Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 1

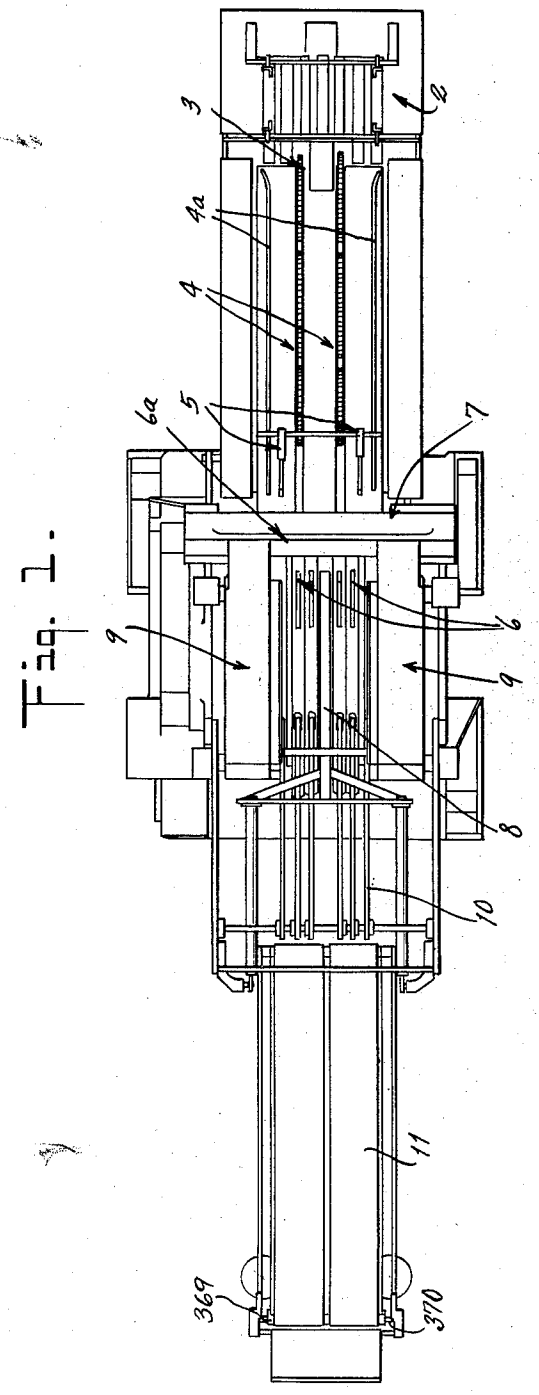


Fig. 1.

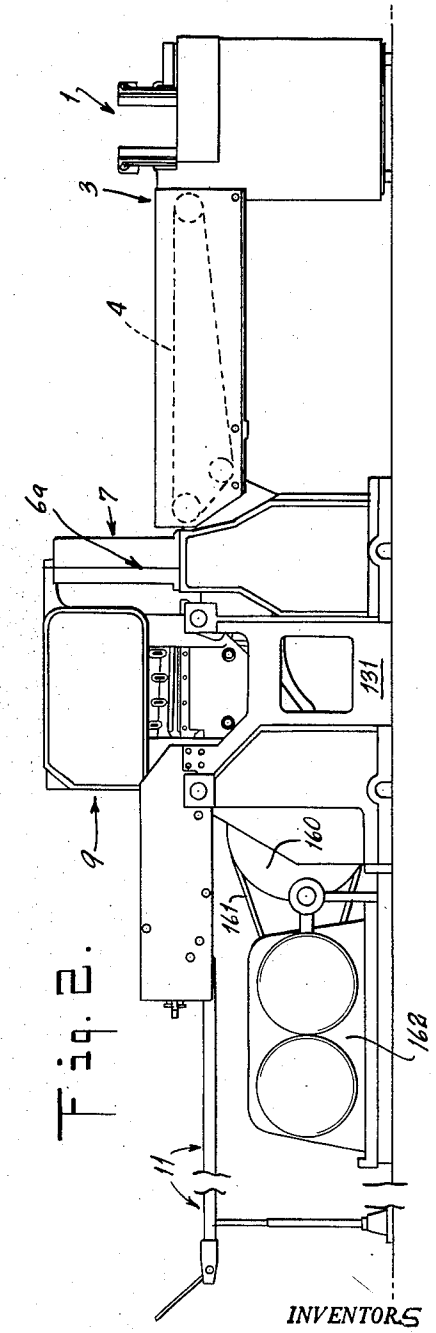


Fig. 2.

INVENTORS
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 2

Fig. 3.

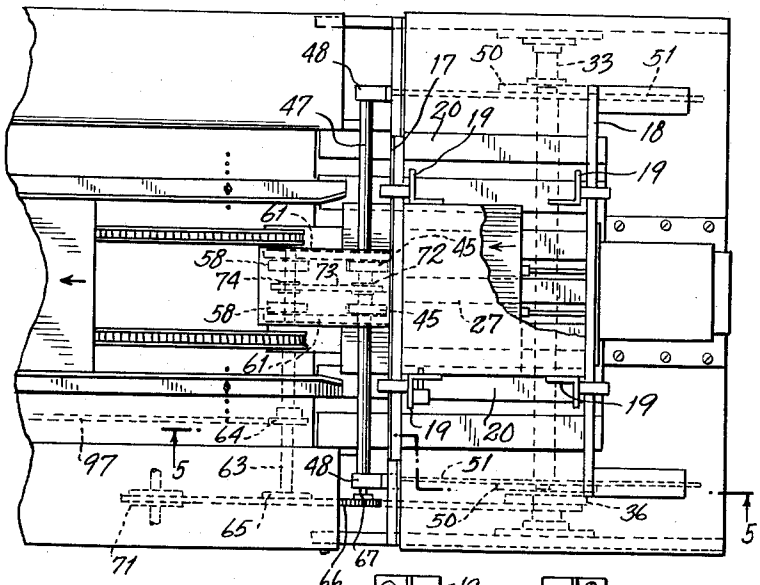
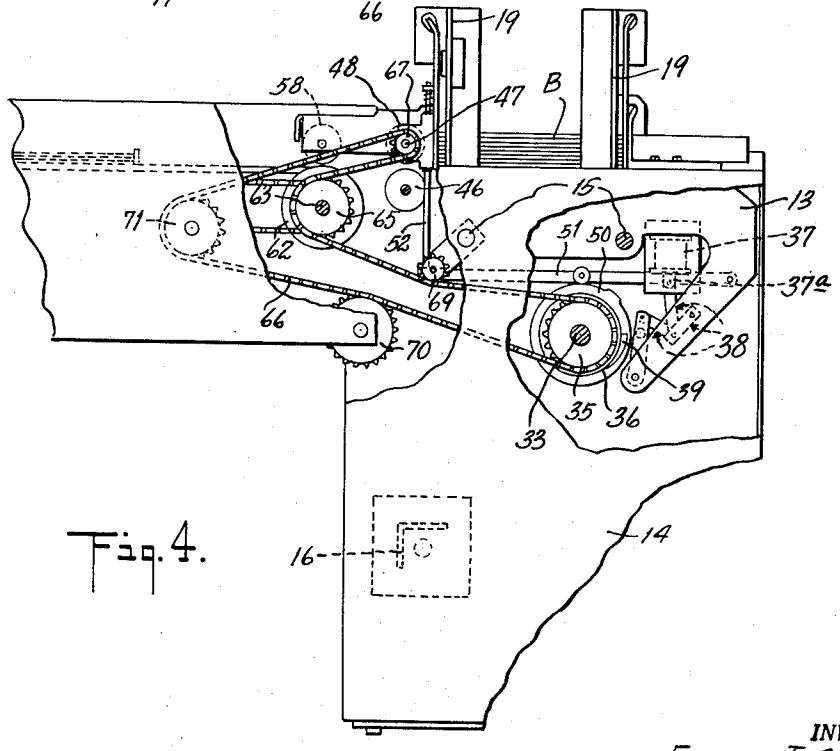


Fig. 4.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Taylor & Taylor
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 3

