of the samples from the vicinity of the cutting machine for purposes of inspection, I provide a sample layboy, indicated generally at 150, at the delivery end of the conveyors 44 and 55. This construction includes a layboy or sheet receiving tray 151 having a substantially planar upper surface which is disposed below the level of the conveyor 55 and which is extended rearwardly under the free end portion of the conveyor 44 to adjacent the delivery end of the conveyor 55. The tray consists essentially of a planar member which, as best shown in FIGURES 4 and 5, is provided with a plurality of spaced parallel longitudinally extending slots 152 therethrough. Slidably mounted in each of the slots 152 is an abutment finger 153, each of which extends above and below the tray 151. At their lower ends, the abutment fingers 153 are connected to a common transverse support bar 154 which is mounted for sliding movement relative to the tray by bearings 155 provided at the ends thereof, the bearings having lower dovetail surfaces slidably engaging longitudinally extending complementary dovetail angle irons 156 suspended from the lower surface of the tray. For purposes of moving the support bar 154 and thus the fingers 153, and for retaining the fingers in a common plane at right angles to the longitudinal axis of the tray, I provide each of the bearings 155 with a chain drive and interconnect the two drives for conjoint operation. Specifically, cross shafts 157 and 158 are located respectively adjacent the head and tail ends of the tray, the shafts being journalled in suitable bearings fixed to the lower surfaces of the tray. Adjacent its ends, each shaft carries a pair of sprockets 159, all of which are preferably identical. A pair of chains 160 are reaved over the sprockets 159 at the respective sides of the table and the respective chains are connected, in accurate alinement, with the respective adjacent bearing 155 of the finger support bar 154. One of the shafts 157 and 158 is provided with an extension for reception of a crank (not shown) whereby the two shafts, the two chains and the two bearings may be moved exactly equal increments to shift the fingers longitudinally of the tray while maintaining the fingers in a common plane at right angles to the axis of the tray. The fingers define an end abutment for the leading edge of the sample sheets and are adjustable in conformity with sheet length to assure neat stacking of the sheets in a uniform pile. The tray may also include sideboards 161 and a head end gate 162. To assist in slowing the sheets as they are delivered to the tray, one or more drag ropes 163 may be suspended from a cross bar 164 elevated above the tray to approximately the level of the lower surface of the conveyor 44, at a point adjacent the tail end of conveyor 44, whereby the sheets pass under the bar and against the ropes to be guided and slowed by the ropes during passage of the leading edges of the sheets to the abutment fingers 153.

The mounting means for the tray 151 is comprised of a pair of spaced parallel rails or tracks 165 which extend transversely of the cutting machine and are supported at spaced points by pedestals 166. The tracks extend beneath the conveyor tapes of the machine and laterally outward to the side of the machine opposite the location of the chain 75. The tray 151 is provided on its lower surface adjacent its four corners with brackets, each of which rotatably supports a grooved caster wheel 167. Respective pairs of the wheels ride on the rails 165, and due to their grooves retain the tray 151 on the rails against displacement in the longitudinal direction. By virtue of this support, the table is movable from a position alined with the delivery tapes 44 and 55 to a position spaced laterally outward from the machine, whereby sample sheets may be conveniently removed from the tray without danger to personnel.

Also, the transverse mobility of the layboy tray in conjunction with foreshortening of the tapes 44 and 55 facilitate access of the lower side of the tapes 71 and to the air nozzles 62 and 64, whereby the nozzles and the air supply may conveniently be adjusted and regulated while the cutting machine is in operation without danger to personnel.

