United States Patent [19]

McCain et al.

[11] **3,732,766**

[45] **May 15, 1973**

[54] SHEET TRIMMING MACHINES

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[73] Assignee: **McCain Manufacturing Corp.,** Chicago, Ill.

[22] Filed: **Feb. 16, 1971**

[21] Appl. No.: **115,174**

[52] **U.S. Cl.** .....**83/104,** 83/157, 83/268, 83/276, 83/282, 83/375, 83/404, 83/467, 83/514, 83/519, 83/618, 83/624, 83/625, 83/925 A

[51] **Int. Cl.**.....**B26d 5/42,** B26d 11/00

[58] **Field of Search**.....83/104, 157, 268, 83/276, 375, 467, 514, 519, 618, 625, 624, 925 A, 282, 404

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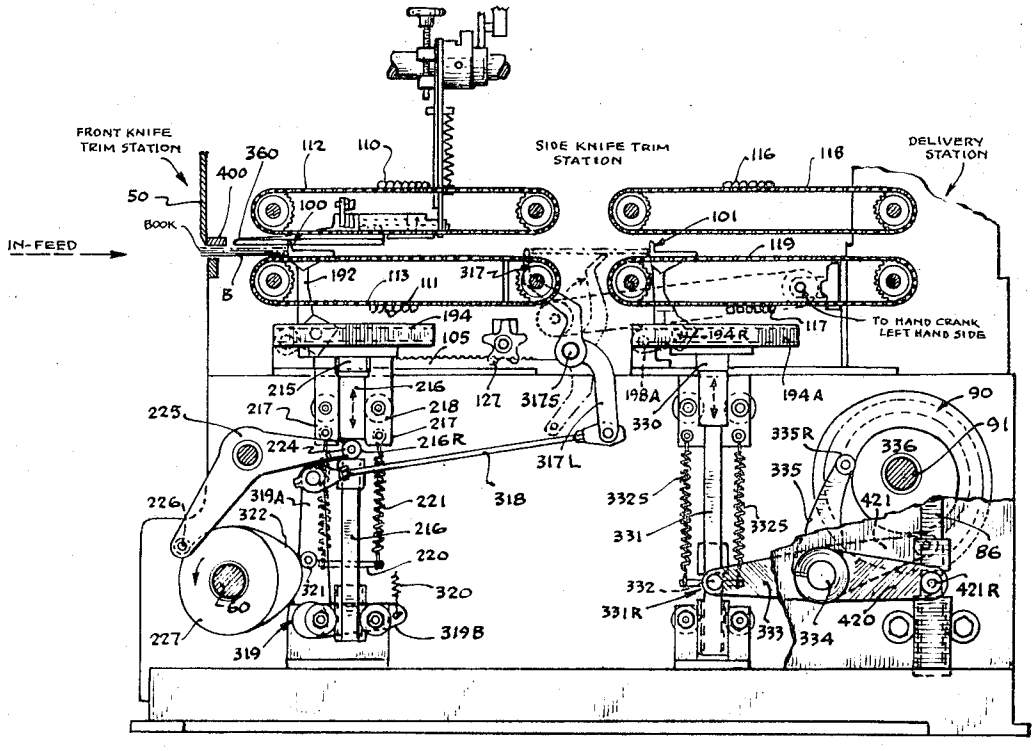
Primary Examiner—Frank T. Yost
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[57] **ABSTRACT**

A three-knife sheet trimmer is so constructed as to separate the drive for the knives (one front knife and two side knives) from the drive for the clamps which hold the sheets (e.g. the sheets of a book) stationary while being trimmed. The knives at the stations are operated out of phase, and the moving masses are therefore balanced compared to the previous form of these trimmers where all knives move in the same direction at the same time. Separating the drives also enables a book to be sooner advanced from the first knife station to the second knife station. This being so, there is a greater allowance of time in which to make the transfer, and hence there is no need to rush the book.

The stops at the several knife stations against which a book is advanced may be adjusted simultaneously, and the separate feed means which advance or feed the books first from the first knife station to the second knife station and then out of the second knife station, may be opened or spread apart simultaneously either for re-adjustment to accommodate books of a different size or for the purpose of clearing a jam.

6 Claims, 38 Drawing Figures



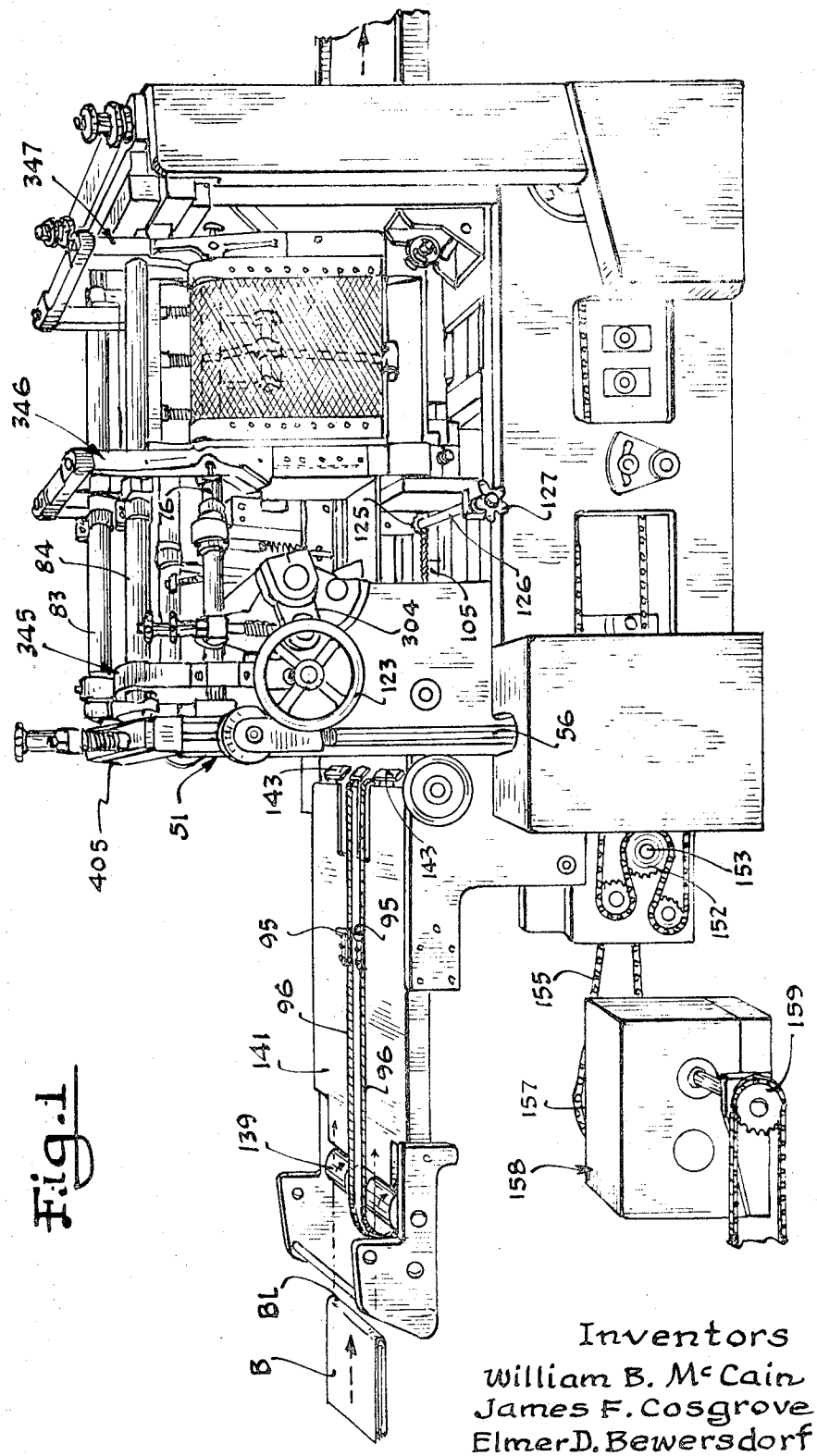


Fig. 1

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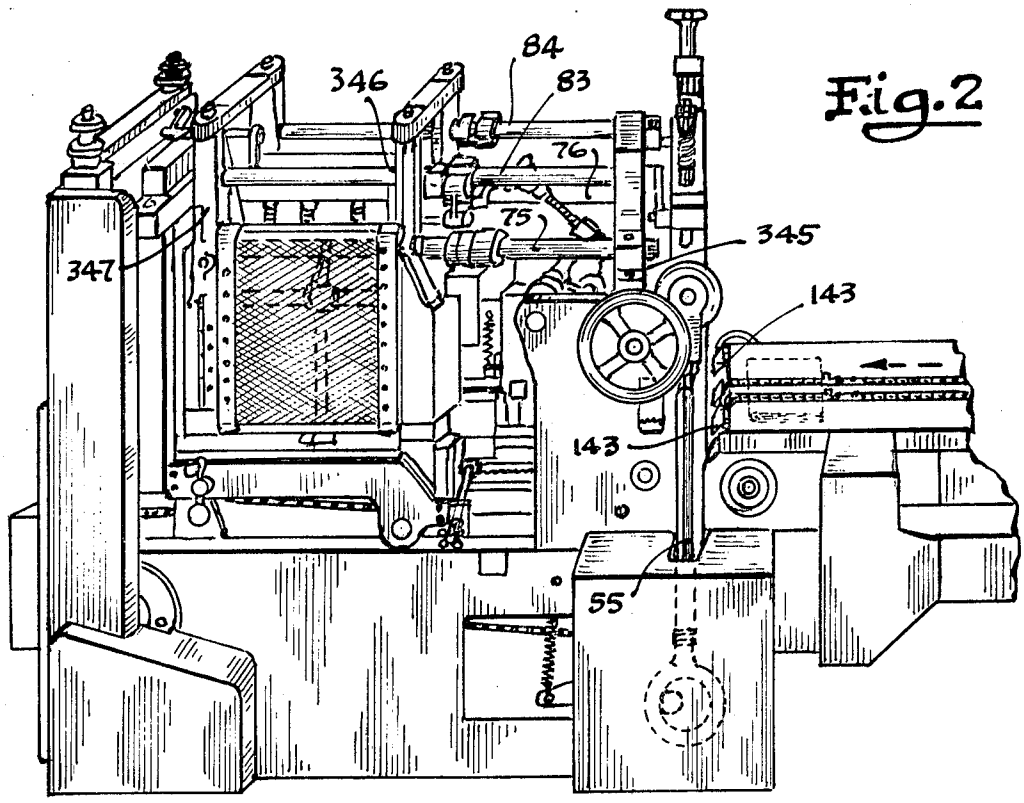


Fig. 2

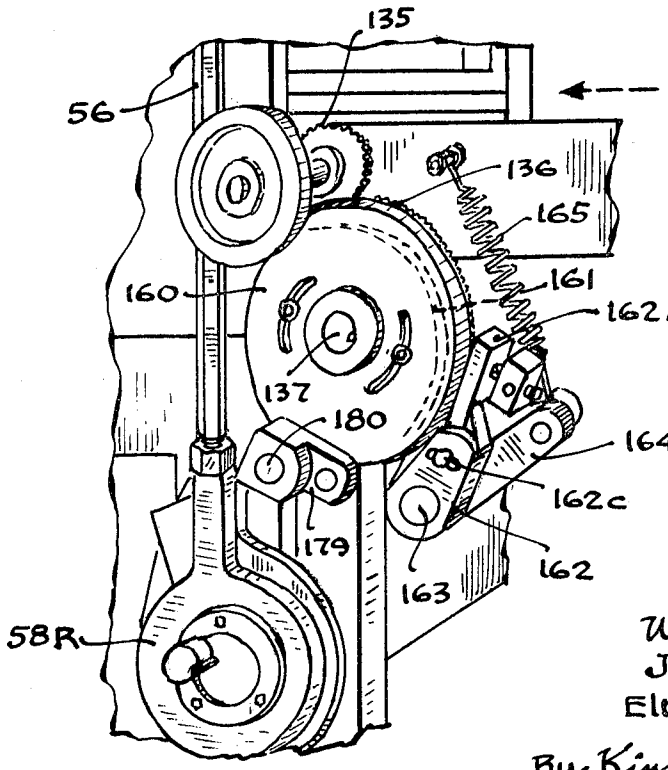


Fig. 2A

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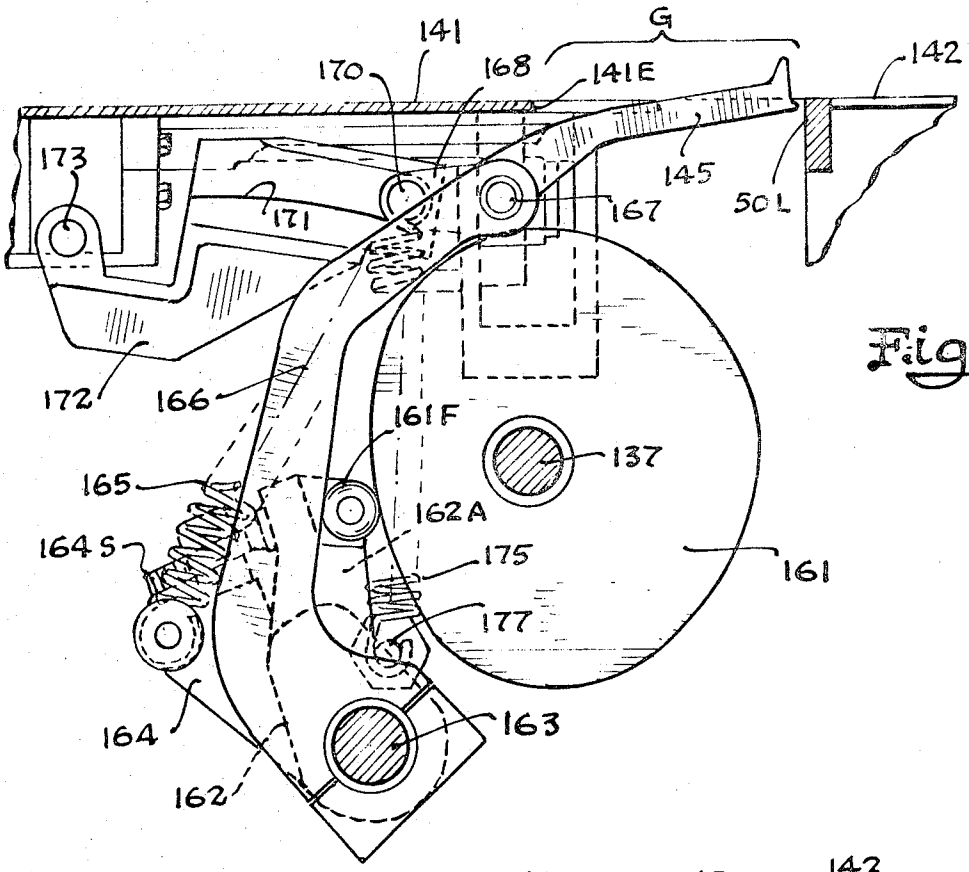