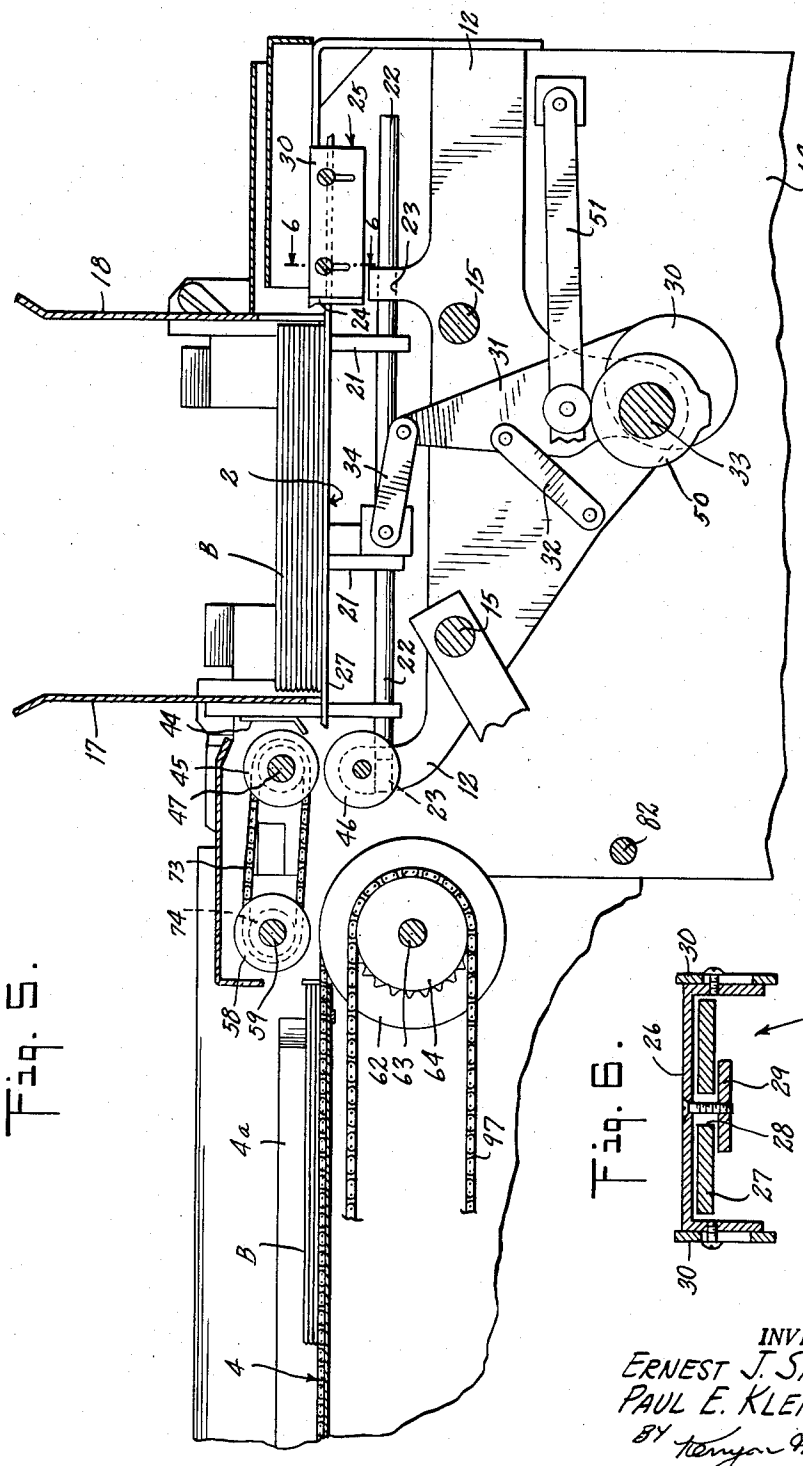


Fig. 5.

Fig. 6.

INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Morgan & Morgan
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 4

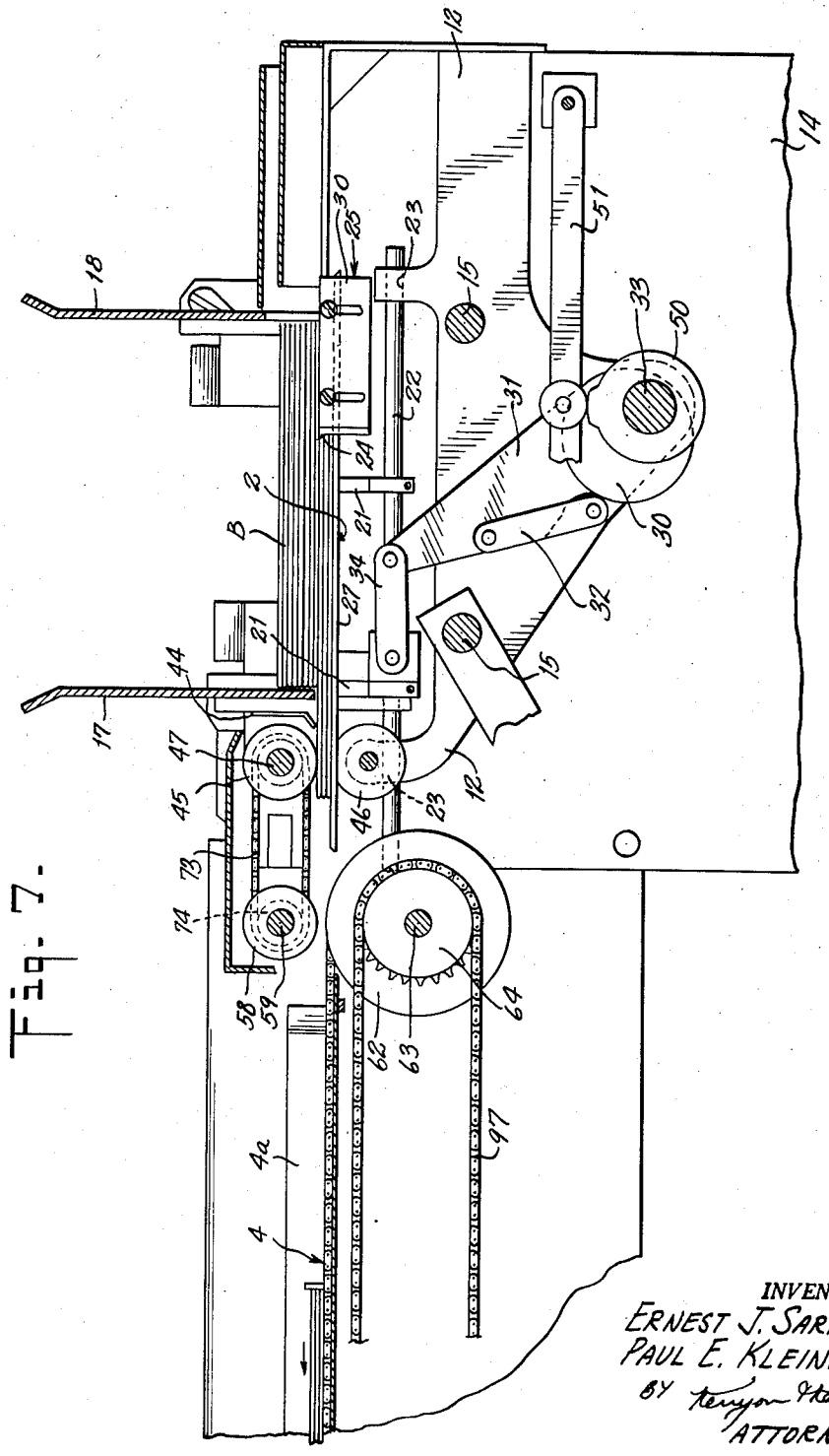


Fig. 7.

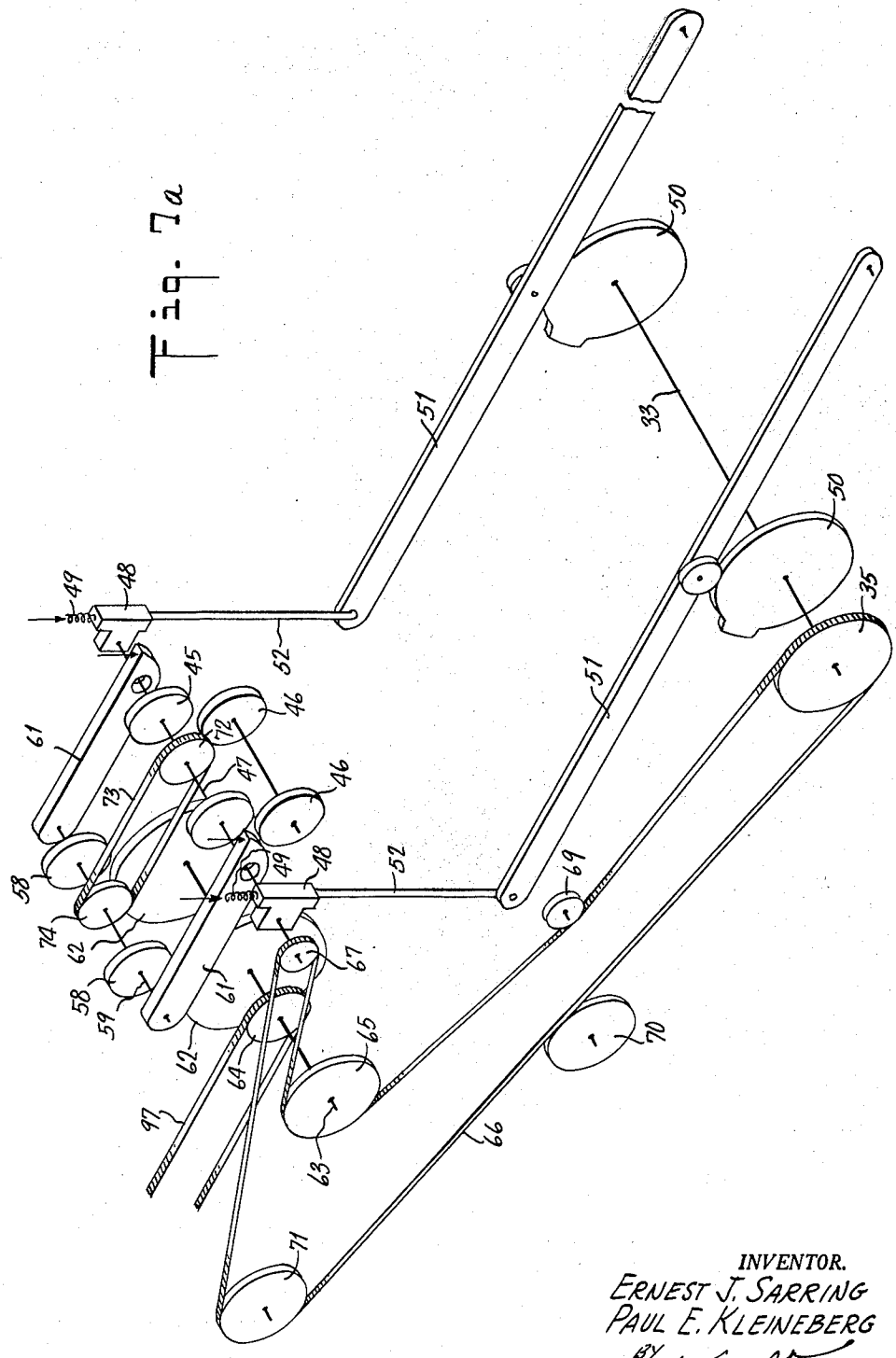
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 5