From the foregoing, it is to be appreciated that the present invention provides an improved automatic sampler for paper cutting machines. It is to be observed that the sampler is not limited in application to cutting machines, but may also be employed in conjunction with other sheet handling apparatus. Moreover, the automatic sampler is characterized by several individually novel features each of which has ready application to a wide variety of sheet handling apparatus. For example, the layboy 150 could be utilized in any number of environments; the sample diverting gate and the sample diverting air jets 61 could be employed in any sheet handling apparatus having plural paths of sheet movement, and the means coordinating operation of the sheet diverting means could likewise be employed in such environments with the gate and air jet means described herein or with other sheet diverting means; the clutch and brake arrangement for the slow speed tapes would obviously have application in other environments, as would the means for coordinating operation of the clutch and brake with the sheet delivery means of the apparatus; and the sample frequency control apparatus would also find use in other areas. Thus, the present invention provides not only an improved sampling apparatus, but also provides improvements in sheet handling apparatus in general. Thus, all of the objects and advantages of the present invention have been shown herein to be attained in a convenient, economical and practical manner.

While I have shown and described what I regard to be the preferred embodiments of my invention, it will be appreciated that various changes, rearrangements and modifications may be made therein, without departing from the scope of the present invention as defined by the appended claims.

I claim:

1. In sheet handling apparatus, a plurality of conveyor means for selectively receiving sheets from a common

source, one of said conveyor means having a brake adjacent its tail end for selectively stopping and starting said one conveyor means, and means for coordinating stopping of said one conveyor means with the movement of sheets over other conveyor means and starting of said one conveyor means with movement of sheets toward said one conveyor means.

2. In sheet handling apparatus, a plurality of conveyor means for selectively receiving sheets, one of said conveyor means having brake means adjacent its tail end for selectively stopping and starting said one conveyor means, photoelectric cell means associated with conveyor means other than said one conveyor means for sensing the presence of sheets on said other conveyor means, and actuator means for said brake means coupled with said photoelectric cell means for stopping said one conveyor means when sheets are present on said other conveyor means and for starting said one conveyor means when sheets are not present on said other conveyor means and are moving toward said one conveyor means.

3. In sheet handling apparatus, a plurality of conveyor means, a sheet delivery means for delivering sheets selectively to said conveyor means, one of said conveyor means having a brake adjacent its tail end for selectively stopping and starting said one conveyor means, and means operatively associated with said delivery means and said brake for coordinating stopping of said one conveyor means with the movement of sheets over other conveyor means and starting of said one conveyor means with movement of sheets toward said one conveyor means.

4. In sheet handling apparatus, a plurality of conveyor means for selectively receiving sheets, one of said conveyor means having a head end and a tail end, drive means adjacent its head end including clutch means, and brake means adjacent its tail end, actuator means for substantially simultaneously applying said clutch means and releasing said brake means and for substantially simultaneously releasing said clutch means and applying said brake means, and means for coordinating the operation of said actuator means with the movement of sheets on said conveyor means.

5. In sheet handling apparatus, a plurality of conveyor means for selectively receiving sheets, one of said conveyor means having an overlap station adjacent its head end, drive means adjacent its head end including clutch means, and brake means adjacent its tail end, actuator means for substantially simultaneously applying said clutch means and releasing said brake means and for substantially simultaneously releasing said clutch means and applying said brake means, and means for coordinating the operation of said actuator means with the movement of sheets on said conveyor means to stop said one conveyor means when sheets are being diverted to other conveyor means at such point in the operation of said first conveyor means that the sheet preceding the diverted sheets stops in overlap position at the overlap station and to start said first conveyor means when sheets are no longer being diverted to said other conveyor means and the sheet following the diverted sheets has commenced to overlap the aforesaid preceding sheet at said station.

6. In sheet handling apparatus, sheet delivery means, a plurality of relatively divergent conveyor means for selectively receiving sheets from said delivery means, means forwardly of said conveyor means adjacent their point of divergence for directing sheets from said delivery means selectively to said conveyor means, one of said conveyor means having drive means adjacent its head end including clutch means, and brake means adjacent its tail end, actuator means for substantially simultaneously applying said brake means and releasing said clutch means and for substantially simultaneously releasing said brake means and applying said clutch means, and means for coordinating the operation of said delivery means, said sheet directing means and said actuator means to stop said one conveyor means when said sheet directing means is operated to divert sheets to conveyor means other than said one conveyor means, and to start said one conveyor means when said sheet directing means again directs sheets to said one conveyor means.