Fig.3

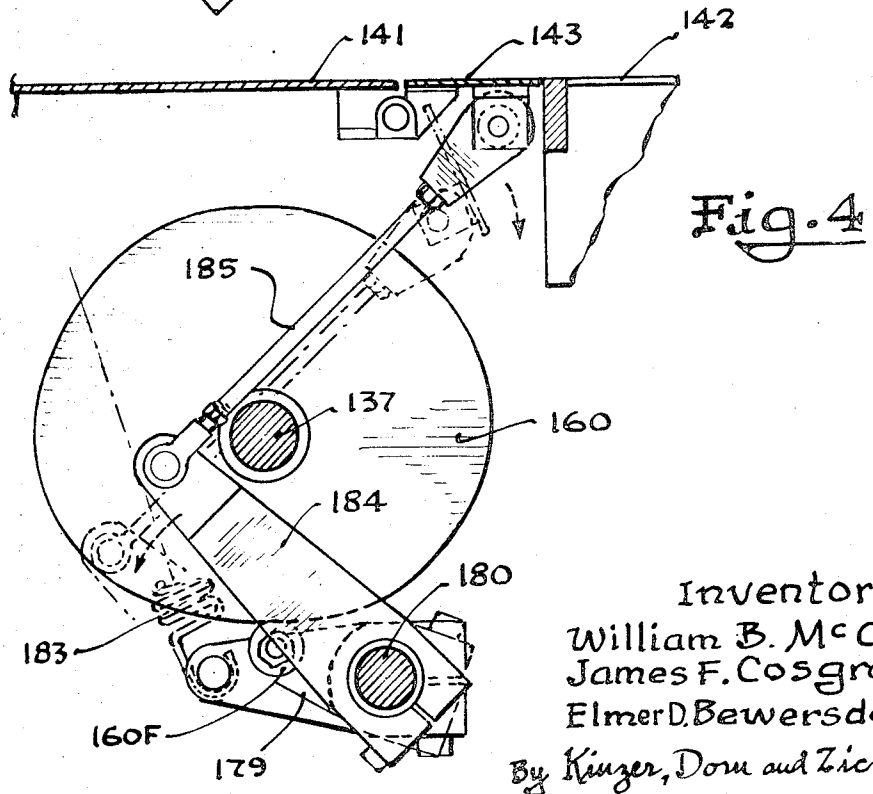


Fig.4

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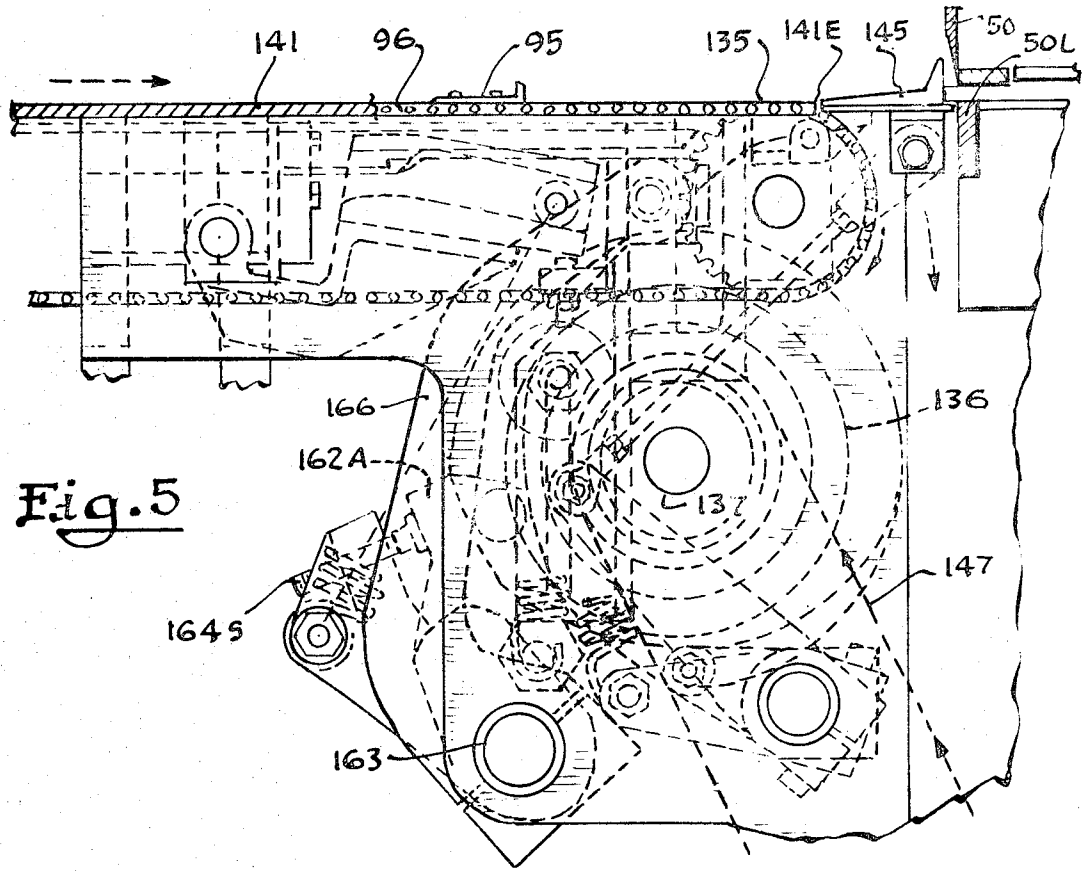


Fig.5

Fig.6

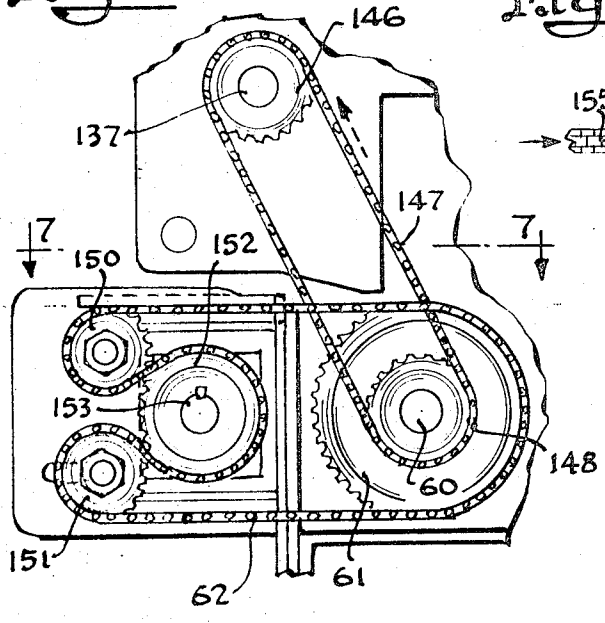
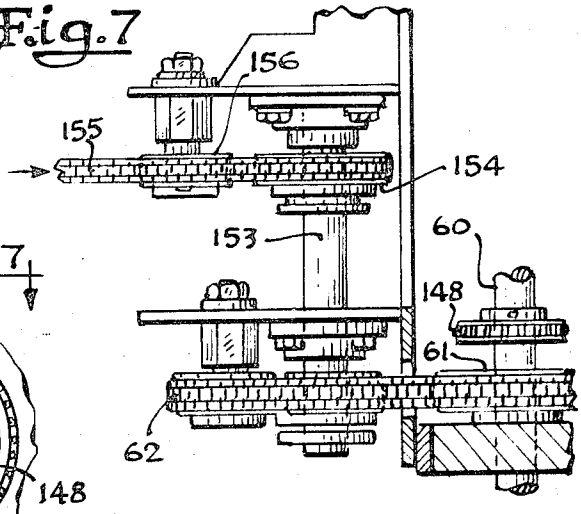


Fig.7



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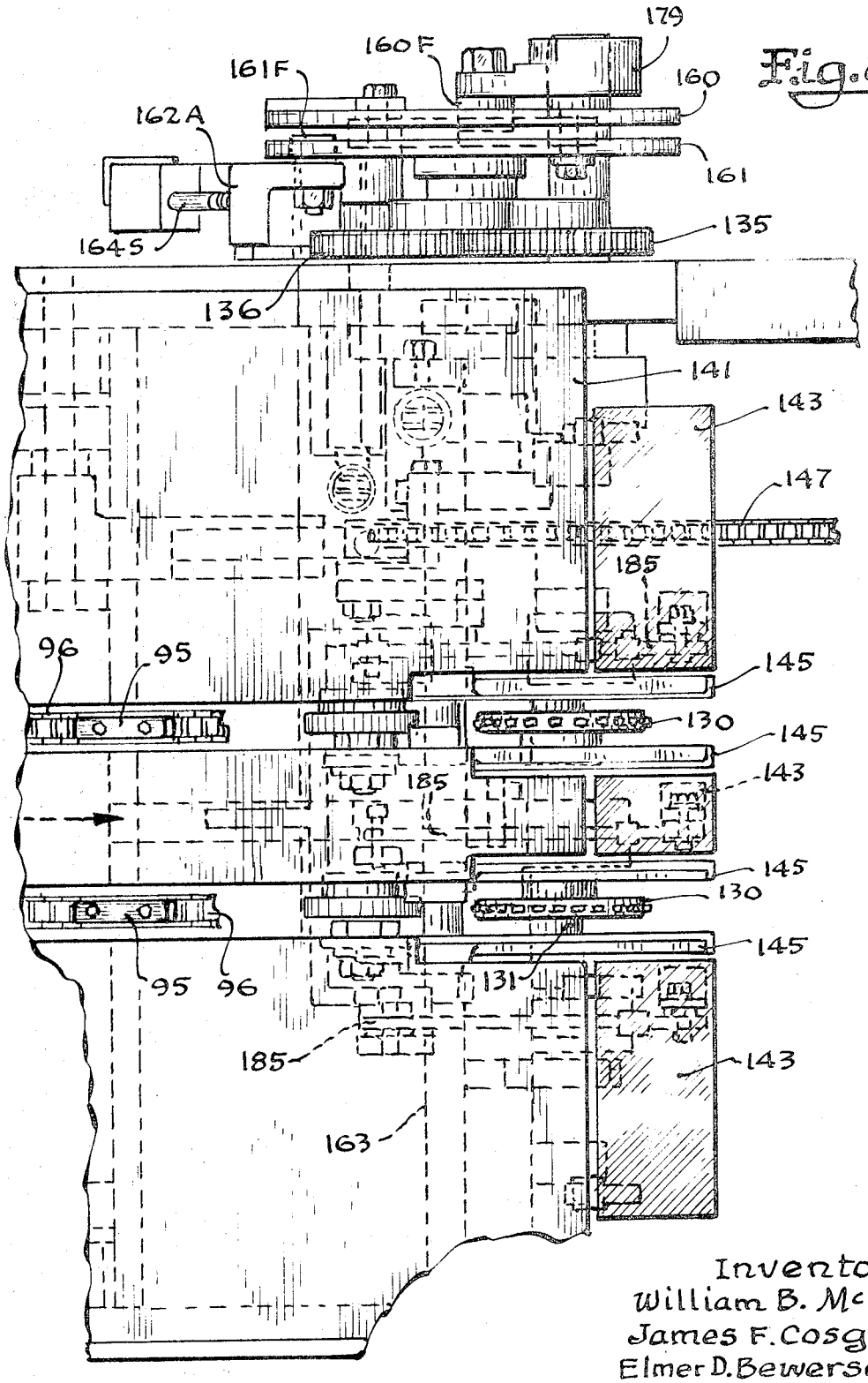


Fig. 8

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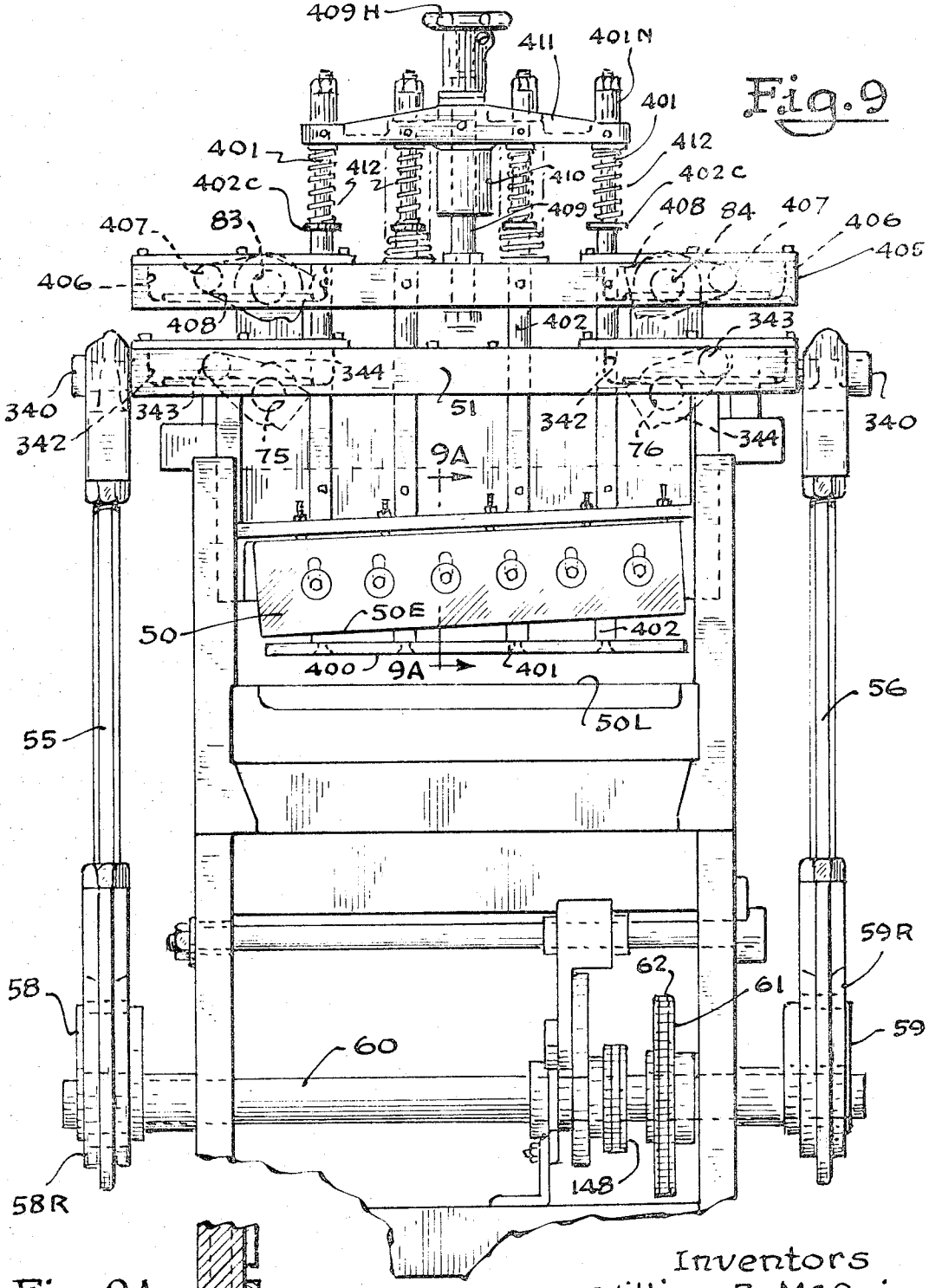


Fig. 9

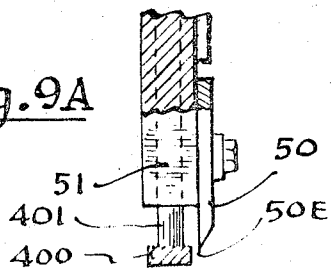


Fig. 9A

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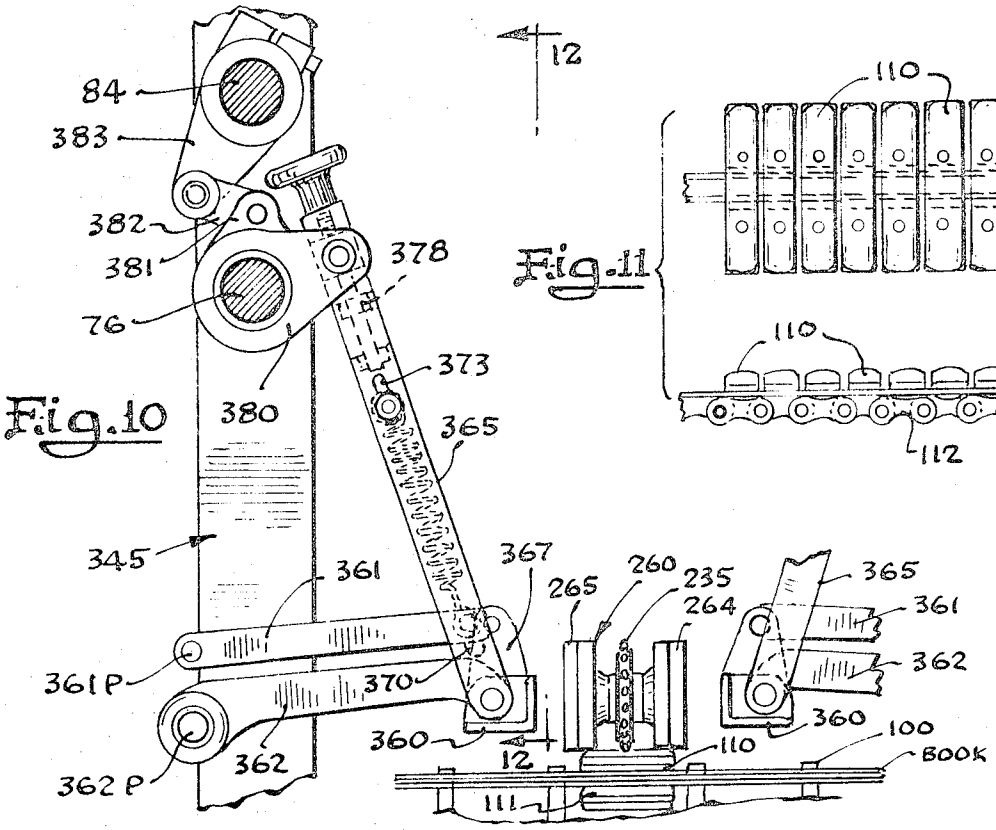