Fig. 7a



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Teagan & Morgan
ATTORNEYS

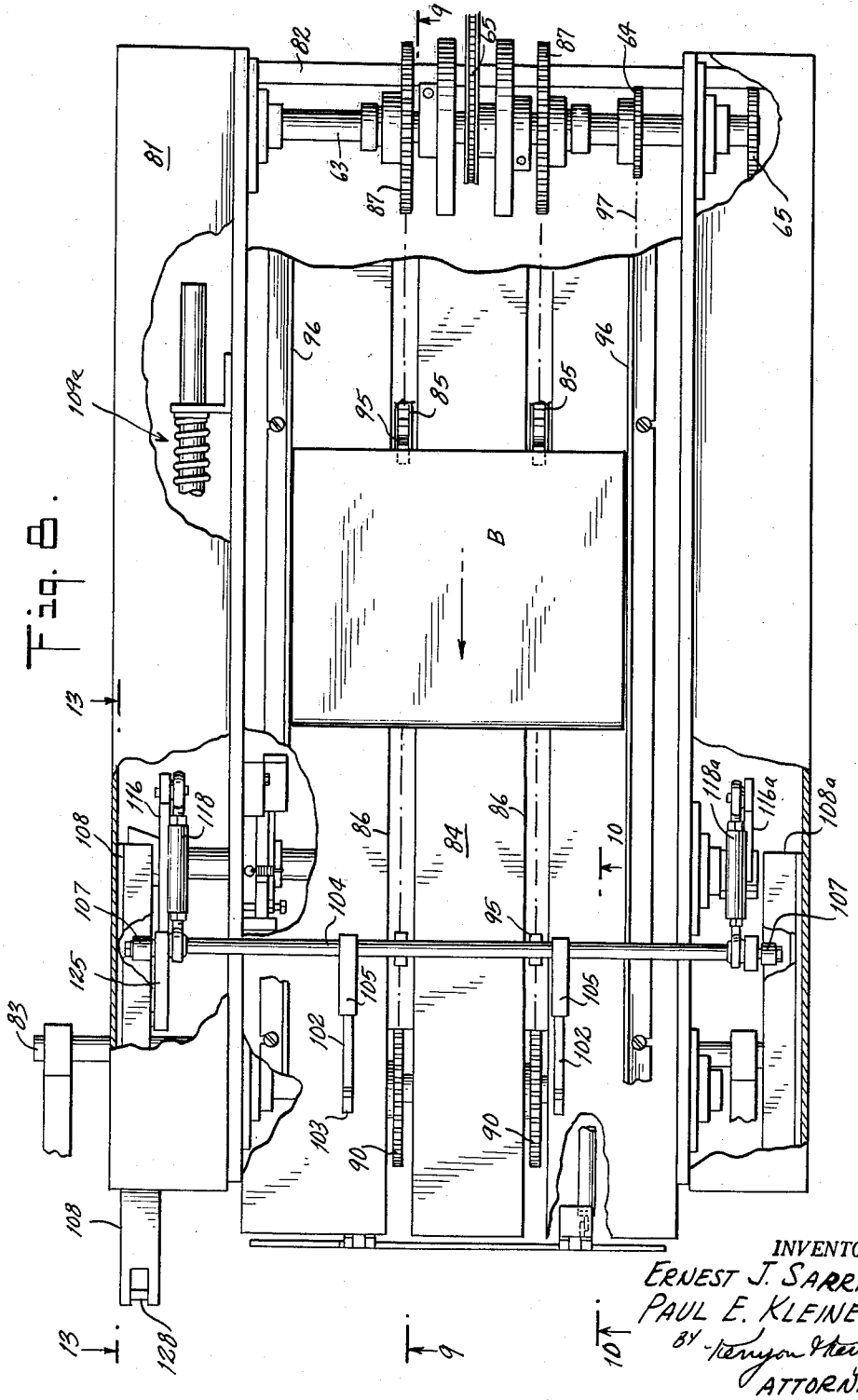
Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960

24 Sheets-Sheet 6

Fig. 8.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 7

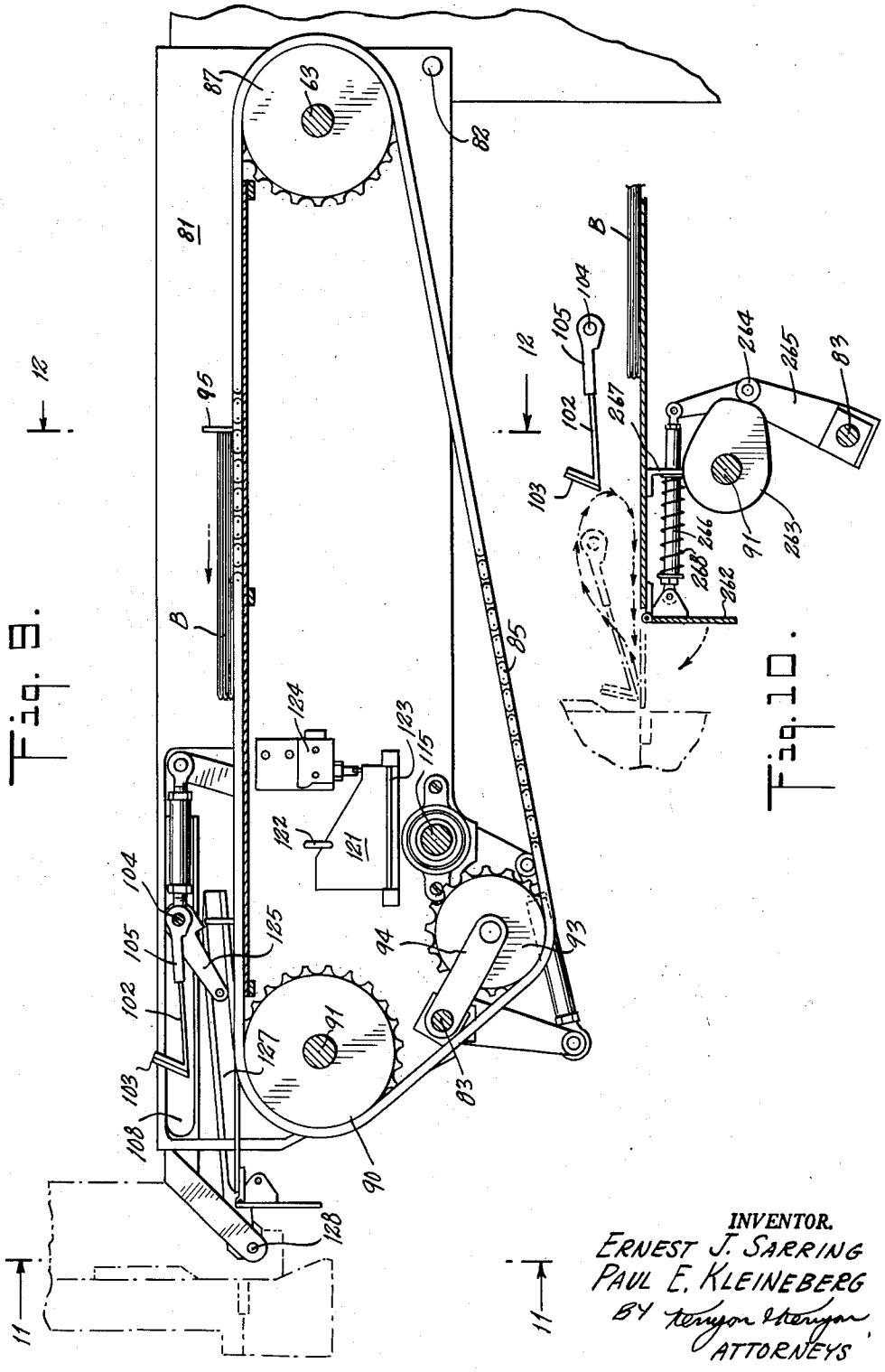


Fig. 9.