7. In sheet handling apparatus, sheet delivery means, a plurality of relatively divergent conveyor means for selectively receiving sheets from said delivery means, means forwardly of said conveyor means adjacent their point of divergence for directing sheets from said delivery means selectively to said conveyor means, one of said conveyor means having an overlap station spaced from said sheet directing means, drive means adjacent its head end including clutch means, and brake means adjacent its tail end, actuator means for substantially simultaneously applying said brake means and releasing said clutch means and for substantially simultaneously releasing said brake means and applying said clutch means, and means for coordinating the operation of said delivery means, said sheet directing means and said actuator means to stop said one conveyor means when the trailing edge of the last sheet delivered thereto reaches the overlap station at times during which said sheet directing means is operated to divert sheets to conveyor means other than said one conveyor means, and to start said one conveyor means when said sheet directing means again directs sheets to said one conveyor means and the sheet trailing the diverted sheets commences to overlap the aforesaid last sheet, said coordinating means including photoelectric cell means associated with conveyor means other than said one conveyor means for sensing the presence of sheets on said conveyor means, said photoelectric cell means being operatively associated with said actuator means and spaced from said sheet directing means in correlation with the spacing of said overlap station from said sheet directing means for causing stopping of said one conveyor means as a function of the passage past said photoelectric cell means of the leading edge of the diverted sheet and starting of said one conveyor means as a function of the passage past said photoelectric cell means of the trailing edge of the diverted sheet.

8. In sheet handling apparatus having delivery means for sheets of variable length, a plurality of conveyor means for receiving sheets, means for directing sheets selectively to said conveyor means, and means for arresting movement of one conveyor while sheets are being directed to other conveyor means, the improvement comprising an adjustable timing wheel operatively associated with and driven in timed relationship to the sheet delivery means, said wheel being adjustable in conformity with the length of sheets handled, means for operating the sheet directing means operatively associated with and driven by said timing wheel for operating the sheet directing means in timed relationship to the delivery means in conformity with the length of sheets handled, a second adjustable timing wheel operatively associated with and driven in timed relationship to said operating means, said second wheel being adjustable in conformity with the length of sheets handled and the timing of said operating means and means for operating said conveyor arresting means operatively associated with and driven by said second wheel for operating said arresting means in timed relationship to the delivery means and said sheet directing means in conformity with the length of sheets handled.

9. In apparatus for cutting lots of flexible web material into sheets and having web fed means, a cutter, conveyor means for receiving sheets from the cutter, second sheet conveyor means diverging from the first, and means adjacent the point of divergence of said conveyor means for normally directing sheets from said cutter to said first conveyor means and operable intermittently to direct sheets to said second conveyor means; the improvement comprising operating means for the sheet directing means including sample frequency control means having spaced control elements thereon and an adjustable speed

drive for operating said control means in inverse ratio to the size of respective lots whereby to secure substantially the same number of samples from each lot.

10. In apparatus for cutting lots of flexible web material into sheets of variable length and having web feed means, an adjustable cutter, conveyor means for receiving sheets from the cutter, second sheet conveyor means diverging from the first, and means adjacent the point of divergence of said conveyor means for normally directing sheets from said cutter to said first conveyor means and operable intermittently to direct sheets to said second conveyor means; the improvement comprising operating means for said sheet directing means including adjustable timer means operatively associated with and driven by the cutter, means actuated by said timer means for actuating said sheet directing means, said timer means being adjustable to vary the time of actuation of said actuating means relative to said cutter in conformity with the length of the sheets, sample frequency control means for said actuating means having spaced control elements for rendering said actuating means intermittently operable, and an adjustable speed drive for operating said control means in inverse ratio to the size of respective lots whereby to secure substantially the same number of samples from each lot.