Fig.10

Fig.11

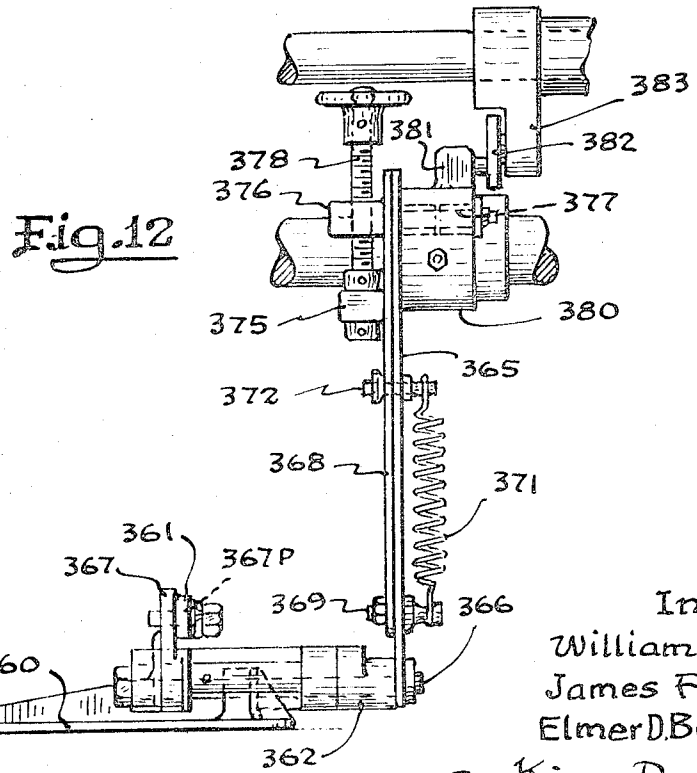


Fig.12

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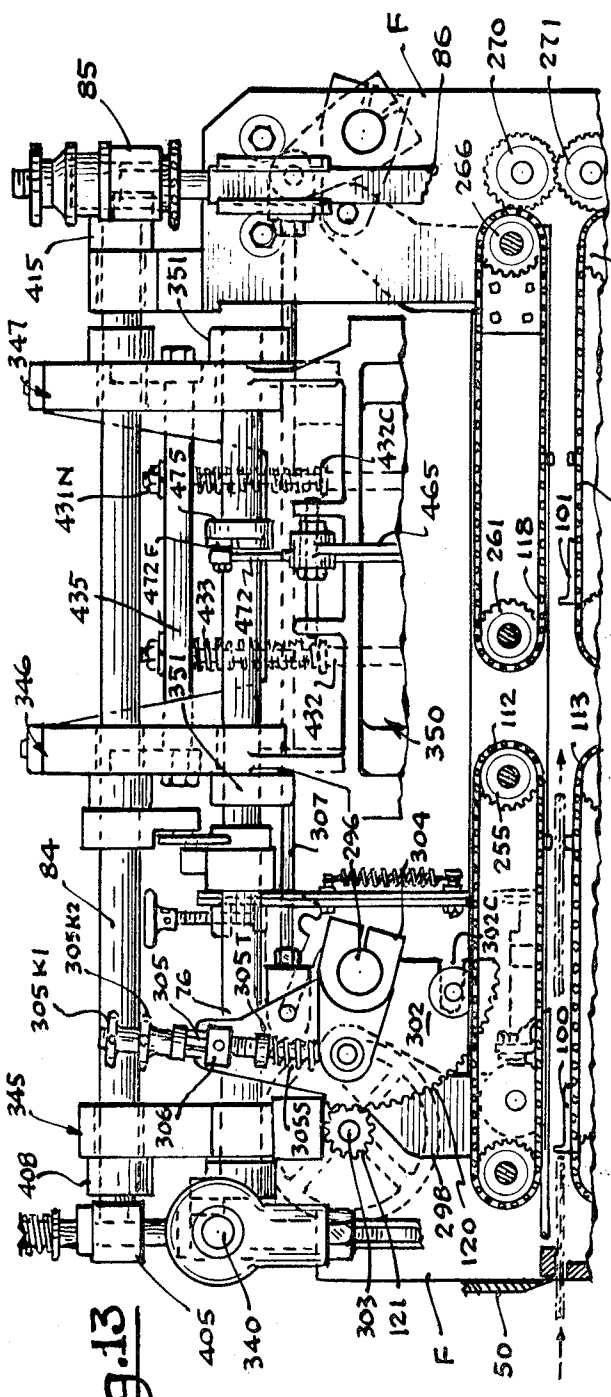


Fig.13

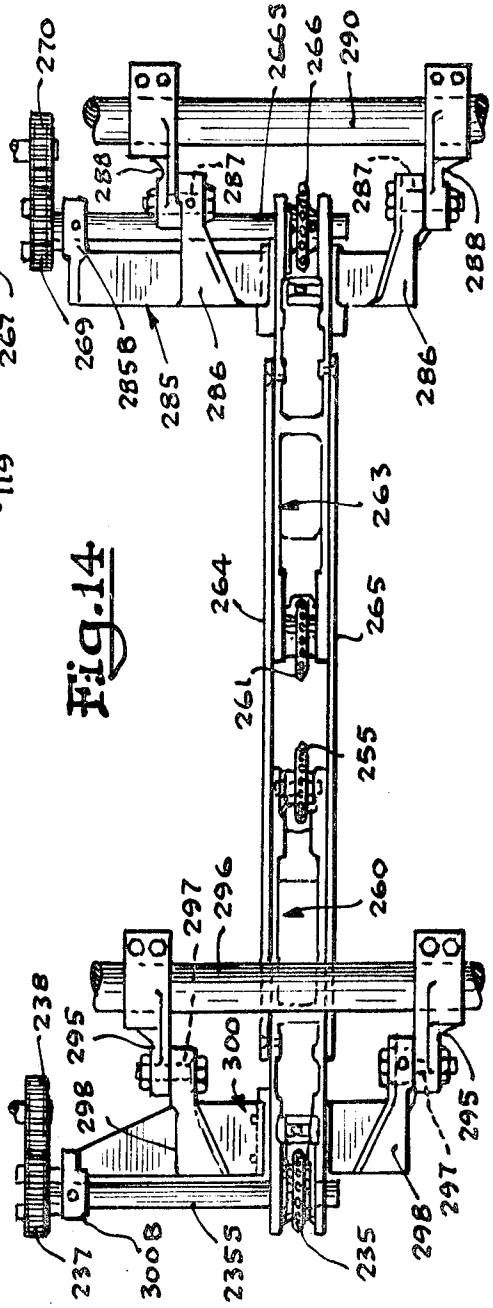


Fig.14

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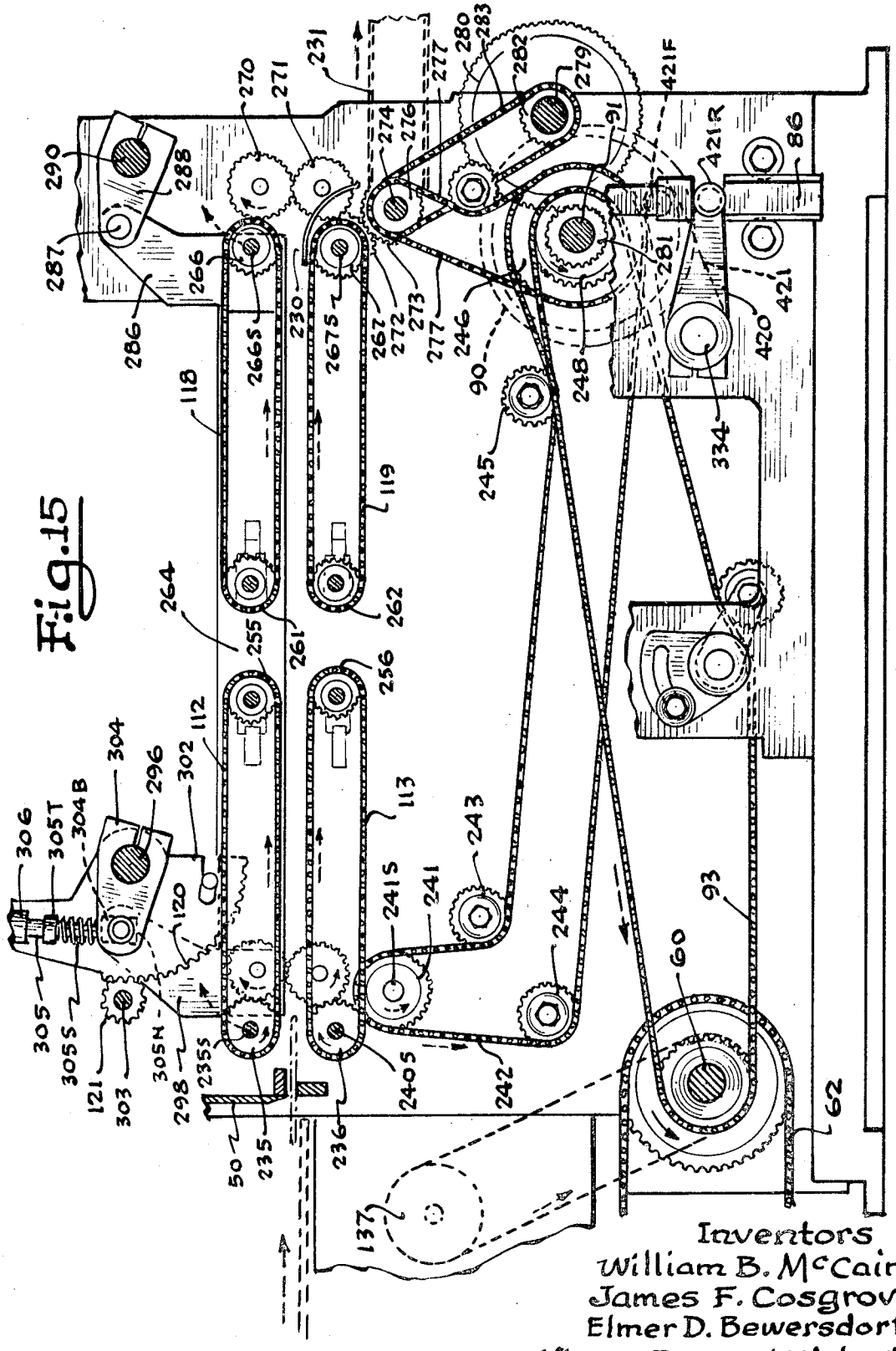
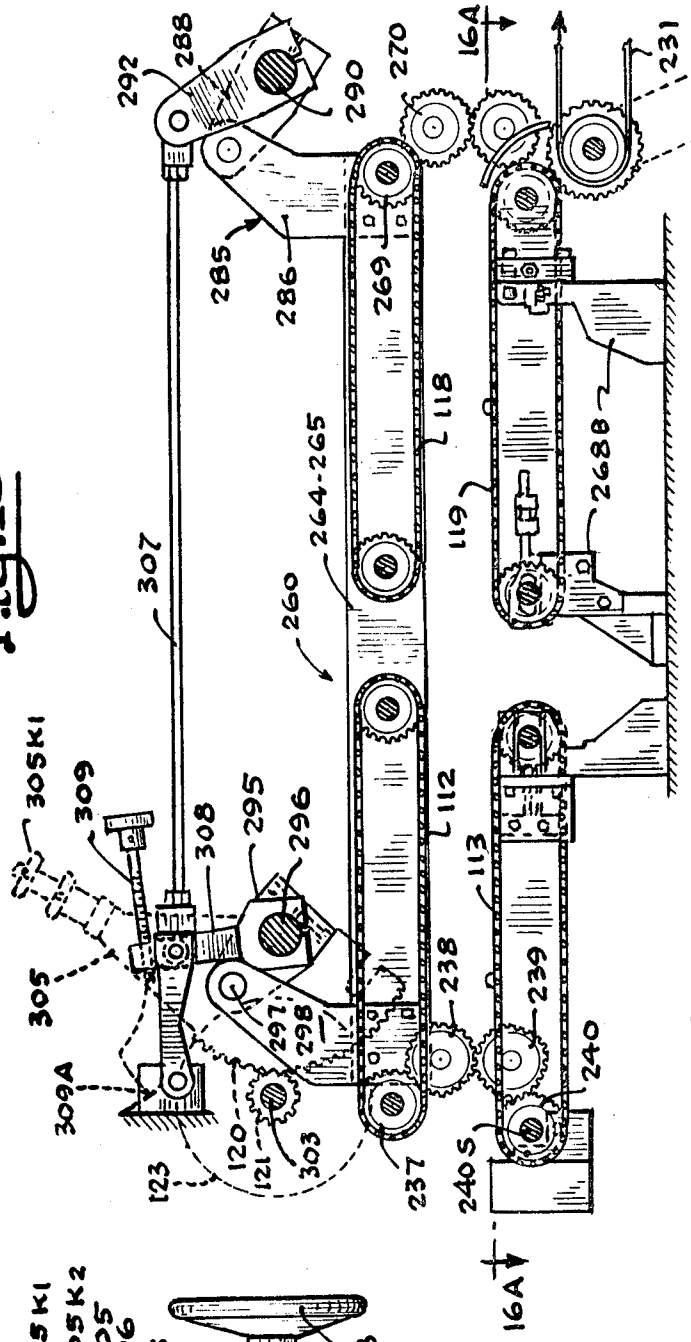


Fig. 15

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Fig.16



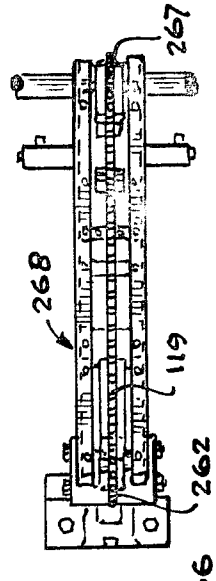


Fig.16A

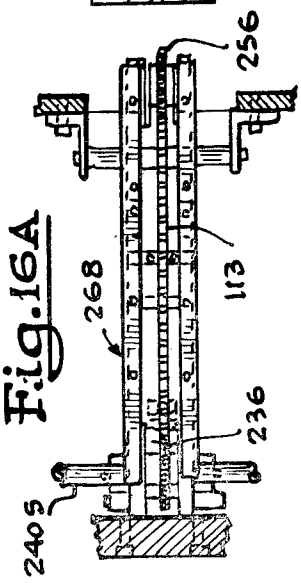
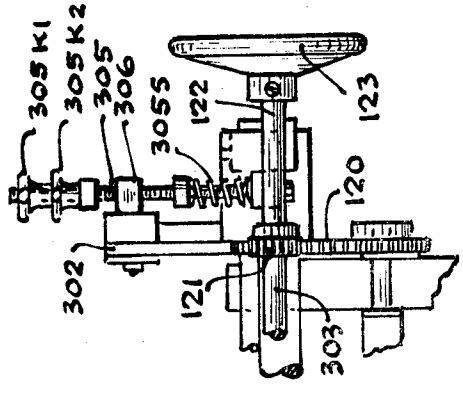
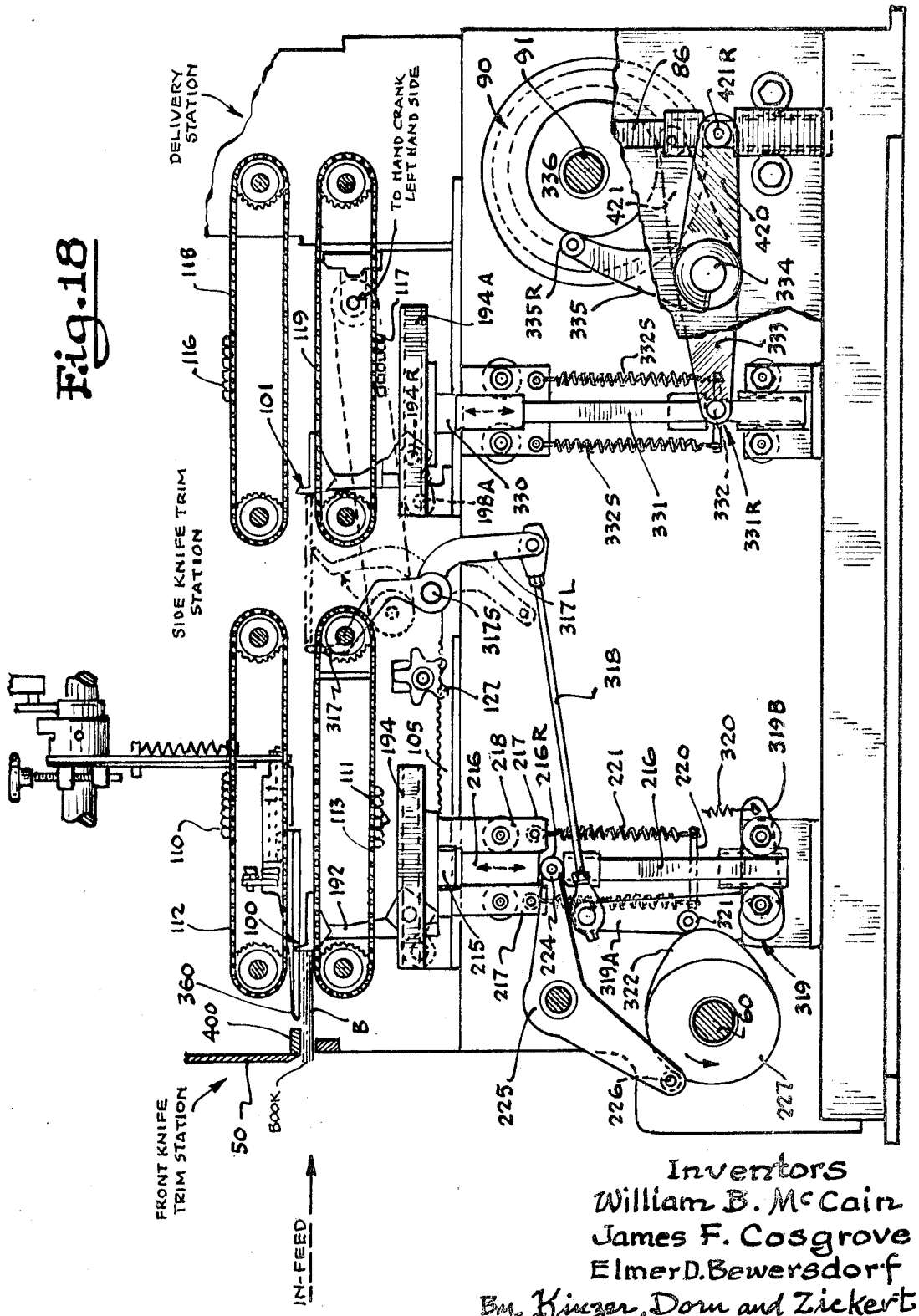