Fig. 10.

INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 8

Fig. 11.

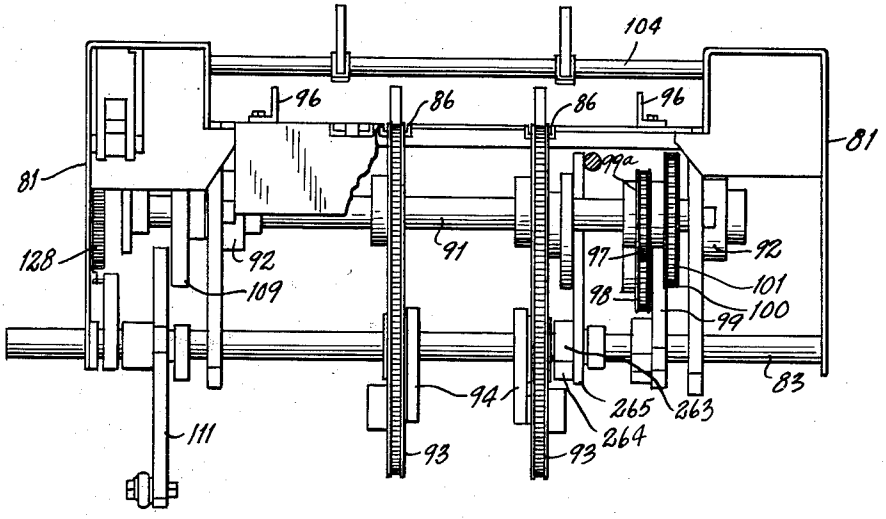
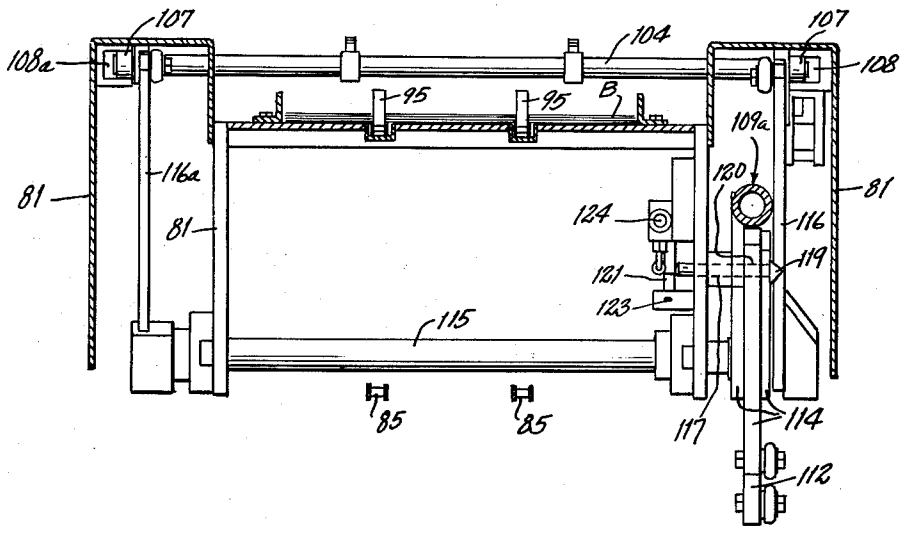


Fig. 12.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 9

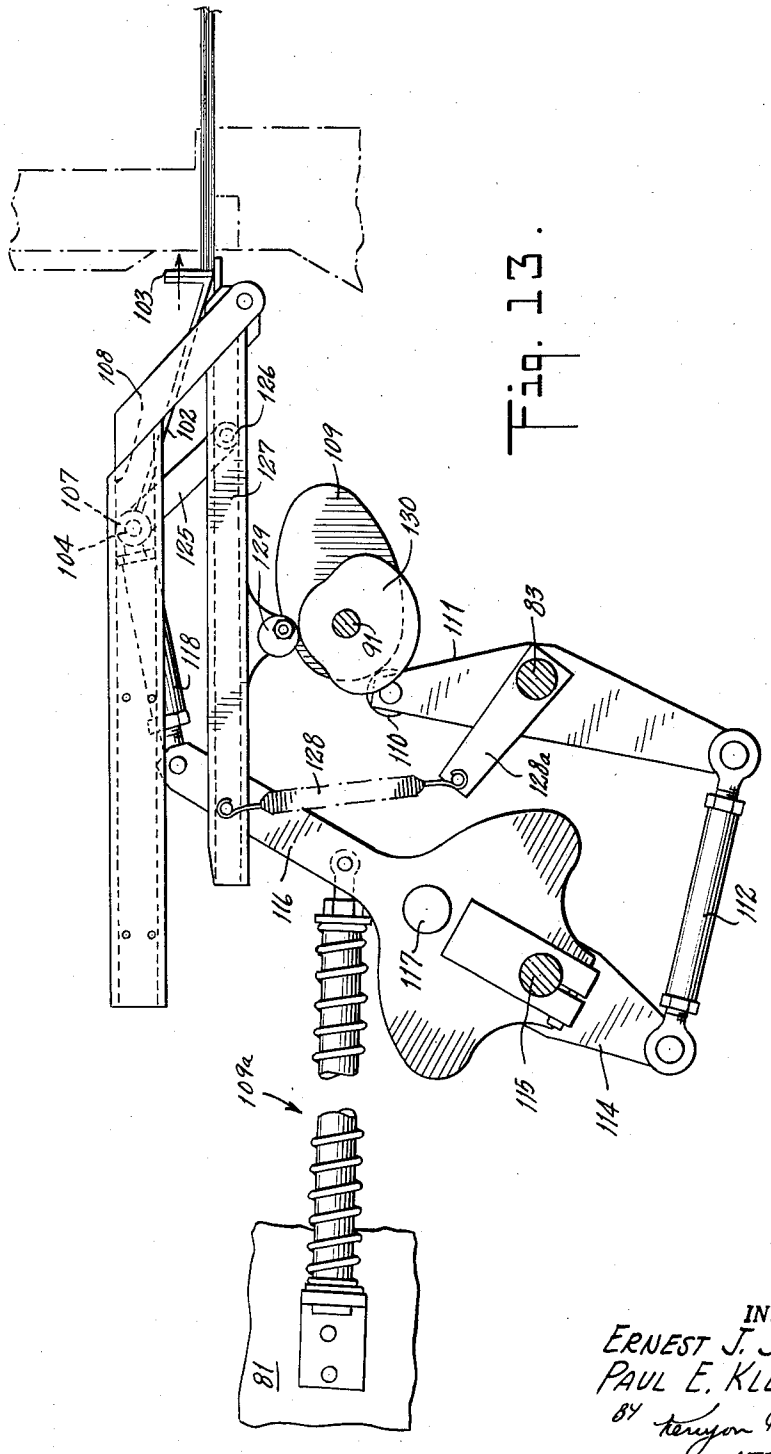


Fig. 13.

INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 10

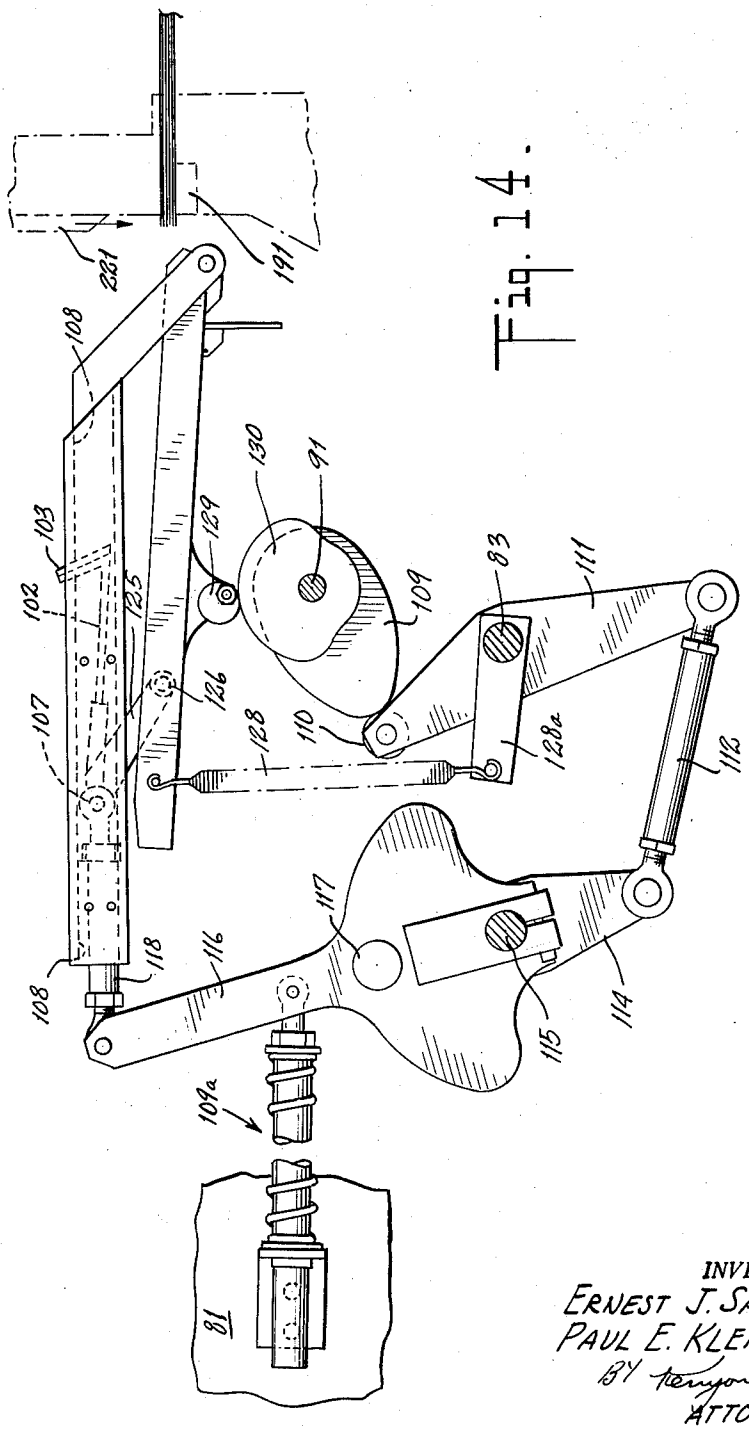


Fig. 14.

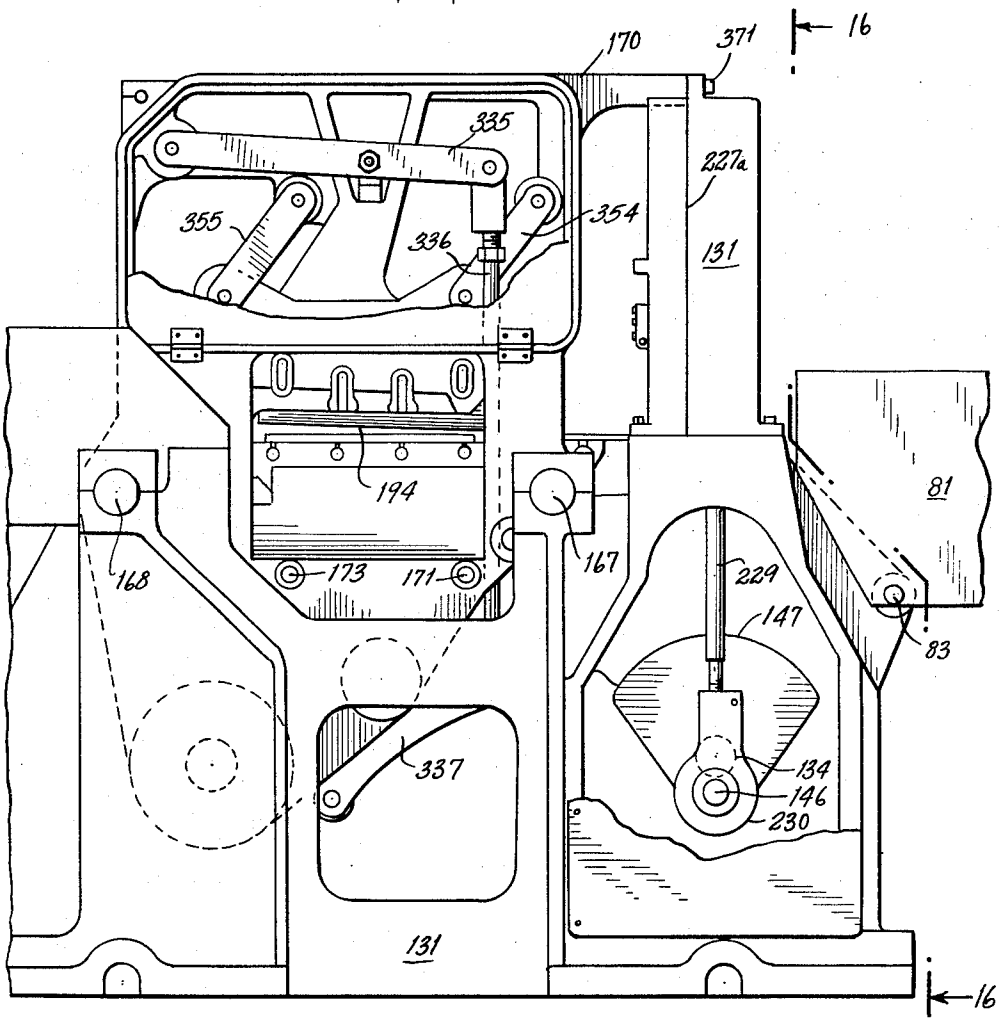
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 11

Fig. 15.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 12

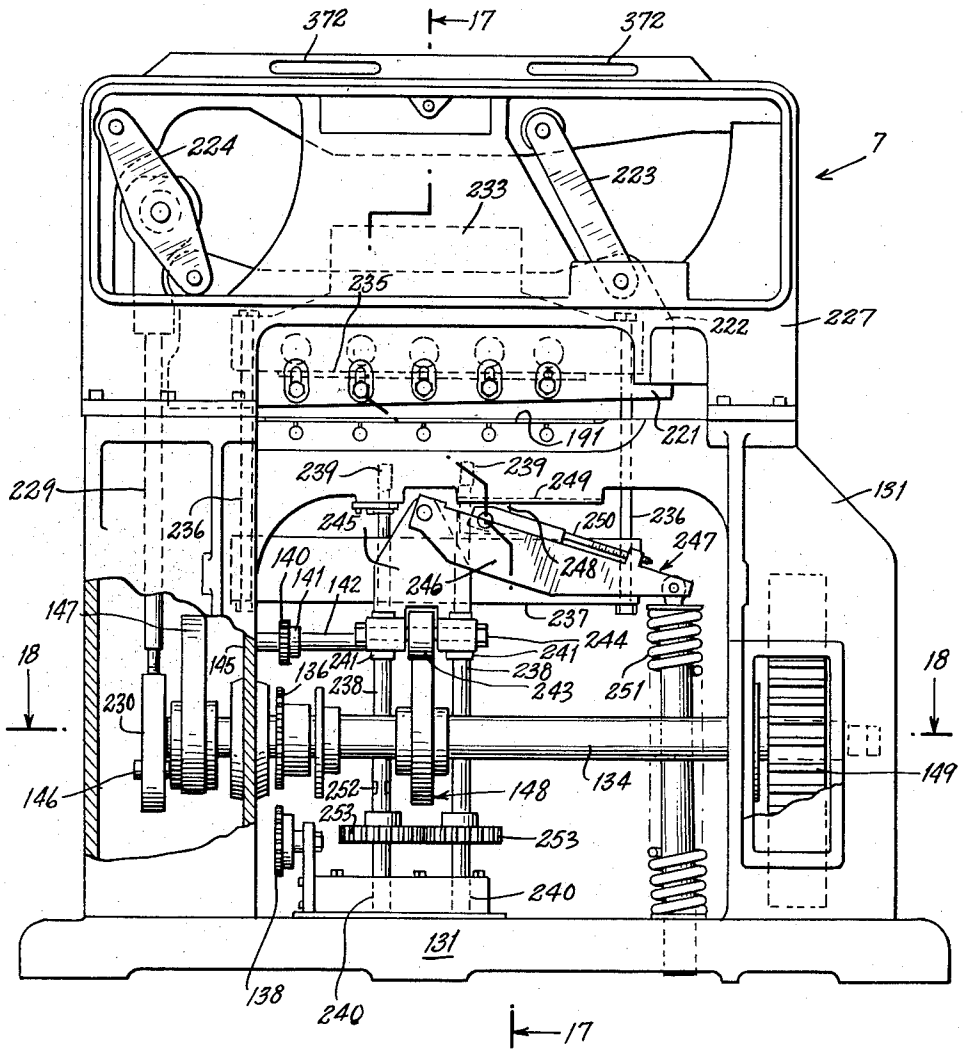


Fig. 16.