11. In sheet handling apparatus having sheet delivery means and sheet conveyor means, an automatic sample comprising second sheet conveyor means diverging from the first, means adjacent the point of divergence of said conveyor means for directing sheets from said delivery means selectively to said conveyor means, means for operating said sheet directing means intermittently to divert sheets to said second conveyor means, means for stopping the first conveyor means when sheets are diverted to said second conveyor means and for starting the first conveyor means when sheets are again directed thereto, and control means for said operating and conveyor stopping and starting means including actuating means for said sheet directing means operatively associated with and operated in timed relationship to said delivery means, sample frequency control means having spaced control elements thereon and an adjustable speed drive for said control means, and means for coordinating stopping and starting of said first conveyor means with the operation of said delivery means.

12. In apparatus for cutting rolls of flexible web material into sheets and having web feed means and a cutter, first conveyor means for normally receiving sheets from the cutter, second conveyor means diverging from the first for intermittently receiving sample sheets from the cutter, means forwardly of said conveyor means adjacent their point of divergence for directing sheets from said cutter selectively to said conveyor means, said first conveyor means having brake means adjacent its tail end for stopping said first conveyor means while sample sheets are being received by said second conveyor means, means for operating said sheet directing means intermittently to divert sample sheets to said second conveyor means, said operating means including normally inoperative actuating means operatively associated and actuated in timed relationship with said cutter for moving said sheet directing means to sample diverting position in timed relationship to the cutter and thus to the leading edge of sample sheets, sample frequency control means for said actuating means having spaced control elements for rendering said actuating means intermittently operable, an adjustable speed drive for said sample frequency control means, and means for coordinating the operation of said cutter, said sheet directing means and said brake means to stop said first conveyor means when said sheet directing means diverts sample sheets to said second conveyor means and to release said first conveyor means when said sheet directing means again directs sheets to said first conveyor means.

13. In apparatus for cutting rolls of flexible web material into sheets and having web feed means and a cutter, first conveyor means for normally receiving sheets from the cutter, second conveyor means operated at at least the speed of the cut sheets and diverging downwardly from the first conveyor means for intermittently receiving sample sheets from the cutter, sheet diverging means directly at the point of divergence of said second conveyor means for directing sheets from said cutter selectively to said second conveyor means, and for pressing the sheets intimately against the sheet carrying side of said second conveyor means without buckling and without time delay, said first conveyor means having drive means adjacent its head end including clutch means, and brake means adjacent its tail end, actuator means for substantially simultaneously applying said brake means and releasing said clutch means and for substantially simultaneously releasing said brake means and applying said clutch means, means for operating said sheet diverting means intermittently to divert sample sheets to said second conveyor means, said operating means including actuating means operatively associated with and actuated in timed relationship to said cutter for actuating said sheet directing means in timed relationship to the cutter and thus to the leading edge of sample sheets, sample frequency control means for said actuating means having spaced control elements for rendering said means intermittently operable, an adjustable speed drive for said sample frequency control means, and means for coordinating the operation of said cutter, said actuating means and said actuator means to stop said first conveyor means when said sheet diverting means diverts sample sheets to said second conveyor means and to start said first conveyor means when said sheet diverting means again directs sheets to said first conveyor means.