Fig.17



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Fig. 18



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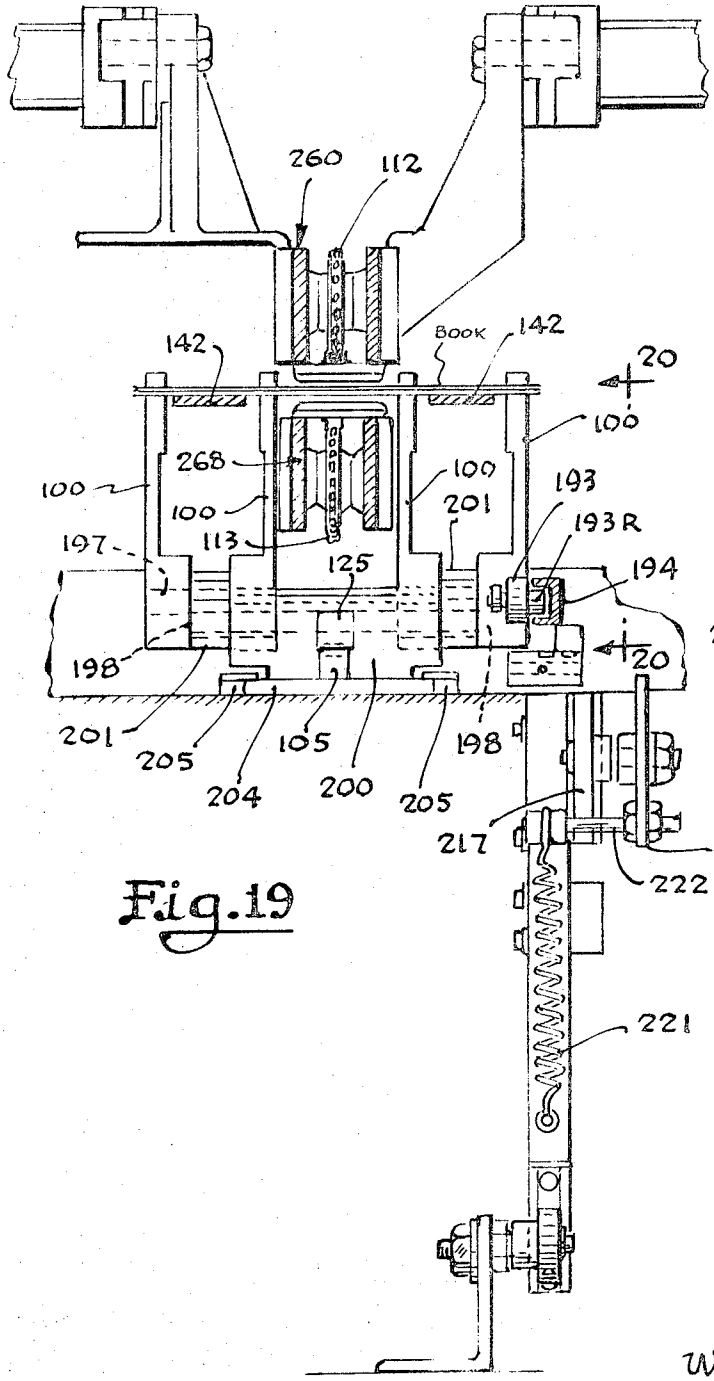


Fig.19

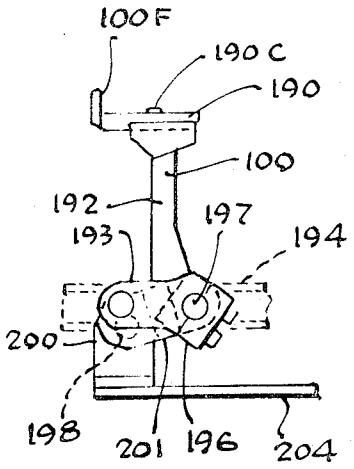


Fig.20

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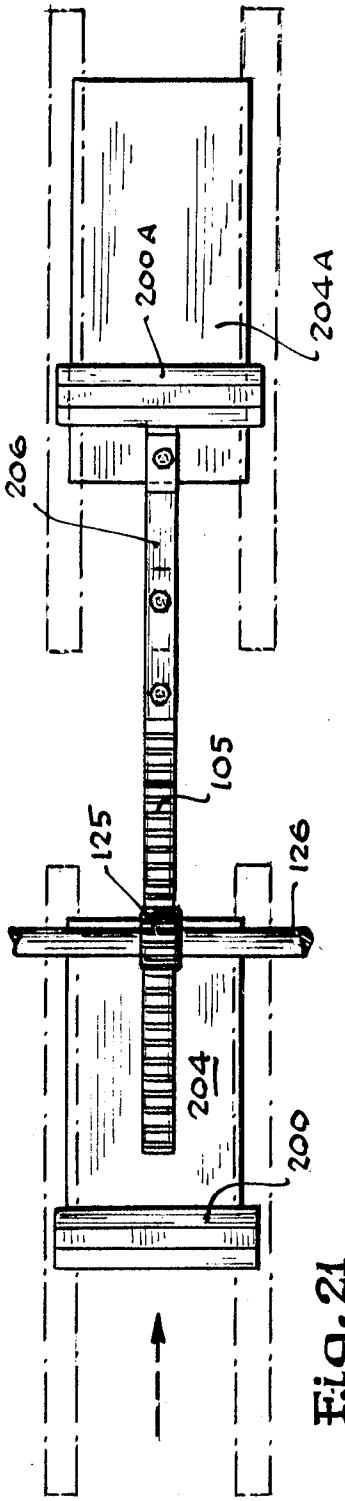


Fig. 21

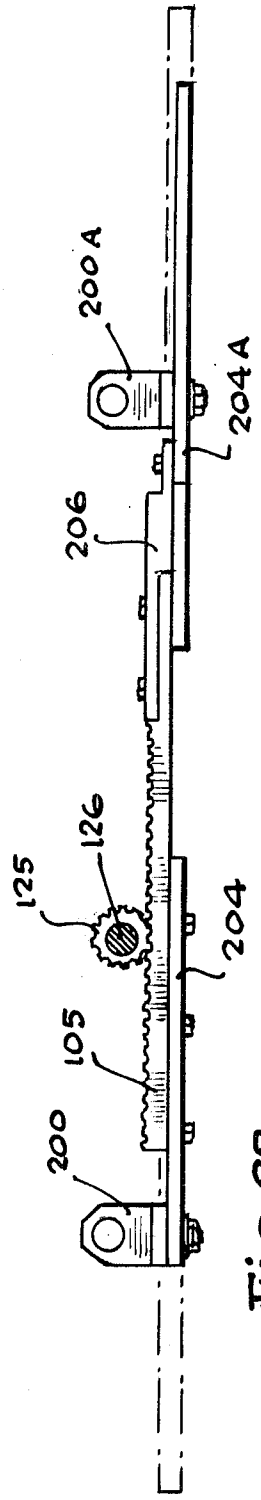


Fig. 22

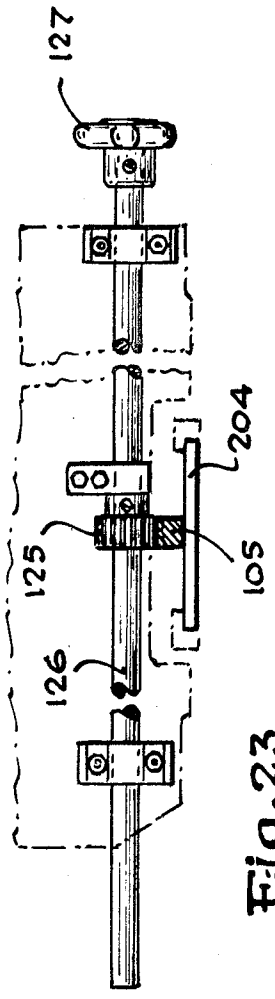


Fig. 23

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Fig.24

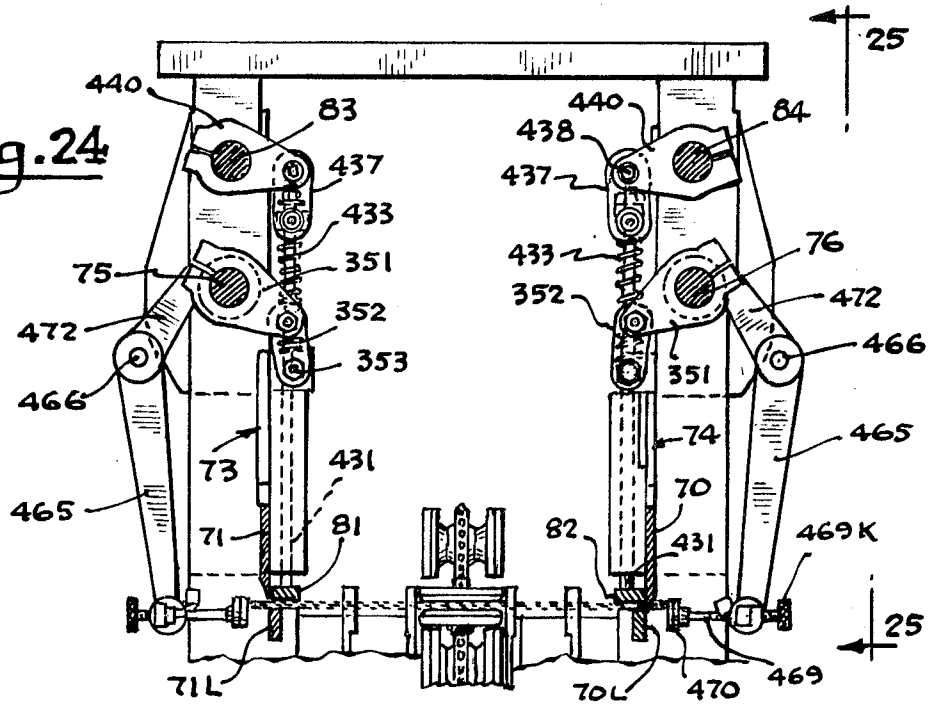


Fig.25

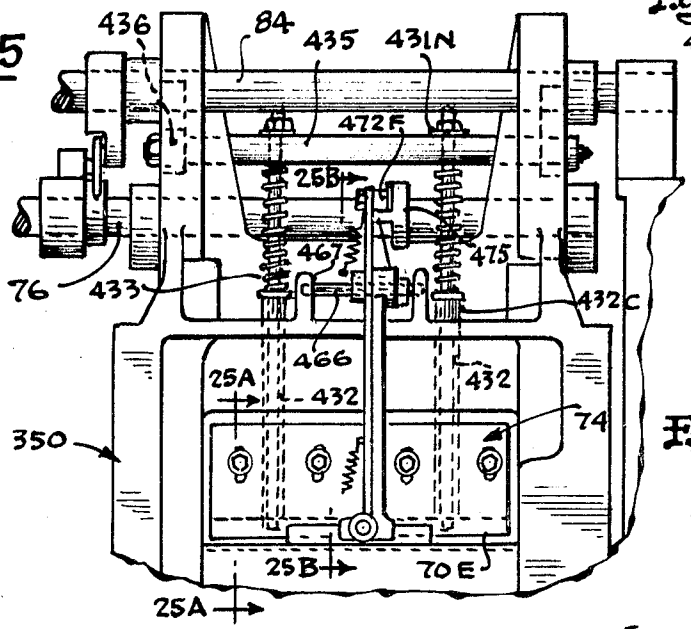
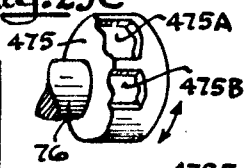


Fig.25C



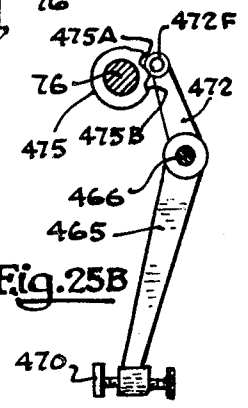


Fig.25B

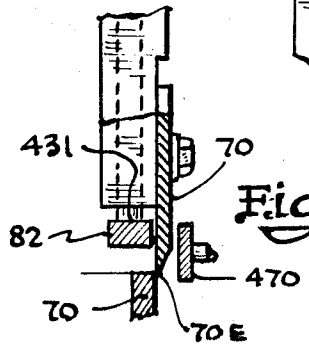


Fig.25A

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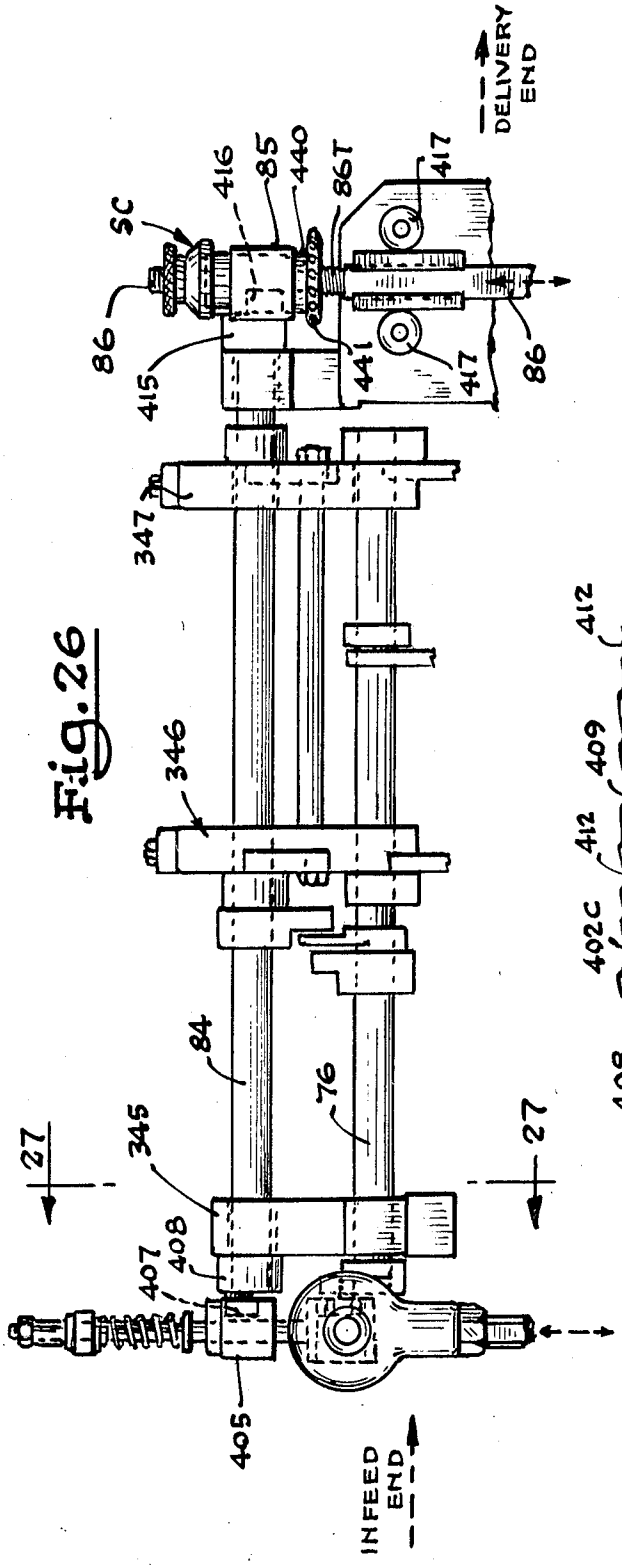