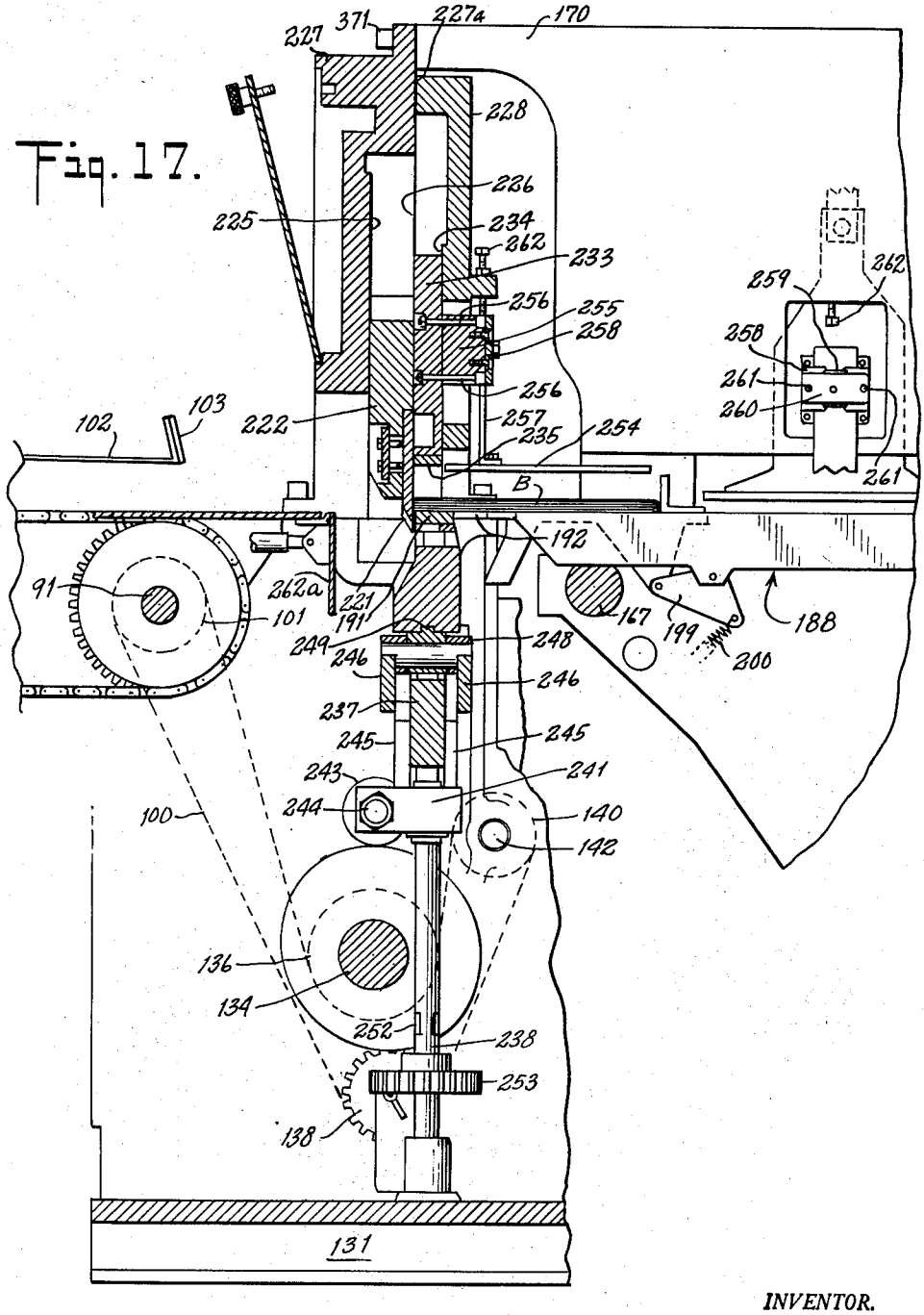
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 13

Fig. 17.



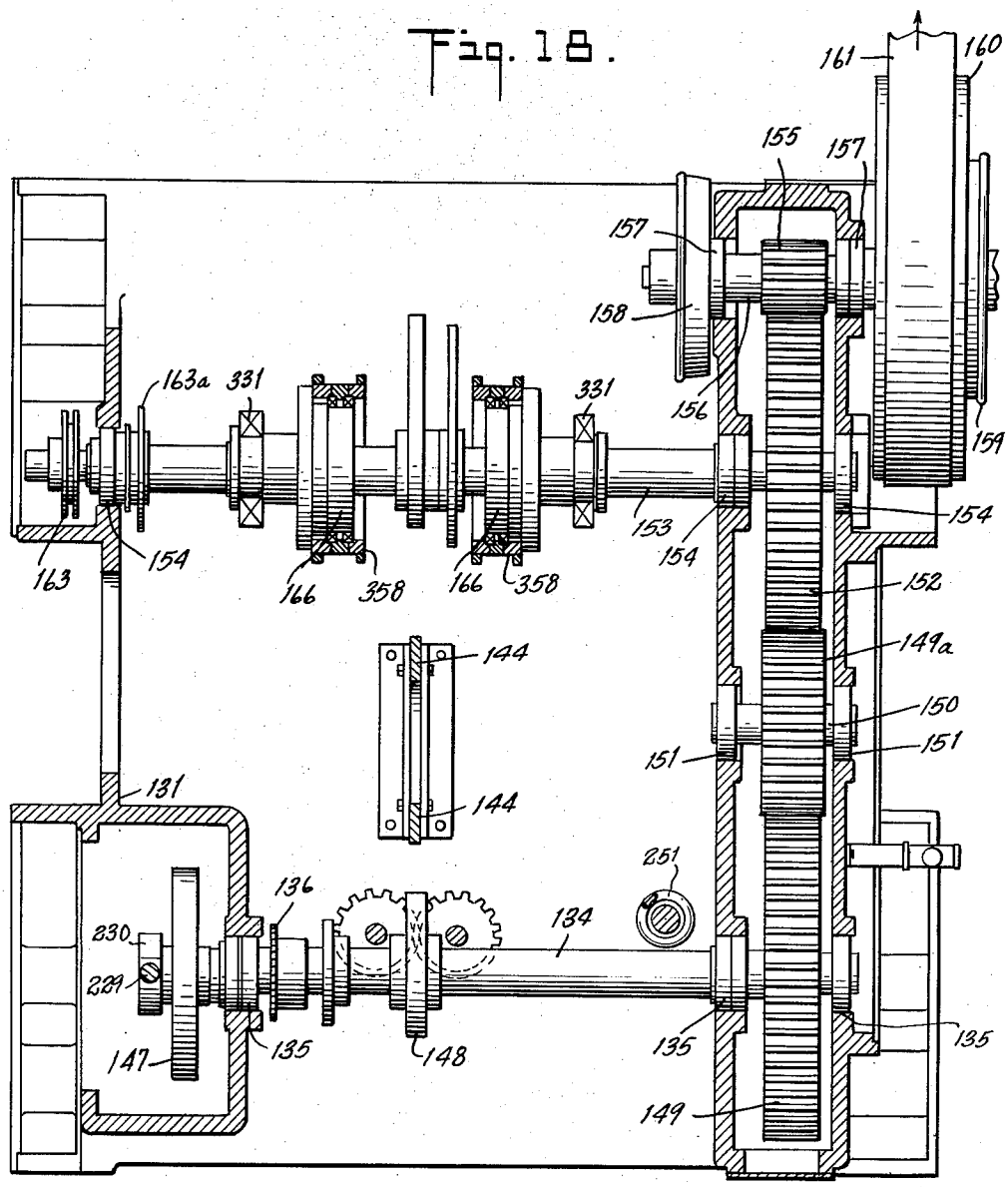
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 14

Fig. 18.