14. In apparatus for cutting rolls of flexible web material into sheets of variable length and having web feed means and an adjustable cutter, a first layboy, first conveyor means for normally receiving sheets from said cutter and stacking them in said first layboy, said first conveyor means including an overlap station to facilitate delivery to and stacking of sheets in said first layboy, a second layboy spaced below said first conveyor means and mounted for movement transversely of said conveyor means from a normal position under said conveyor means to a position spaced laterally therefrom, said sample layboy including longitudinally adjustable abutment means adjustable in conformity with sheet length, second conveyor means diverging downwardly from said first conveyor means to said sample layboy for intermittently receiving sample sheets from said cutter, means forwardly of said conveyor means adjacent their point of divergence for directing sheets from said cutter selectively to said conveyor means, and including means directly at the point of divergence of said second conveyor means pressing sample sheets without buckling and without time delay against the sheet carrying side thereof, said first conveyor means including arresting means for stopping said first conveyor means while sample sheets are being directed to said second conveyor means and for starting said first conveyor means when sheets are again directed thereto, actuating means operatively associated with said sheet directing means, an adjustable timing device operatively associated with and driven by said cutter and drivingly associated with said actuating means, said device being adjustable relative to said cutter in conformity with sheet length for operating said actuating means intermittently in timed relationship to said cutter in conformity with sheet length for intermittently diverting sample sheets from said cutter to said second conveyor means and said sample layboy, and means for coordinating the operation of said cutter, said sheet directing means, and said arresting means in conformity with sheet length to stop said first conveyor means when the sheet preceding sample sheets is in overlap position at said overlap station and to start said first conveyor means when the sheet trailing

sample sheets commences to overlap the aforesaid preceding sheet.

15. In apparatus for cutting rolls of flexible web material into sheets of variable length and having wed feed means and an adjustable cutter, a first layboy, first conveyor means for normally receiving sheets from said cutter and stacking them in said first layboy, said first conveyor means including an overlap station to facilitate delivery to and stacking of sheets in said first layboy, a sample layboy spaced below said first conveyor means and mounted for movement transversely of said conveyor means from a normal postion under said conveyor means to a position spaced laterally therefrom, second conveyor means diverging downwardly from said first conveyor means to said sample layboy for intermittently receiving sample sheets from said cutter, movable gate means forwardly of said conveyor means adjacent their point of divergence for directing sheets from said cutter selectively to said conveyor means, air jet means adjacent said gate means directed at the point of divergence and along the sheet carrying side of said second conveyor means for pressing sample sheets intimately and without buckling against its sheet carrying side, said first conveyor means including clutch means adjacent its head end and brake means adjacent its tail end for stopping said first conveyor means while sample sheets are being directed to said second conveyor means and for starting said first conveyor means when sheets are again directed thereto, normally inoperative gate and air jet actuating means operatively associated with said gate and said air jet means, an adjustable timing device operatively associated with and driven by said cutter and operatively associated with said gate and air jet actuating means, said device being adjustable relative to said cutter in conformity with sheet length for actuating said gate and air jet actuating means intermittently in timed relationship to said cutter and in conformity with sheet length for intermittently diverting a sample sheet from said cutter to said second conveyor means and said sample layboy, sample frequency control means for said gate and air jet actuating means having spaced control elements for rendering said means intermitently operable, an adjustable speed drive for said sample frequency control means, and means for coordinating the operation of said cutter, said gate means, said clutch means and said brake means in conformity with sheet length to stop said first conveyor means when the sheet preceding a respective sample sheet is in overlap position at said overlap station and to start said first conveyor means when the sheet trailing the respective sample sheet commences to overlap the aforesaid preceding sheet.

16. A method of diverting sample sheets from the normal path of sheet movement in a sheet overlapping conveyor means, comprising the steps of obstructing the normal path of sheet movement forwardly of the overlapping position to cause sheets to be diverted in a given direction from their normal path of movement, removing the divert sheets from said normal path at at least the speed of the sheets in said path without buckling and without time delay, stopping the conveyor means when the sheet preceding the diverted sheets is in overlap position, removing the obstruction, and starting the conveyor means when the sheet following the diverted sheets reaches overlap position relative to the aforesaid preceding sheet.