Fig. 26

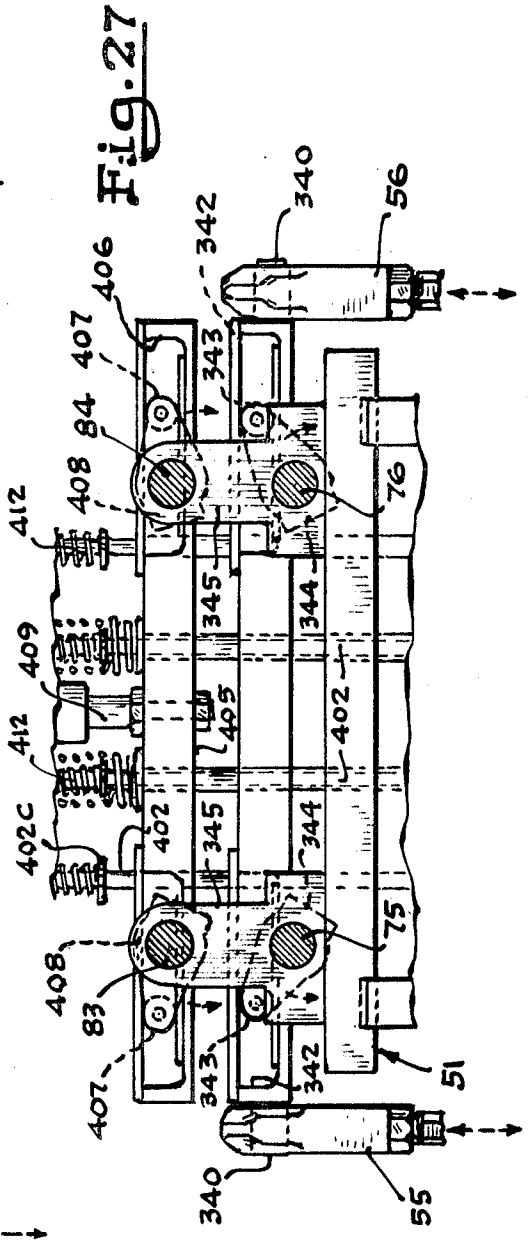


Fig. 27

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Fig. 28

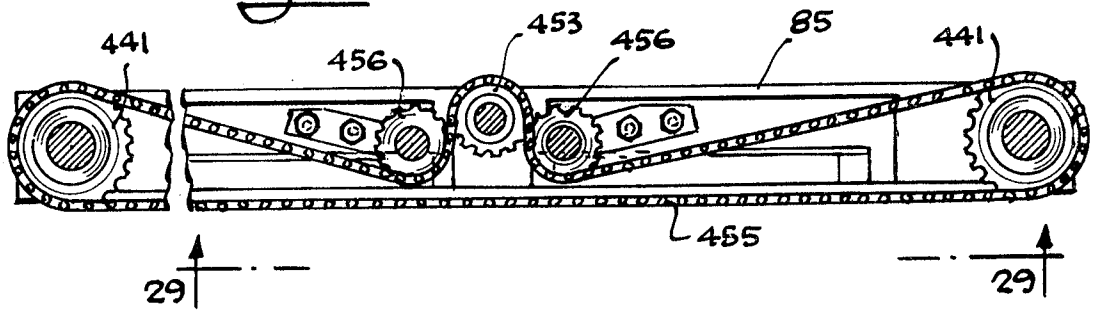


Fig. 29

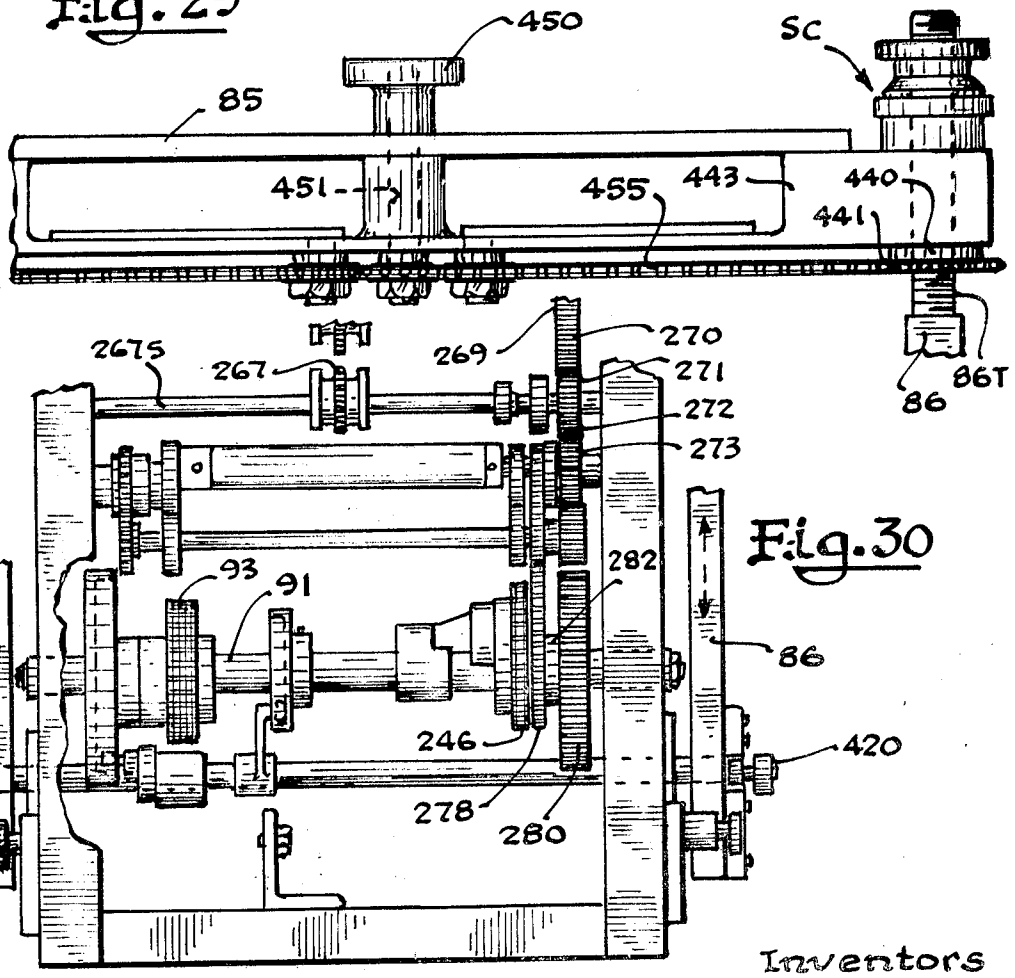


Fig. 30

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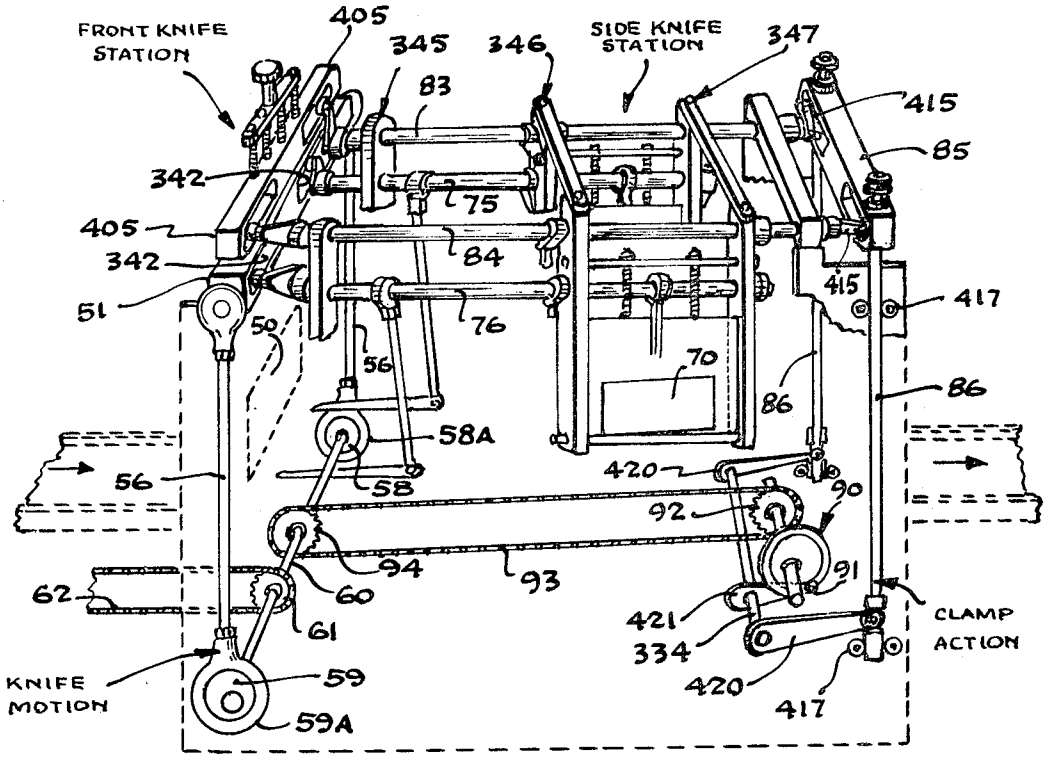


Fig. 31

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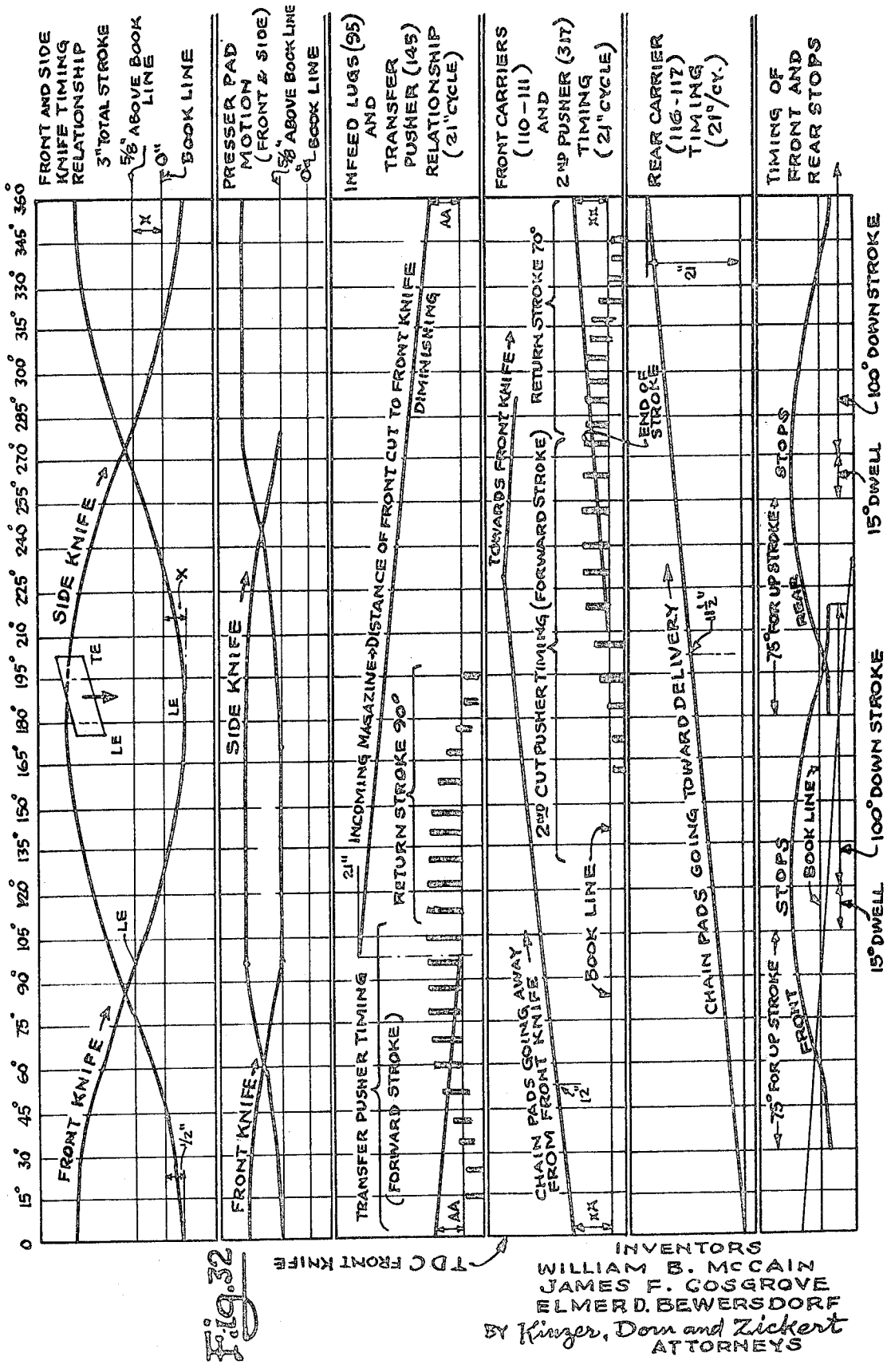


Fig. 32

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SHEET TRIMMING MACHINES

This invention relates to a cyclically operable trimming machine in which stacked sheets such as signatures or the like are fed through the machine in successive cycles and have the edges thereof trimmed.

Signatures (folded sheets) which comprise books (e.g. magazines, newspaper supplements and the like) are collected into individual groups or stacks and are joined at their backbones (the fold) to complete the content of the individual books. The backbones of the signatures in the collected group may be joined by staples. After the signatures are gathered into groups, and the groups thus joined into books, it is customary to trim each book to accurate size by a front cut, which is a cut along the edges of the sheets parallel to the backbone, and a so-called head and foot cut at right angles to the front cut.

The machine employed for the trimming operation is usually designated as a three-knife trimmer, there being a knife of shearing form for making the front cut and a pair of similar shear-cut knives spaced from one another and cutting at right angles to the first knife for producing trims at the head and foot of the book. Each knife has a moving head presenting a cutting edge which cuts in opposition to a fixed knife edge therebeneath, and in the known machine the front knife head is effective to drive the side knives, but in a manner different from the way in which the front knife drives the side knives under the present invention.

In a three-knife trimmer as heretofore constructed the front knife has been effective in one cycle of the machine, whereafter the book is advanced to the second knife trimming station for head and foot trimming in the next cycle of the machine. In actual operation it has been necessary to accelerate the book very rapidly from the front knife trimming station to the side knife trimming station between successive cycles of the machine. This need for acceleration has been necessitated by the fact that the hold-down devices for clamping the book and holding it stationary at the front knife station are carried by the head of the front knife for movement therewith. Thus the three-knife trimmer as heretofore constructed is one where the book clamps are brought into engagement with the book at the front knife station as an incident to the downward cutting stroke of the front knife. Release of the clamps is a function of the return stroke of the knife. In fact the construction of the known machine is such that the front knife is clear of the book in the course of its return stroke for nearly one-fourth of a cycle before the clamps are freed from the book, and of course it is not possible to transfer the book to the second knife station in the meantime.

There can be no question about the efficiency and satisfactory operation of the three-knife trimmer which preceded the present invention, but an analysis reveals that by separating the drive for the book clamps from the drive for the trimming knives the book can by transferred from the first knife station to the second knife station at less speed whereby the tolerances for registering are enlarged (e.g. the book does not have as much momentum or "bounce" at the slower speed) and it is possible at the same time to operate the front on the one hand and the side knives on the other hand 180° out of phase thereby balancing knife motion. Thus, by separating the drives for the clamps and the knives we are able to transfer the book in an easier fashion and to minimize vibrations. The separation of the clamp drive and the knife drive to allow the foregoing advantages to be realized constitutes the primary object of the present invention.