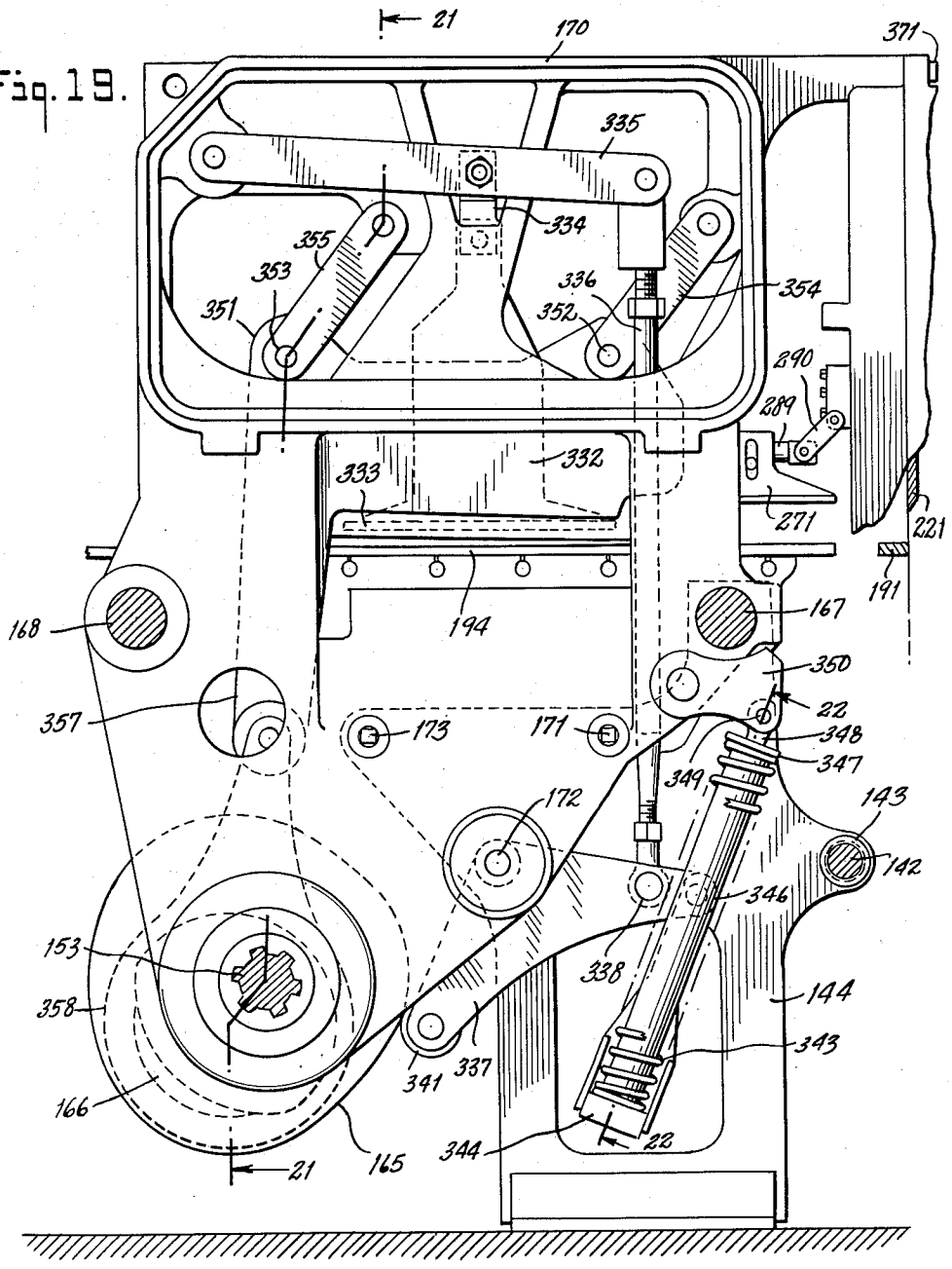
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 15

Fig. 19.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 16

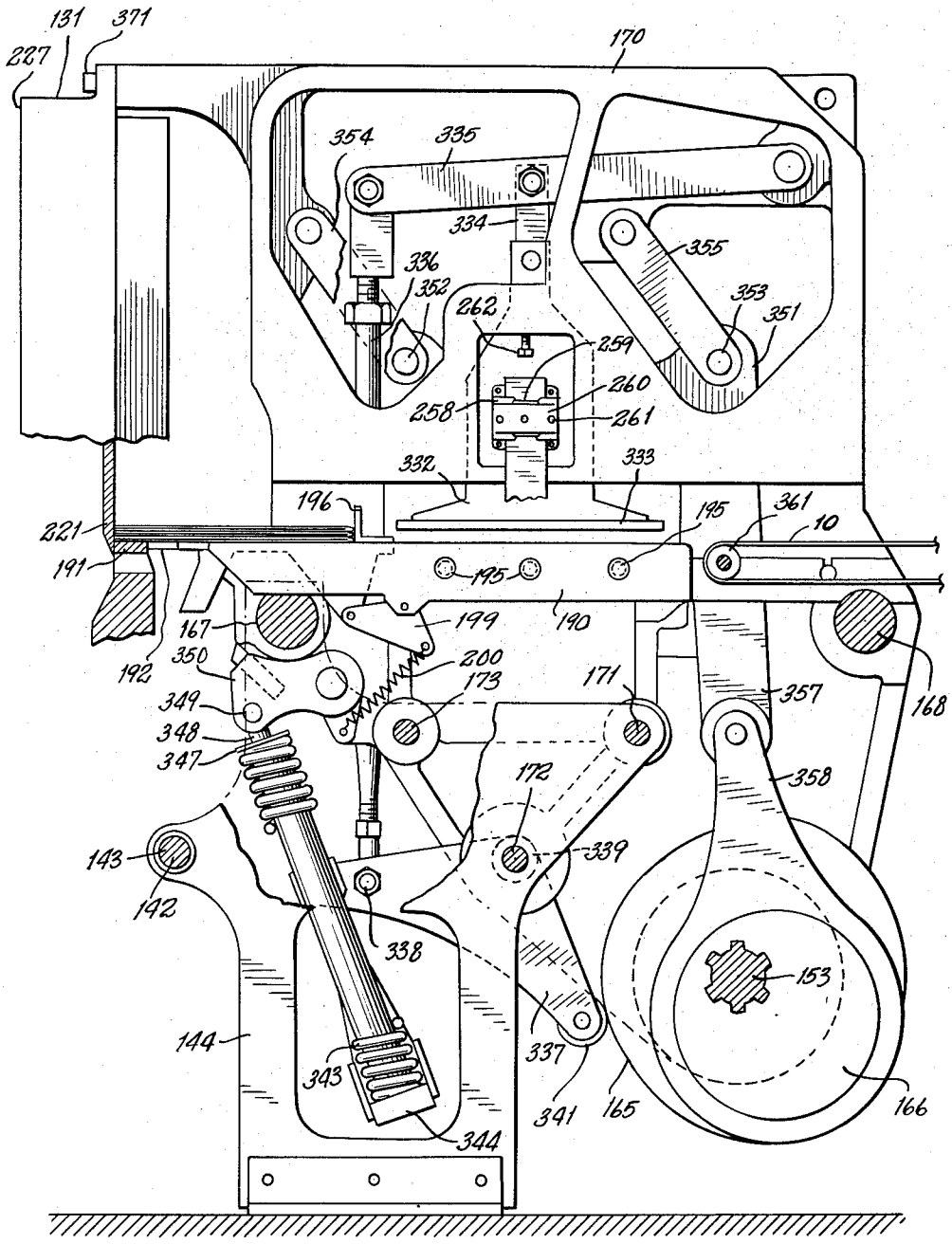


Fig. 20.

INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 17

Fig. 21.

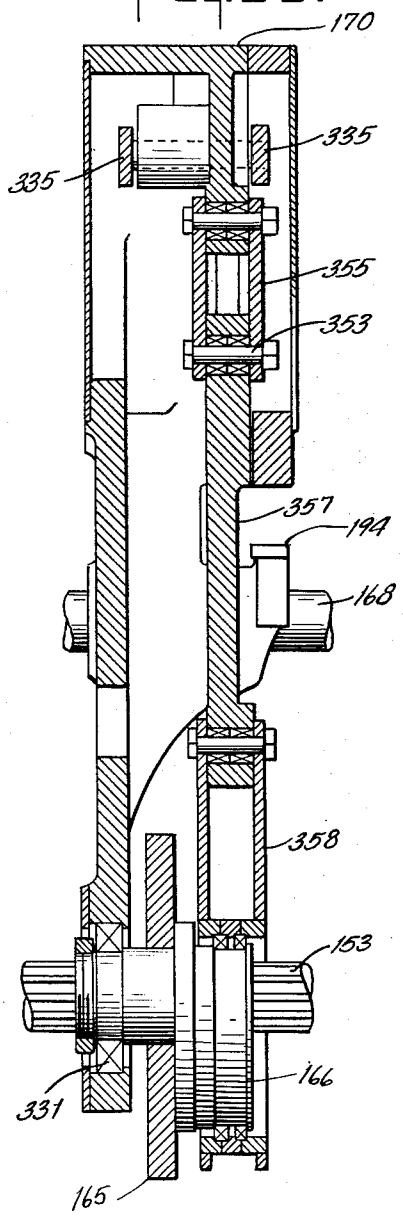
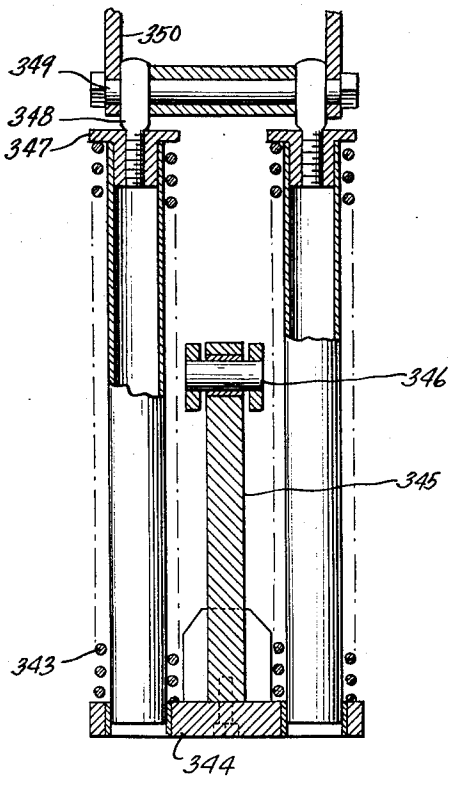