17. A method of diverting sample sheets from the normal path of sheet movement in a sheet overlapping conveyor means, comprising the steps of periodically diverting sheets out of said normal path, disconnecting the conveyor means adjacent its head end from its drive means and applying a braking force to the conveyor means adjacent its tail end during the time sheets are diverted from the normal path and at such time that the sheet preceding the diverted sheets is stopped in overlap position, discontinuing the diversion of sheets from said normal path, and connecting the conveyor means to its drive means and discontinuing application of said braking force to start said conveyor means when the sheet following the diverted sheets reaches overlap position relative to the aforesaid preceding sheet.

18. A method of diverting sample sheets from the normal path of sheet movement in a sheet overlapping conveyor means, comprising the steps of applying forwardly of the overlapping position and against the surface of a first sheet an obstable to the normal path of sheet movement to cause a second sheet following said first sheet to be diverted in a given direction from its normal path of movement, removing the diverted sheet from said normal path at at least the speed of the sheets in said path without buckling and without time delay, disconnecting the conveyor means adjacent its head end from its drive means and applying a braking force to the conveyor means adjacent its tail end during the time the second sheet is diverted from the normal path and at such time that said first sheet is stopped in overlap position, removing the obstacle when the second sheet has partially but not fully been diverted from the normal path thereby to permit a third sheet following said second sheet to move in the normal path, and connecting the conveyor means to its drive means and discontinuing application of said braking force to start said conveyor means when said third sheet reaches overlap position relative to said first sheet.

19. In sheet handling apparatus having substantially planar main carrier means for receiving space sheets and transporting them to a point of delivery, secondary carrier means diverging from an intermediate point in the main carrier means and operated at at least the speed of the sheets on the main carrier means at said point of divergence, said main and secondary carrier means including means for substantially continuously supporting sheets throughout the area of divergence in passage of sheets from the main carrier means to the secondary carrier means, sheet diverting means for optionally diverting sheets from the main carrier means to the secondary carrier means, said sheet diverting means including means directly at the juncture of said secondary carrier means with the main carrier means for immediately and continuously pressing the leading end and progressively following portions of sheets intimately and without buckling against said sheet supporting means throughout the area of diversion and along the sheet carrying side of said secondary carrier means, and control means operated in timed relation to the sheets on the main carrier means for operating said sheet diverting means during passage of a sheet along the main carrier means past the point of diversion and for rendering the sheet diverting means inoperative during passage of a succeeding sheet past the point of diversion and along said secondary carrier means.

20. In sheet handling apparatus having main conveyor means normally receiving sheets along a generally planar path from a delivery means, sample receiving conveyor means diverging from said planar path at the point of juncture of the delivery means and the main conveyor means, said sample receiving conveyor means operated at at least the speed of sheets delivered from the delivery means, the delivery means and said sample receiving conveyor means including means for substantially continuously supporting sheets throughout the area of divergence in passage of sheets from the delivery means to said sample receiving conveyor means, sample diverting means forwardly of the conveyor means for directing sheets from the delivery means selectively to said main and sample receiving conveyor means, said sample diverting means including means directly at the juncture of the delivery means and said sample receiving conveyor means operative to cause sheets to be intimately adhered without buckling against said supporting means throughout the area of diversion and along the sheet carrying side of said sample receiving conveyor means, said last-named means immediately and continuously pressing the leading end and progressively following portions of each sheet to be diverted into intimate supported contact with said

supporting means and continuously maintaining said leading end and said progressive portions in such pressed intimate supported contact with said supporting means and said sample receiving conveyor means, and control means correlated to the sheets in the delivery means intermittently operating said diverting means when a sheet is passing from the delivery means to the main conveyor means and rendering the same inoperative when the succeeding sheet is passing from the delivery means to said sample receiving conveyor means.