In preparing for a run with any machine of the kind involved, a considerable amount of "make-ready" is involved in that all operating parts having functions related to the dimensions of the sheets must be adjusted to those dimensions. Such parts include stops and feed belts. Other objects of the present invention are to construct a three-knife trimmer so that make-ready time is materially diminished and to do this by enabling the stops at the two trimming stations to be adjusted simultaneously, and to enable the feed bands for transferring the sheets from one station to another to be adjusted simultaneously through a parallelogram link system.

In the drawings:

FIG. 1 is a perspective view of the three-knife trimming machine of the present invention;

FIG. 2 is a fragmentary perspective view of the machine on the side opposite that shown in FIG. 1;

FIG. 2A is a detail perspective view showing an eccentric and a cam and related parts of the machine;

FIGS. 3, 4 and 5 are detail sectional views of the machine showing certain cams and related parts;

FIG. 6 is a detail view in elevation showing the manner in which an eccentric shaft and a cam shaft are driven;

FIG. 7 is a sectional view on line 7—7 of FIG. 6;

FIG. 8 is a fragmentary view on an enlarged scale showing a portion of the in-feed mechanism;

FIG. 9 is an end elevation at the front of the machine;

FIG. 9A is a detail sectional view of the front knife and front clamp;

FIG. 10 is a fragmentary elevation, partly in section, showing the clamps and related parts at the first knife station of the machine;

FIG. 11 is a combined view showing a fragment of one of the feed bands both in plan view and in elevation;

FIG. 12 is a fragmentary sectional view showing the presser pad and related parts used to flatten the backbone of the book at the first trimming station;

FIG. 13 is a fragmentary side elevation of the machine showing the two trimming stations;

FIG. 14 is a top plan view of the supports and drives for the upper feed belts or carriers;

FIG. 15 is a fragmentary sectional view of the machine showing the manner in which many parts are driven;

FIG. 16 is a detail sectional view of the means for adjusting the upper feed belt carriers;

FIG. 16A is a plan view on the line 16A-16A of FIG. 16;

FIG. 17 is a fragmentary elevation of the hand wheel and gears for making the adjustment to the feed carriers;

FIG. 18 is a sectional view of the machine showing in particular the way in which the stops are operated;

FIG. 19 is a sectional view of the machine also showing aspects of the stop operating mechanism and the supports for the feed bands;

FIG. 20 is a detail view of a stop;

FIGS. 21, 22 and 23 are, respectively, a plan, a side elevation and an end elevation of the adjusting mechanism for the stops;

FIG. 24 is a detail sectional view showing the clamps and side joggers at the second trimming station;

FIG. 25 is a view on the line 25—25 of FIG. 24;

FIGS. 25A and 25B are detail sectional views on the lines 25A—25A and 25B—25B of FIG. 25;

FIG. 25C is a detail perspective of one of the jogger cams;

FIG. 26 is a side elevation showing the rock shafts associated with the knife heads and the clamp heads;

FIG 27 is a sectional view on the line 27—27 of FIG. 26;

FIGS. 28 and 29 are, respectively, a detail side elevation and a plan view of the adjusting chain associated with the knife clamp, FIG. 29 being taken on the line 29–20 of FIG. 28;

FIG. 30 is a detail and elevation at the delivery end of the machine;

FIG. 31 is a perspective view of the machine somewhat schematized to simplify the understanding of the general arrangement and organization of the machine; and

FIG. 32 is a timing chart showing phases of operation.

GENERAL DESCRIPTION

Referring to FIGS. 9 and 31, the front knife 50 of the machine at the front knife station, is carried by a massive head 51 which is reciprocated by a pair of rods 55 and 56 operated by eccentrics 58 and 59 themselves of sufficient mass to produce a fly-wheel effect. The eccentrics are fixed to an eccentric operating shaft 60 having a sprocket 61 keyed thereto and driven by a chain 62 to rotate the eccentrics. The cutting edge 50E, FIG. 9, of the first knife trims the sheets by shearing in opposition to a fixed lower edge 50L.

Referring to FIGS. 24 and 31, the reciprocal side knives 70 and 71 have cutting edges working in opposition to fixed lower edges 70L and 71L, FIG. 24, to trim the heads and feet of the sheets at the second or side knife station, FIG. 31. The side knives are each supported by a massive head 73 and 74, and as will be explained in more detail, motion of the front knife is transmitted through a pair of rock shafts 75 and 76 to operate the side knives in unison.

Referring to FIGS. 24, 25, and 25A, there is a front clamp 400 for clamping the front of the book adjacent the front margin while being trimmed at the front knife station, and a pair of side clamps 81 and 82 for clamping the sides of the book adjacent the head and foot margins while being trimmed by the side knives.

The clamps thus afforded at the two trimming stations have reciprocal motion inparted thereto by means including a pair of rock shafts 83 and 84, FIG. 31. These rock shafts in turn are oscillated by means to be described in more detail below including a reciprocating head 85 reciprocated vertically by a pair of rods 86 controlled by a box cam assembly 90. The box cam 90 is fixed to a cam shaft 91 having a sprocket 92 thereon, turned by a chain 93. The chain 93 in turn is driven by a sprocket 94 fixed to the eccentric drive shaft 60.

The books or stacked sheets to be trimmed are advanced to the first trimming station by in-feed means in the form of lugs 95 projecting upwards from related in-feed chains 96, FIG. 1. Interposable stop means in the form of upwardly projecting fingers 100, FIG. 18, engage the backs of the sheets advanced to the front knife at the proper time, accurately to position the sheets for the front edge trim, following which the sheets are fed forward to a second stop 101 of similar form and function for accurately registering the books for trimming at the second station.

The stops 100 and 101, while independently related functionally to the front knife station and the side knife station, are supported in such a fashion that both can be adjusted simultaneously through a rack 105 to accomodate the stops to sheets of different length.

The book or group of stacked sheets subjected to front knife trimming is transferred to the side knife station by means including resilient transfer lugs, there being an upper set of such lugs 110 and a lower set 111, FIG. 18, respectively carried on a pair of upper feed bands 112 and a pair of lower feed bands 113 in the form of endless chains as will be described in more detail below. The feed lugs 110 and 111 at the proper time, following the front trim, engage the upper and lower side of the stack to transfer the stack to the stop 101. In like manner, there are upper and lower transfer lugs 116 and 117 at the side knife station supported on carrier chains 118 and 119, and these are effective to deliver the book or stack from the second knife station following head and foot trimming.

In order rapidly and efficiently to clear a jam at the front knife station or the side knife station and to be able quickly to adjust the carrier chains thus described to accommodate a book of different thickness, the supports for the upper carrier chains 112 and 118 are joined in a parallelogram linkage as will be described in more detail below so that the support system may be readjusted through a gear segment 120, FIG. 16, positioned by a pinion 121 fixed to a shaft 122 adapted to be rotated by a wheel 123 accessible at the side of the machine as shown in FIG. 1. It will also be noted in FIG. 1 that the rack 105 is engaged by a pinion 125 carried on a shaft 126 which may be rotated by a handle or knob 127 available at the side of the machine.

DELIVERY OF BOOKS TO THE FIRST KNIFE STATION

While the machine in this instance is specifically concerned with trimming operations performed on books such as magazines or the like, herein identified by reference character B, it will be appreciated that a book is but one example of a stack of sheets which may be trimmed by the present machine, so the term "book" is inclusive and not necessarily exclusive.

Each book to be trimmed is in-fed or advanced toward the front knife trimmer by the in-feed lugs 95, carried by in-feed chains 96 which are laterally spaced. The in-feed chains 96, FIG. 8, are turned by sprockets 130 carried on a sprocket drive shaft 131 turned by a driven gear 135 in an outboard position on the left side of the machine, FIG. 2A. The gear 135 in turn is driven by an outboard gear 136, FIGS. 2A, 5 and 8. Gear 136 is carried on the cam shaft 137, FIG. 5.

The chains 96 are constantly driven and the lugs 95 thereon are effective to advance the books toward the front trim knife. The books may be presented to the lugs 95 by rollers 139, FIG. 1, in such a fashion that a book is deposited on the chains 96 in advance of the arrival of a set of lugs, with the backbone BL in leading position, FIG. 1. The books may be arriving from a stitching machine where the signatures were joined to afford the book.

The in-feed lugs **95** move forwardly to the right as viewed in FIG. **1** along a plate or table **141.** The inner end **141E** of the table **141,** FIG. **5,** terminates short of the lower knife edge **50L** associated with the front knife in order to allow room for the lugs **95** to make the necessary down turn, downward around the sprockets **130** for return travel as will be apparent on reference to FIGS. **8** and **1.** This necessarily leaves a gap, reference character G, FIG. **3,** between the front edge of plate **141** and the adjacent table or plate **142** associated with the front knife and which supports the book during the front trim. This gap is normally spanned by a trap door **143** in elevated position, FIG. **4.**

Four feed fingers **145,** FIGS. **3, 5** and **8,** are effective to advance the book up against the front stops **100,** which is to say that as the in-feed lugs disappear beneath the top of the plate **141** the feed fingers **145** come forward to take over in a manner that will now be explained.

The cam shaft **137** extends laterally of the machine forward of the front knife station. This cam shaft has a sprocket **146** turned by a chain **147,** FIG. **6,** and the chain **147** in turn is driven by a sprocket **148** carried on the eccentric drive shaft **60.** As shown in FIG. **6,** the sprocket **61** for turning shaft **60** is driven by the chain **62** described above, and the chain **62** is trained around two tensioning idler sprockets **150** and **151,** the chain **62** being driven by a sprocket **152** carried on a sprocket drive shaft **153.** Referring to FIG. **7,** the drive shaft **153** carries a sprocket **154,** and this sprocket is driven by a chain **155** having a tensioning idler **156.** The chain **155** in turn is driven by a large drive sprocket **157,** FIG. **1,** on a shaft (not shown) which is part of a gear box **158,** and the input to the gear box **160** is in the form of a chain and sprocket drive **159** deriving constant motion from a motor, not shown.

Referring to FIG. **8,** the cam shaft **137** carries two relatively large cams **160** and **161** which are located in an outboard position on the left hand side of the machine, as will be more apparent in FIG. **2A.** The outer one of these two cams **160,** FIGS. **8** and **4,** is adapted to raise and lower the trap door **143** and the inner one of the cams **161,** FIG. **2,** controls the pusher fingers **145.** Cam **161** for operating the pusher fingers will first be described.

As shown in FIG. **3,** a cam follower **161F** is located on the rear side of cam **161** and is supported on an arm **162** as best shown in FIG. **2A.** Arm **162** is secured to a rock shaft **163,** and this same rock shaft has another arm **164** fixed thereto so that the assembly in effect is a bell crank. A spring **165** is tensioned between the free end of arm **164** and a stud at the side of the machine as shown in FIG. **2A,** whereby the cam follower **161F** is urged against its cam **160.** The "zero" position of shaft **163** may be varied as will be described.

Rock shaft **163,** FIGS. **3** and **5,** extends parallel to the cam shaft **137** beneath the plate **141,** and a large push finger operating arm **166,** FIG. **3,** is fixed thereto extending upwardly therefrom. Arm **166** pivotally supports a rock shaft **167** on which the four pusher fingers **145** are located.

A relatively short control arm **168,** FIG. **3,** is secured at its forward end to the rock shaft **167,** and at the opposite end, arm **168** is provided with a roller **170** which travels in an arcuate guide slot **171.** The guide slot **171** is formed in a bracket **172** which is positioned for adjustment on a pin **173** projecting from a support beneath plate **141.** The bracket **172** is spring biased against an adjustable stop (not shown).

A coil spring **175** is tensioned at one end on a pin (not shown) projecting from arm **168,** and the opposite end of the spring **175** is hooked to a stud **177** fixed to the machine. Thus it will be seen that the spring **175** acting on arm **168** serves at the same time to urge the rock shaft **167** counterclockwise as viewed in FIG. **3,** thereby biasing the roller **170** to follow the slot **171.**

In FIG. **3** the cam follower **161F** is on the dwell or low part of the cam **161.** The pusher fingers **145** are in a forward or extended position engaged with the trailing edge of the book, having pushed the book forward against the stops **100** at the front knife station. At this time, the roller **170** is located at the lower part, the forward end, of the guide slot **171.** As cam **161** turns to present its lobe or high part to the follower **161F,** rock shaft **163** which carries the push finger operating arm **166** is turned counterclockwise, thereby retracting fingers **145** leftward as viewed in FIG. **3,** and at the same time the fingers **145** are depressed or moved downward due to clockwise turning movement of shaft **167** effected by the roller **170** moving leftward along the rising portion of the slot **171.** When the dwell of the cam is presented, arm **166** carries the fingers **145** forward once more. It will be appreciated that this to-and-fro motion of the pusher fingers **145** is a cyclical operation controlled entirely by the cam **161.** It should be stressed that the fingers **145** are moved forward to further in-feed the book at the time when the in-feed lugs **95** turn downward at the end of their forward flight.

Motion of the trap door **143** is under control of cam **160** which is also on cam shaft **137,** FIGS. **3** and **4.** The cam **160** has a follower **160F** associated therewith. The follower **160F** is carried on one end of an arm **179** fixed to a rock shaft **180.** The rock shaft **180** has another arm **181** fixed thereto, and this arm is tensioned by a spring **183.** Thus the spring **183** in effect tends to turn rock shaft clockwise as viewed in FIG. **4,** holding the follower **160F** against the periphery of cam **160.** A trap door control arm **184** is fixed to the rock shaft **180** and extends rearwardly and upwardly therefrom.

In the condition illustrated in FIG. **4,** the dwell of cam **160** is presented to the follower **160F.** The trap door is elevated. At the time of the cutting stroke of the front knife, however, the rise or high part of cam **160** is presented to the follower **160F** turning rock shaft **180** counterclockwise as viewed in FIG. **4.** The control arm **184** is rocked rearward, withdrawing a link **185** which at one end is pivotally connected to the free end of arm **184** and which at the opposite end is pivotally connected to the underside of the door **143.** It may be mentioned that the trap door is represented by three distinct and separate plates **143,** FIG. **8,** each having its own operating link **185.** In like manner, there are three operating arms **184.**

It will be seen from the foregoing that the sheets in a stack to be trimmed are moved against the registering stops **100** by the reciprocating pusher fingers **145** which engage the trailing edge of the book as the in-feed lugs **95** disappear beneath the top of plate **141.** Thus the pushers **145** continue the in-feed, and when a book has been advanced against the stops **100** then the pusher fingers are retracted or withdrawn rearwardly and at the same time are lowered.

The trap door **143** is raised and lowered under cam control just as the reciprocal advancing and retracting

movement of the pusher fingers is under cam control. The trap door elements **143** are in their lowered position at the time the front knife completes its cut.

The manner in which the book is registered for the front cut will now be described in more detail.

There are four front stop assemblies **100**, FIG. **19**, laterally spaced from one another to engage the backbone of the book B, FIGS. **18** and **19**. These stops are positioned to operate vertically in slots in the plate **142**, FIGS. **3**, **4** and **19**, thereby to be interposed in and withdrawn from the path of the book moving to and from the front knife station.

As shown in FIG. **20**, each stop assembly **100** includes a vertically oriented finger **100F** projecting upward at one end of a horizontal support **190**. It is this finger which stops the book. The support **190** in turn is fastened at the upper end of a carrier arm **192** by a screw **190C** extended through an elongated slot in the support which allows for fine adjustment to be made as to the precise position of the stop finger **100F**.

The right hand support arm **192**, FIGS. **19** and **20**, has a rearwardly projecting extension **193** to which a roller **193R** is journalled. The roller fits in the slot of a guide rail **194** which is responsible for raising and retracting the four stop fingers in unison in a manner to be described.

Each support arm **192** is formed with a forwardly projecting split clamp **196** which is clamped to a bail or shaft **197** which extends laterally. In this manner, the stops are joined by the bail **197** for operation in unison.

A support shaft **198** extends laterally, parallel to shaft **197** and rearward thereof. This shaft is journalled in an adjustment bracket **200**. The ends of the shaft project outward of the bracket **200** and serve to pivotally support a pair of arms **201** which at their opposite or forward ends are fitted to the bail **197**.

In effect, shaft **198** supports the two forwardly extending arms **201**, the latter support the bail **197**, and the bail joins the front stop support arms **192**. The assembly of shafts and arms is secured against displacement by the clamps **196**.

Before describing in detail the manner in which the stops **100** are interposed and retracted with respect to the book, it is appropriate to disclose the manner in which the front stops **100**, FIG. **18**, are connected to the rear stops **101** so that the two stop assemblies may be adjusted longitudinally in unison. Referring to FIG. **21**, the bracket **200** supporting shaft **198** for the front stops is secured to a slide plate **204** which, as shown in FIG. **19**, is adapted to slide in a guide afforded by laterally spaced flange-ways **205**.