21. In sheet handling apparatus having a sheet delivery path, a plurality of conveyor means diverging from substantially a common point in the direction away from said delivery path for selectively receiving sheets from said path, and movable gate means in the sheet delivery path at substantially the point of divergence of said conveyor means for directing sheets selectively to said conveyor means, the improvement comprising, in combination, one said conveyor means diverging downwardly from the sheet delivery path and operated at at least the speed of sheets in said path, and air jet means disposed above said gate means to the delivery path side thereof and directed to blow air under pressure downwardly onto the juncture of the delivery path and said diverging conveyor means and along the sheet carrying side of the latter for pressing the leading end and progressively following portions of sheets directed toward said diverging conveyor means downwardly against the same to cause the sheets to be intimately adhered without buckling against the sheet carrying side of said diverging conveyor means, said gate means including surface portions extending downwardly from said juncture juxtaposed to said diverging conveyor means and forming with a sheet on the latter a funnel for confining the air from said air jet means and causing the air to press against the leading end and progressive portions of each sheet to maintain each sheet in pressed supported contact with said diverging conveyor means, the end of said surface portions spaced from said juncture closely adjoining said diverging conveyor means for retaining sheets on the sheet carrying side thereof despite dissipation of the sheet pressing force created by said jet means.

22. A method of obtaining a statistical sampling of lots of flexible sheets moved sheet-by-sheet along a normal path of movement, comprising the steps of intermittently applying at random time intervals an obstacle to sheet movement in said normal path for causing the next approaching sheet in said path to be diverted in a given direction from said path, extracting said sheet from said normal path at at least the speed of the sheets in said path, substantially continuously supporting said sheet from said normal path throughout the area of diversion and along a second path divergent to said normal path, and continuously pressing the leading edge and progressively following portions of said sheet into intimate supported contact with the supporting surfaces therefor as said edge and progressive portions pass said area of diverison and continuously maintaining said leading edge and said progressive portions of said sheet in such pressed intimate supported contact from said normal plane throughout the area of diversion and along said second path without buckling and without time delay, removing the obstacle when said sheet has at least partially been diverted from said normal path to permit the sheet following it to move in said normal path, and varying the frequency of application of said obstacle in inverse ratio to the size of respective lots whereby to secure substantially the same number of samples from each lot.

23. A method of diverting sheets from a normal plane of sheet movement into a second plane of sheet movement diverging from said normal plane at an intermediate point thereof, comprising the steps of applying at the point of diversion and against the surface of a first sheet an obstacle to sheet movement in said normal plane thereby to cause the sheet following said first sheet to be diverted towards said second plane, extracting the diverted sheet from said normal plane at at least the speed of the sheets in said normal plane, substantially continuously supporting the diverted sheet from said normal plane throughout the area of diversion and along said second plane, immediately and continuously pressing the leading edge and progressively following portions of the diverted sheet into intimate supported contact with the supporting surfaces therefor and continuously maintaining said leading edge and progressive portions of the diverted sheet in such intimate supported contact from said normal plane throughout the area of diversion and along said second plane without buckling and without time delay, and removing the obstacle when the leading edge and progressive portions of the diverted sheet but not the entirety of the diverted sheet have been diverted from said normal plane thereby to permit the sheet following the diverted sheet to move in the normal plane.

24. In sheet handling apparatus having sheet delivery conveyor means including a generally horizontal main run and a downwardly inclined run constituting a continuation of said main run, receiving conveyor means generally aligned horizontally with said main run and overlying said inclined run, and sheet diverting means between said main run and said receiving conveyor means adjacent the juncture of said main and inclined runs for diverting sheets from said main run optionally to said receiving conveyor means and said inclined run; improved sheet diverting means comprising means normally accommodating unimpeded horizontal travel of sheets from said main run to said receiving conveyor means, means optionally operative for forcibly and continuously pressing the leading end and progressively following portions of sheets into intimate support contact with said delivery conveyor means at the juncture of said main and inclined runs and along said inclined run for causing the sheets to follow the inclined run in intimate supported engagement therewith, and control means correlated to the sheets on said main run for rendering said pressing means operative when a sheet is traveling from said main run to said receiving conveyor means and for rendering the same inoperative when a succeeding sheet is partly on said inclined run and partly on said main run.

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