The slide plate **204** carried the adjustment rack **105**, and the right-hand end of this rack **105** as viewed in FIG. **22** is fastened to a bracket **206** which in turn is fastened to a slide plate **204A** which supports a bracket **200A** identical to the bracket **200**. The bracket **200A** is associated with the rear stops in a manner quite similar to the bracket **200** for the front stops. Thus, when pinion **125**, FIGS. **21–23**, in turned, both slides **204** and **204A** are shifted to alter the for-aft position of the brackets **200** and **200A** which support the front and rear stop assemblies. Since the brackets move, the front stop shaft **198** moves and so does the rear stop shaft **198A**, FIG. **18**, for the rear stop assemblies **101**. The roller **193R** merely moves on the rail **194**, being carried along, noting that there is a rear rail **194A**, FIG. **18**, supporting a roller **194R** which operates similar to the roller **193R** in all respects as will now be described.

The rail **194** is secured to the upper side of a pedestal **215**, FIG. **18**, carried on a slide **216**. The slide **216** is guided for vertical movement between a pair of fixed bars **217**. Each bar supports an anti-friction roller **218** engaged with one side of the slide **216**. The lower end of the slide is similarly guided.

A horizontal pin **220** is inserted in the slide and springs **221** at their lower ends are hooked to the pin **220** and at their upper ends are tensioned on studs **222**, FIG. **19**, secured to a plate **223** fastened to the guide bars **217**. In this manner, the rail **194** is biased upwards to normally interpose the stop assemblies **100** in the path of the book.

Rail **194A** which operates the rear stop assemblies **101** is similarly supported, guided and biased as shown in FIG. **18**.

The slide **216** is cam controlled to retract the rail and support arms for the stops. Thus, the slide is provided with means defining a recess **216R** intermediate its ends. A roller **224** is carried at the forward end of one arm of a bell crank lever **225**, pivotally supported as shown in FIG. **18**. The other arm of the bell crank carries a cam follower **226** associated with an operating cam **227** turned by cam shaft **60**. Springs **221** hold the follower on the cam.

When the high part of cam **227** is presented to follower **226**, the bell crank is rocked clockwise, FIG. **18**, forcing slide **216** downward. Rail **194** is pulled downward and is effective on roller **193**, FIG. **20**, to withdraw the stops.

The effective operating angle of the rock shaft **163**, and therefore the length of stroke of the pusher fingers **145**, may be selected and adjusted through a set screw **164S**, FIG. **3**, threadedly mounted in arm **164**. To this end, follower **161F** is carried on a finger **172A**, FIG. **2A**, adjustable on arm **162** through a screw and slot connection thereto, shown by reference character **162C**. The free end of screw **164S**, FIGS. **3** and **5**, bears on an abutment on the rear side of finger **162A**. By adjusting the set screw and concurrently loosening **162C**, the zero or index position of rock shaft **163** may be preset thereby to determine the effective stroke of the pusher fingers **145**.

DELIVERY OF BOOKS TO AND FROM THE SECOND KNIFE STATION

As noted above, the carrier chains **112** and **113**, FIG. **13**, are provided with a plurality of soft, resilient carrier bars **110** and **111**, and these are effective, following the front trim, to advance the partially trimmed book B toward the back or rear stop elements **101**. Following head and foot trimming by the side knives, the back stops **101** are lowered, the trimmed book is picked up by similar carrier bars **116** and **117** on the carrier chains **118** and **119**, and the completely trimmed book is advanced in the direction of a guide plate **230**, FIG. **15**, which guides the trimmed book to a delivery belt **231**.

The forward carrier chains **112** and **113** are respectively driven by driving sprockets **235** and **236**, FIG. **15**, one above the other. Referring to FIG. **14**, sprocket **235**, shown in plan view, is carried on a shaft **235S** and the outboard end of this shaft is provided with a driven gear **237** meshed with a drive gear **238**. Gear **238**, FIG. **16**, is meshed with a transmitting gear **139** in turn

driven by gear 240 on a shaft 240S which supports sprocket 236, FIGS. 15 and 16A. The gears 238 and 239 are part of the train which includes 237–238–239–240, and are journalled on stud shafts supported by the side plate (not shown) of the machine. Gear 240 is meshed with and driven by a gear (not shown) journalled on a similarly supported stub shaft 241S, FIG. 15, which carries a sprocket 241 driven by a chain 242. The chain 242 is tensioned by idlers 243, 244 and 245 and is driven by a sprocket 246 on cam shaft 91. The cam shaft 91 supports a sprocket 248 driven by chain 93.

The carrier chains 112 and 113 are trained around rear sprockets 255 and 256, FIG. 15, which are idler sprockets. As shown in FIG. 14 the front and rear sprockets 235 and 255 (and in like manner the sprockets 236 and 256) are journalled at the opposite ends of support arms as 260.

In like manner, the rear carrier chains 118 and 119 are trained around idler sprockets 261 and 262, one above another, each journalled at the front end of a support arm as 263, FIG. 14. The support arms as 263, FIG. 14, support driving sprockets 266 and 267 at their opposite or rear ends, FIG. 15, around which the respective carrier chains 118 and 119 are trained. The support arms as 260 and 263 which support the carrier chain sprockets are joined by plates 264 and 265, FIG. 14.

As shown in FIGS. 16A and 19, the sprockets for the lower carrier chains are similarly supported including support arms 268. The support arms 268, however, are stationarily fixed to brackets 268B, FIG. 16.

Drive sprocket 266 is carried on a shaft 266S, FIGS. 14 and 15, and this shaft is equipped at its end with a driven gear 269 in turn rotated by a driving gear 270 which as shown in FIG. 15 is meshed with a transmitting gear 271 in turn driven by a gear 272 fixed to shaft 267S which carries the driven sprocket 267. Thus, there is another gear train 266–270–271–272–273 for driving the carrier chains 118 and 119.

Gear 272 is meshed with a driving gear 273 which is part of the same gear train. Gear 273 is carried on a stub shaft 274 at the side of the machine, provided with a sprocket 276 driven by a chain 277 which in turn is driven by a sprocket 278, FIG. 30, on shaft 91 adjacent sprocket 246 and the same size as sprocket 246.

A shaft 279, FIG. 15, carries a large gear 280 meshed with and turned by a smaller gear 281 carried on shaft 91. Shaft 279 carries a sprocket 282 which drives a chain 283 connected to a sprocket (not shown) adjacent sprocket 276 on shaft 274, thereby to drive the delivery carrier 231.

Thus it will be seen that the upper and lower carrier chains in both the front set and the rear set derive power from independently driven gear trains which in turn receive rotary motion from shaft 91, transmitted by chains and sprockets. The gear trains for the carrier chains are of identical ratios so that all carrier chains move at the same linear speed. Further, the support arms 260 and 263 which support the upper carriers 112 and 119 are joined by plates, and this enables both upper carrier chains to be adjusted simultaneously through the same adjusting increment as will now be described.

As shown in FIGS. 14 and 15 a bracket 285 including a pair of laterally spaced vertically extending arms 286 is pivotally supported on pins as 287, and pins 287 in turn are carried at the free ends of forwardly projecting arms 288 clamped to a support shaft 290 which extends between and is supported by the side frames of the machine. Bracket 285 is fastened to the right hand end of the support arm 263.

Support shaft 290, FIG. 16, has an oscillatable operating arm 292 clamped thereto, and when this arm is oscillated, shaft 290 is rocked whereby the support arms 286 will be raised or lowered as the case may be in which event gear 269 uses gear 270 as a track. Thus by comparing FIGS. 15 and 16, it will be noted that gear 269 is in a higher or more elevated position, FIG. 17, compared to the lower position in FIG. 15. This is equally true of gear 237 which uses gear 238 as a track, and the manner in which this precise and equal adjustment is accomplished will now be described.

Again referring to FIG. 14, a pair of arms 295 are clamped to a support shaft 296 which extends between and is supported by the side frames of the machine. The arms 295 extend forwardly and upwardly, FIG. 16, and are provided with pins 297 on which are journalled a pair of arms 298 which are part of a bracket 300. The bracket 300 is fastened to the left-hand or forward end of arm 260. Bracket 300 is provided with a bearing extension 300B which serves to support one end portion of shaft 266S. The opposite end portions of shafts 235S and 266S are supported for rotation at the ends of their respective arms 260 and 263.

A plate 302, FIGS. 15 and 17, presenting segment gear 120, is rotatably mounted on shaft 296. Normally, plate 302 is stationarily clamped to the adjacent side frame F of the machine by a washer-type clamp 302C, FIG. 13.

It will be recalled that pinion 121 is meshed with gear 120. The pinion 121 is fixed to a shaft 303, FIGS. 13 and 15, and this shaft carries the adjusting wheel 123, FIG. 1, which when turned, will be effective to turn plate 302 when the clamp 302C is released.

An arm 304, FIGS. 1 and 15, is clamped to the outboard end of shaft 296. Arm 304 at the free end thereof has an anchor block 304B, FIG. 15, having an opening through which is passed freely the lower end of a tie rod 305, FIG. 15. A nut is fixed to the lower end of rod 305. The upper end portion of the rod 305 extends, by a threaded connection, through a support block 306 at the upper end of the segment gear plate 302. Thus, when plate 302 is rocked, say clockwise, as viewed in FIG. 13, rod 305 is lifted. Rod 305, through nut 305N, turns arm 304, rocking shaft 296 in the same direction.

The adjusting plate 302 is joined to the arm 292, FIG. 16 by a rod 307. Thus when pinion 121 is turned, segment 120 is turned, plate 302 rocks on shaft 296 and transmits similar rocking motion to arm 292 which moves the connecting rod 307. The connections and centers are such that arms 286 and 298 are raised or lowered by the same increment.

The primary advantage to supporting the upper carrier chains in the manner described is that a jam of books between the knife stations may be easily and readily cleared by releasing clamp 302C, FIG. 13, and turning handle 123 to raise the supports for the upper carriers through the parallelogram linkage described. Moreover this same means enables the vertical spacing between the carrier lugs 111–112 and 116–117 to be adjusted to accomodate books of different thickness. In this connection adjustable stop means are provided to

determine accurately the set spacing between the upper and lower carriers.

Referring to FIG. 16, shaft 296 to which the gear segment plate 302 is clamped is provided with an arm 308, and an adjusting screw 309 is threadedly mounted on the free end thereof. This screw at its upper end has a handle enabling the screw to be turned, and the opposite end of screw 309 bears on a fixed abutment 309A.

When shaft 296 is turned clockwise incidental to raising the upper carrier supports, the free end of screw 309 is disengaged from the abutment 309A, but when the carrier supports are returned screw 309 will engage the abutment 309A to maintain the fixed position separating the carriers by the required distance.

Nonetheless, arm 304, FIG. 13, is yieldable, which is to say that the connection between arm 304 and plate 302 is yieldable. This is accomplished by a known lost motion connection including a spring 305S, FIG. 13, which surrounds a portion of rod 305. The lower end of the spring bears on the top of the abutment 304B on arm 304 in which the lower end of the rod 305 is slidably fitted. The upper end of the spring bears on a stop 305T carried by rod 305. Rod 305 is threadedly mounted in the block 306 and may be adjusted therein by lock knobs 305K1 and 305K2 to vary the spring pressure. If a jam is encountered, the carriers may tend to be lifted and this is manifest in clockwise motion of arm 304, compressing spring 305S.

The books to be trimmed by the side knives are advanced by the carrier lugs 110 and 111 to a set of pusher fingers 317, FIG. 18, carried on a rock shaft 317S to which is affixed an operating lever 317L adapted to be oscillated by a reciprocable rod 318. Thus, one end of the rod 318 is pivotally connected to the lower end of the lever 317L and the opposite end of the rod 318 is pivotally connected to the upper end of one arm 319A of a bell crank lever system 319. The opposite arm 319B of the bell crank is tensioned by a spring 320, urging a follower 321 against a cam 322 on shaft 60.

As shown in FIG. 18 the high part of cam 322 is presented to the follower 321, positioning the pusher fingers 317 in their rearwardmost position, ready to deliver a book, advanced thereto by the carrier lugs 110 and 111, to the stops 101 at the side knife trimming station. As the high part or lobe of cam 322 passes off the follower cam 321, spring 320 is effective to rock the bell crank system 319 counterclockwise as viewed in FIG. 18, pulling rod 318 rearward, resulting in forward or clockwise motion of the pusher fingers 317 which deliver the book to the stops 101. From this it will be seen why it is important to be able to adjust the stops 100 and 101.

As was mentioned above, the stops 101 in their operation are essentially similar to the stop elements 100. Thus the rear stops 101 are pivotally supported in the manner of the stops 101 and are associated with a guide rail 194A similar in all respects to the rail 194. Additionally the rail 194A is supported by a pedestal 330, FIG. 18, in turn joined to a vertical slide 331 normally biased upwardly by springs 332S.

The slide 331 is provided with means which define a recess 331R, and a roller 332 is disposed therein. The roller 332 is carried at the forward end of one arm of a bell crank lever 333 rotatably mounted on a rock shaft 334. The other arm of the bell crank, 335, is provided at its free end with a roller 335R which follows a cam 336 on cam shaft 91. Thus cam 336 is effective to raise and lower rail 194R to interpose and retract the stops 101 relative to the path of the book being delivered to the side knives by the pushers 317.

OPERATION OF THE KNIVES

As described above, the front knife is carried by a massive head 51, FIG. 9, and the two side knives 70 and 71 are carried by heads 73 and 74, FIGS. 24. Shaft 60, FIGS. 9 and 31, carries the eccentrics 58 and 59, and these eccentrics are effective through the usually associated races 58R and 59R to reciprocate a pair of vertical, front knife operating arms 55 and 56 extending upwardly therefrom. The upper ends of the front knife operating arms are pivotally connected to studs 340 projecting outwardly from opposite sides of the head 51 for the front knife as best shown in FIG. 9. The manner in which the knife head 51 is guided will be described below. The manner in which the front knife is constructed constitutes no part of the present invention and in fact operation of the front knife is standard.

The rear side or face of the knife head 51, at the top thereof, is provided with means affording a pair of horozontally elongated recesses 342, and rollers 343 are fitted therein, FIGS. 9 and 27. The rollers 343 are journalled at the free ends of arms 344, and the arms 344 are clamped to the free front ends of the longitudinally extending side knife operating shafts 75 and 76. Each of the shafts 75 and 76, FIGS. 1 and 2, is supported for rocking motion in a respective set of three bearings presented by upright posts 345, 346, and 347 at opposite sides of the machine. These same posts present bearings which rotatably support the shafts 83 and 84 for controlling certain ones of the clamps.

When the front knife head 51 is driven downward by rods 55 and 56, FIG. 27, arms 344 are rocked at the same time, turning rock shafts 75 and 76. This downward stroke of the front knife head is accomplished by upward movement of the heads 73 and 74 which support the side knives, and on reverse or return movement of the front knife, the side knives are dropped to perform their cutting action. It may be noted that the cutting edge as 70E, FIG. 25, of each side knife is angled just as the cutting edge of the front knife is angled, and that each side knife edge as 70E, FIG. 25A, cooperates with a fixed cutting edge presented by a block 70L in the manner of the front knife.

Motion is transmitted from shafts 75 and 76 to the side knife heads in a manner now to be described.

The heads of the side knives are guided at their side edges for motion in vertical ways or slots presented by a stationary knife holder as 350, FIG. 13. A pair of arms as 351 are clamped to the respective rock shafts as 76, FIGS. 13 and 24, and the inner free end of each arm is pivotally connected to a connector link 352 in turn pivotally connected to a pin or stud 353 at the upper end of the vertically guided side knife head. Thus when the rock shafts 75 and 76, FIG. 27, are rocked, the side knives are reciprocated vertically in an upward stroke or a downward stroke as the case may be.

OPERATION OF THE CLAMPS

As mentioned above, certain of the clamps for holding the books while being trimmed are operated through the rock shafts 83 and 84, FIG. 27. There are a pair of presser pads for flattening the backbone or fold of the book at the time of trimming the front edge,

and there is a bar engageable with the front margin of the book at the time of trimming the front edge. The presser pads for the backbone will first be described.

Referring to FIGS. **10** and **12**, a pair of elongated presser pads or shoes **360** are presented at the first knife station and these shoes are supported for up and down motion, effective in the down position to flatten the back of the book. A pair of support arms **361** and **362** project inward from pivot pins **361P** and **362P** supported by the side frame of the machine. The inner ends of these arms pivotally support the presser shoe in the manner shown in FIGS. **10** and **12**.

The flatteners **360** are reciprocated by means including a flat drive bar **365** which at its lower end is pivotally connected to a pin **366** to which the right hand end of arm **362** is pivotally connected. It may be observed further that the pressure pad or shoe has a lug **367** projecting upward therefrom, and this lug supports a pivot pin **367P** to which the right hand end of arm **361** is connected.

A shorter flat bar **368** is juxtaposed on bar **365**. Bar **368** carries a stud **369** which is extended through an elongated slot **370** in bar **365**. A spring **371** is anchored at its lower end to stud **369** and at its upper end the spring is anchored to a stud **372** which is carried by bar **365**, noting that the stud **372** projects through an elongated slot **373** in the short bar **368**, FIG. **10**. Because of the stud-in-slot, spring tensioned arrangement, bar **365** is adapted to slide relative to bar **368**.

The short bar **368** has a lug **375** secured thereto. A lug **376** has a journal pin **377** projecting through an aperture in arm **368**, and the pin is journalled in a bearing carried by a short arm **380** pivotally mounted on the side knife operating shaft **76**. A screw **378** is threadedly mounted in lug **376**, and the end of the screw is joined to lug **375** as shown in FIG. **12**. It will be recognized that by turning screw **378**, the index position of pad **360** may be varied.

An ear **381** on arm **380** serves to support a pin to which is pivotally connected one end of a connector link **382**, and the opposite end of the connector link **382** is pivotally connected to a pin on arm **383** clamped to the rock shaft **84**.

Thus when rock shaft **84** is turned counterclockwise as viewed in FIG. **10**, arm **380** is turned clockwise, and this motion is transmitted to the drive bar **365** through bar **368** and spring **371**. In the event of a jam of some kind, the drive bar **365** will yield as permitted by the tensioning spring **371** and the stud-in-slot connections.

The arrangement thus described, FIGS. **10** and **12**, is repeated for the right hand backbone flattener **360**.

There is an additional clamp at the front knife station represented by a horizontal bar **400**, FIG. **9**, adapted to apply pressure to the front margin of the book during the time that the knife edge **50E** is operative to trim the front edge of the book. The clamp bar **400** is carried by four rods **401**, the clamp bar **400** being fixed to the lower ends of the rod **401**. The rods **401** extend upwardly through guide sleeves **402**. The sleeves **402** also extend through a clamp bar drive head **405** and terminate in collars **402C**.

The drive bar **405** is provided with slots **406** in the rear face thereof. Rollers **407** are mounted in the slots **406**, and these rollers are pivotally supported at the outboard ends of arms **408** which are clamped to the rock shafts **83** and **84**. Thus when the rock shafts **83** and **84** are turned the arms **408** are turned therewith and serve to transmit vertical motion to the clamp drive head **405**.

As shown in FIGS. **9** and **27**, a large tie rod **409** is fixedly secured to the clamp bar drive head **405** and extends upwardly therefrom. The intermediate portion of the rod **409** is threadedly mounted on an adjusting boss **410** which is fixed to and depends from a cross head **411**. The upper ends of the rods **401** extend through apertures in the cross head **411** and large nuts **401N** in effect connect the rods **401** to the cross head **411** for movement therewith. Coil springs **412** concentrically surround portions of the rods **401** between the drive head **405** and the cross head **411**. The springs **412** at their upper ends react at the underside of the cross head **411** and at their lower ends bear on the collars **402C**.

The tie rod has a knob or handle **409H** at the upper end thereof enabling the tie rod to be turned in the boss **410**, thereby to adjust the position of the front knife clamp relative to the side knife clamp. It will be recognized that when the clamp **400** engages a book, the springs **412** allow the cross head **411** to float.

The rock shafts **83** and **84** as already mentioned are supported in bearings in the posts **345**, **346** and **247** at the sides of the machine. The ends of the rock shafts **83** and **84** opposite the arms **408** are provided with similar arms **415**, and the arms **415**, clamped to the rock shaft **84**, have rollers **416**, FIG. **26**, at the free ends thereof fitted in the slots in the drive bar **85**. The drive head **85** for the clamp **400** extends laterally of the machine, and the arrangement thus described is duplicated at the opposite side of the machine with respect to rock shaft **83** as will be apparent in FIG. **31**.

It has already been mentioned that the drive head **85** is operated by a pair of vertically extending arms or bars **86**. Drive bars **86** are guided by sets of guide rollers as **417** at the side of the machine, FIGS. **26** and **31**, and are operated by a pair of levers **420** in the manner apparent from FIGS. **15** and **31**. The levers are secured to opposite ends of the rock shaft **334**, and at their free ends are provided with rollers **421R**, FIG. **15**, engaging abutments on the arms **86** to operate the same.

As already mentioned, the operation of the clamp drive head **85** is under control of a box cam **90**, and in this connection it will be observed that an operating lever **421**, FIGS. **15** and **31**, is secured at one end to rock shaft **334**. At its opposite end, lever **421** is provided with a follower **421F** which travels in a cam slot in the box cam **90**. Thus, the box cam **90** is responsible for oscillating lever **421** and motion is transmitted through rock shaft **334** to the levers **420** which operate the drive arms **86** to raise and lower the cross head **85**, thereby operating the book clamp bar **400**.

In addition there are clamps **81** and **82** adjacent each side knife as already mentioned, FIG. **24**, and these clamps are supported at the lower ends of rods **431** extended through guide sleeves **432**, FIG. **25**, which in turn extend upward through each knife head as **74**. The upper ends of the guide sleeves are provided with collars **432C**. Coil springs **433**, FIG. **25**, surround the rods **431** in the portions thereof which extend upward above the knife head. The lower ends of the springs **433** bear on the tops of the collars **432C**, and the upper ends thereof react at the underside of a reciprocal cross head **435**. The rods **431** are secured to the cross head **435** for movement therewith by nuts **431N**. The ar-

rangement is of course duplicated for each of the side clamps **81** and **82.**

Each cross head **435** includes pins **436** at the opposite ends thereof, FIG. **25,** and connector links **437** are pivotally mounted thereon. The opposite ends of the connector links are pivotally mounted on pins **438,** FIG. **24,** carried at the inner ends of arms **440** which are clamped to the rock shafts as **83** and **84.**

Thus when the rock shafts as **83** and **84** are rocked the clamps **81** and **82** associated therewith are rocked to engage the margins of the book adjacent the cutting lines of the side knives.

Provision is made for adjusting the effective stroke of the clamp drive head **85,** FIGS. **13** and **26,** and in this connection it should first be noted that the upper ends of the drive bars **86** are threaded at **86T,** FIGS. **26** and **29.** A stop nut **440** is threaded onto the threaded portion of the drive bar **86,** and this nut has a sprocket **441** integral therewith. The arrangement thus far described is repeated for each of the drive bars **86.**

The cross head **85** is provided with a sleeve **443,** FIG. **29,** which surrounds a concentric extension of the drive bar **86,** and appropriate spacers and clamp nut assemblies SC, FIGS. **26** and **29,** are used to tighten the cross head **85** against the stop nuts **440.**

The cross head or drive head **85** supports a knob **450,** FIG. **29,** to which is secured a shaft **451.** The shaft **451** at its opposite or lower end carries a sprocket **453,** FIG. **28,** around which is trained a chain **455.** The chain **455** is also trained around the sprockets **441** and a pair of tensioning sprockets **456.** The arrangement and thread hands are such that upon turning the knob **450,** the sprockets **441** associated with the nuts **440** are turned, thereby to simultaneously raise or lower the cross head **85** by an equal amount at each end. This varies the effective stroke imparted by the cross head **85** to the clamp operating arms **415.**

Prior to making the head and foot cuts with the side knives **70** and **71,** and prior to the head and foot margins being immobilized by the side clamp bars **81** and **82** (all moving clamps force the books against the stationary anvil represented by plate **142**) the side edges of the books are simultaneously jogged to assure a straight cut. In this connection attention is directed to FIGS. **24** and **25** showing a pair of vertically extending side jogger support arms **465** pivotally mounted on a stationary shaft **466** supported by a pair of ears **467** at the upper end of each side knife holder **350.** The arrangement now being described is repeated for each of the side knives as will be apparent from the drawing.

The lower end of each side jogger support arm **465** carries an adjustable finger **469** extending inwardly as will be apparent in FIG. **24,** and the inner end of the finger **469** has a flat jogger blade **470** attached thereto. Each jogger blade **470** extends accurately in a plate parallel to the path of movement of the book into and from the side knife trimming station.

The jogger support fingers **469** are threadedly supported at the lower end of each support arm **465** and are adjustable through a knob **469K** which is part of the support finger **469.**

An operating lever **472,** FIG. **24,** integral with arm **465** extends upwardly therefrom and is normally biased in an inward direction by a spring (not shown) effective to present a follower **472F,** FIGS. **13** and **25,** to an oscillating cam **475** mounted on the corresponding rock shafts **75** and **76** as will be apparent from FIG. **25B.** The cam **475** has two pockets **475A** and **475B,** FIG. **25B,** for receiving the follower **472F,** the pockets being separated by a lobe or high part, whereby the jogger support arm **465** is operated each time the knife control rock shaft is oscillated. Consequently, both of the flat jogger blades **470** are presented to the head and foot edges of the book to align these edges parallel with the cutting edges of the side knives.

TIMING, FIG. 32

The machine is of course cyclically operated, and a cycle of operation is defined as a 360° cycle which includes the downward stroke of a knife and its return, FIG. **32.** The "book line" FIG. **32,** is defined as the upper surface of the plate **142** on which the book reposes at each trimming station.

In connection with the operation of the knives it should be borne in mind that each knife edge is slanted, and in FIG. **32** it will be assumed that the book is ⅝ inch thick. Thus the lower or leading corner of the slanted front knife edge **50E** commences to cut through the book (five-eighths inch above book line) after about 97½° of the machine cycle, and the cut is finished after 180° characterizing the upper or trailing corner of the front knife attaining the book line position. The lower corner of the front knife on the upstroke clears the book after about 262½° of the machine cycle, and in the meantime the side knives have been operating in the reverse manner, thereby balancing the moving masses of the machine represented by the knife heads.

The cyclical operation of the front presser pad or block **400** and that of the presser pads **81** and **82** for the side knives is next set forth in FIG. **32,** and in this connection it will be noted that the pressure pad **400** engages the top of the book concurrently with the commencement of the front cut. The clamped condition for the book at the front knife station is held until about 170° of machine cycle, whereafter the pressure of the front pad is relieved well in advance of the front knife clearing the top of the book during the front knife return stroke. Thus by separating the clamp drive (rock shafts **83** and **84**) from the knife drive (rock shafts **75** and **76**), it is possible to correlate actions as desired.

When the front clamp **400** (and **360** as well) is released, this means that the front carrier lugs or bars **110** and **111** may pick up the book and advance it toward the book stops **101.** This occurs at the 210° phase of the machine cycle, and at this time the front stops are retracted below the book line.

Therefore after about 210° of machine cycle the carrier bars **110** and **111,** in their motion away from the front knife, advance the book toward the pushers **317.** It must now be borne in mind that as the book moves away from the first knife station, the front knife is being raised and conditions are being established for the next cycle of operation. After about 195° of the next or second cycle, the carrier pads **110** and **111** have advanced the book well beyond the first knife, say 20 5/16 inches, FIG. **32,** to the pushers **317** which now push the book to the rear stops **101.** The book to be trimmed by the side knives engages the rear stops at about the 275° phase of the second machine cycle, just a few degrees prior to the side knives and the side clamps becoming effective.

At the attainment of about 97½° of a machine cycle, a new book on in-feed chains is about 21 inches from

the front knife, FIG. 21, and is advanced forward by the in-feed lugs 95 throughout the remainder of the cycle. At about 35° in the next cycle, this book is picked up by the pusher fingers 145 which advance the book to the front stops 100. The book is against the front stops at about 95°, just a few degrees prior to the front knife making its penetration.

SUMMARY

It will be seen from the foregoing that under the present invention the front knife is undergoing its downstroke when the side knives are in the course of upward movement at their respective knife stations, and vice versa. In accomplishing this, the force applying means for operating the knives, represented by the eccentrics 58 and 59, is connected directly to the front knife head through connecting rods 55 and 56, so that a stroke of the latter in one direction is translated into motion in the opposite direction for the side knives by the arrangement of the rock shafts 75 and 76 and the associated lugs or arms.

In like fashion, the box cam 90 is responsible for operating the connecting rods 86, applying force to the clamp operating head 85, oscillating the rock shafts 83 and 84 and the associated arms connected to the clamps. Just as the side knives are 180° out of phase with respect to the front knife, so the clamps 81 and 82 are 180° out of phase with respect to the front clamp 400, and again this is accomplished by harnessing a set of rock shafts appropriately.

The books or stacked sheets to be trimmed are advanced sequentially to the first knife station along the guide plate 141 by in-feed lugs 95 carried by the endless chains 96. The trap door means 143 represents an extension of the table or plate 141, being located at the point where the chains 96 reverse their travel from a direction toward the front knife station to a direction away from the front knife. At this point of change the reciprocal pusher fingers 145 are advanced forwardly to engage the trailing edge of the book and force it firmly against the front stops 100, which have been interposed in the path of travel of the book along the guide plate or table 142, whereafter the pusher fingers are retracted for the next forward feeding cycle. The trap doors 143 are lowered when the first cut is made, thereby to drop the chips or trims. This entails timed operation of the pusher fingers 145 and the trap door 143, and such timing is conveniently achieved by means of the cams 160 and 161.

Following the trimming operation at the front knife station the stops 100 are lowered, the front clamp 400 is released along with the backbone clamps 360, and the book is picked up by the carriers 110 and 111 which advance or feed the book to a second set of pusher fingers 317. These pusher fingers are also timed in their operation by a cam and are effective to advance the book delivered thereto against the stops 101, which are interposed and retracted in a sequence timed by a cam 336 just as timed operation of the front stops is under control of a cam 227.

The two sets of stops, 100 and 101, can be adjusted in a longitudinal direction parallel to the path of movement of the books simultaneously by means of the rack 105.

The carrier chains 112–113 and 118–119 are also of endless form. The upper carrier chains 112 and 118 are individually supported on their gear driven sprocket shafts for simultaneous adjustment toward and away from the opposed, lower carrier chains 113 and 119. This is accomplished through a parallelogram linkage, the supports being so arranged as to use gears 238 and 270 as an accurate index or track. Thus as gear 237 is advanced or retracted by any fraction of a tooth, gear 269 moves the same fraction.

We claim:

1. In a cyclically operable machine for trimming stacked sheets such as signatures or the like fed through the machine in sets of stacks one after another: a vertically operable knife at a first knife trimming station for trimming the sheets in a stack along one edge and a vertically operable knife at a second knife trimming station for trimming the sheets of the same stack along a second edge, feed means to feed a stack first to one knife station for trimming and then to the other knife station for trimming, each knife having a head guided for vertical movement, knife drive means connected to the head of one knife and operable to impart reciprocal motion thereto in a downward cutting stroke and an upward return stroke in a single cycle of the machine, and means joining the heads of the knives and configured to translate reciprocal motion of the driven knife head into motion of the other knife head in the opposite direction within the same machine cycle.

2. A machine according to claim 1 in which there are two knives each with a head at the second trimming station for trimming parallel side edges of the sheets, the means joining the heads of the knives of the two stations including a pair of rock shafts each having an operating arm at one end joined to the head of the knife at the first station whereby reciprocation thereof oscillates the rock shafts in unison, and each rock shaft at the opposite end being linked respectively to a knife head at the second trimming station to impart concurrent motion thereto.

3. A machine according to claim 1 provided with a set of vertically movable clamps operable independently at each trimming station to clamp the stack being trimmed, drive means for operating one set of clamps, and means joining the driven set of clamps to the other set of clamps and configured to translate vertical motion of the driven set of clamps into motion of the other set of clamps in the opposite direction during the same machine cycle.

4. A machine according to claim 3 wherein there are two knives each with a head at the second trimming station for trimming parallel side edges of the sheets, the means joining the heads of the knives of the two stations including a pair of rock shafts each having an operating arm at one end joined to the head of the knife at the first station whereby reciprocation thereof oscillates the rock shafts in unison, and each rock shaft at the opposite end being linked respectively to a knife head at the second trimming station to impart concurrent motion thereto.

5. A machine according to claim 3 wherein the clamp drive means is a reciprocable cross head, the means joining the clamps including rock shafts operated by said cross head and operating links joining the rock shafts and the clamps.

6. A machine according to claim 5 wherein there are two knives each with a head at the second trimming station for trimming parallel side edges of the sheets, the means joining the heads of the knives of the two stations including a pair of rock shafts each having an operating arm at one end joined to the head of the knife at the first station whereby reciprocation thereof oscillates the rock shafts in unison, and each work shaft at the opposite end being linked respectively to a knife head at the second trimming station to impart concurrent motion thereto.

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