Fig. 22.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 18

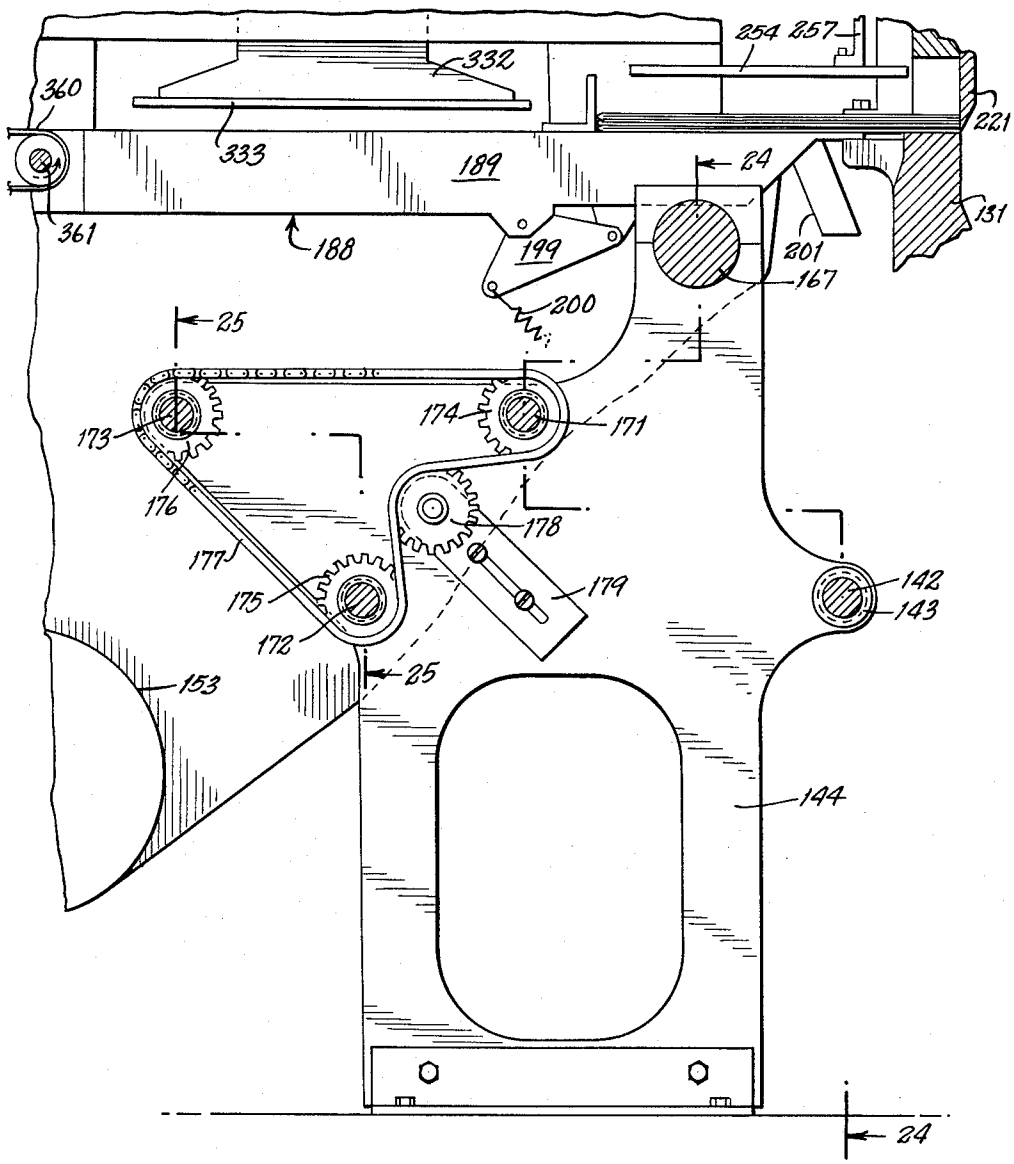


Fig. 23.

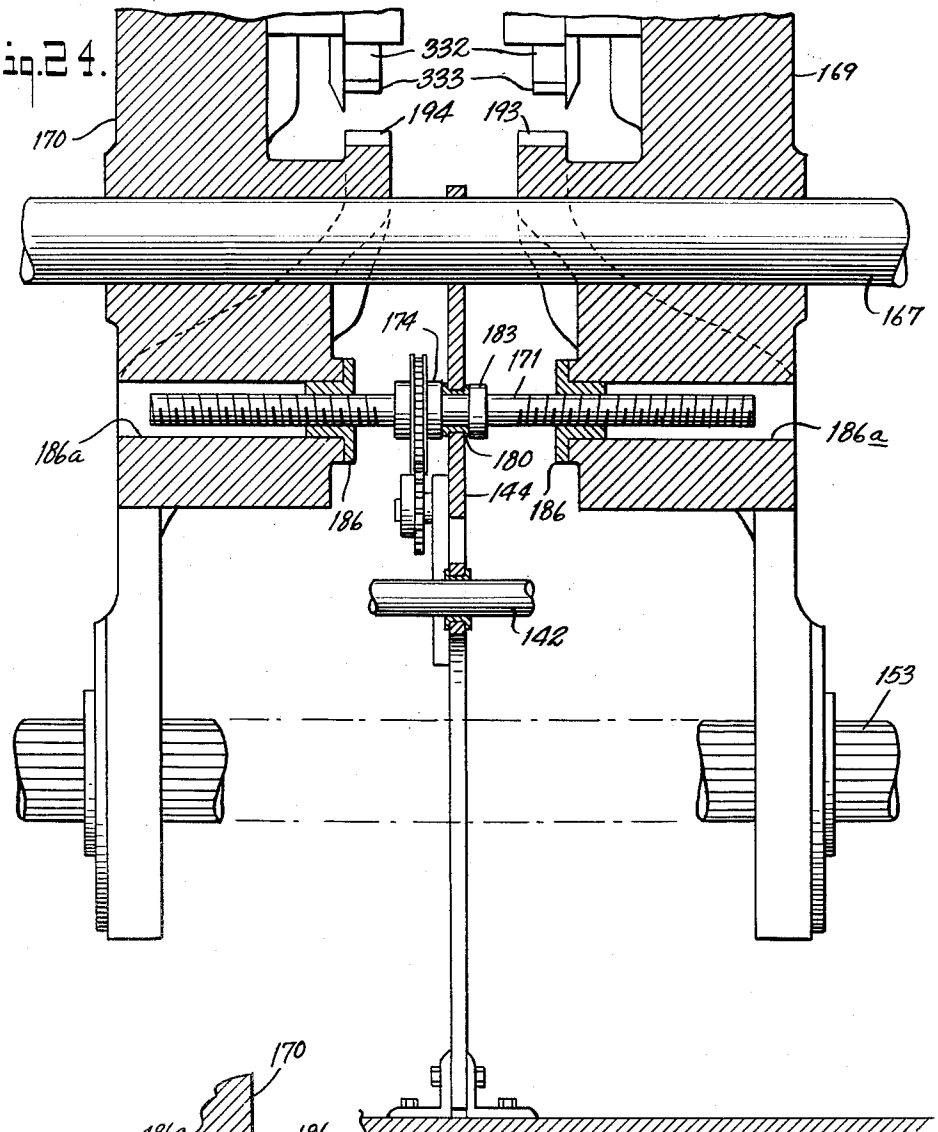
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 19

Fig. 24.



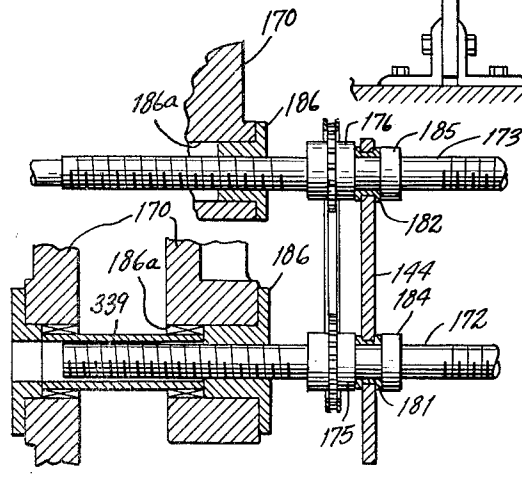


Fig. 25.

INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 20

Fig. 26.

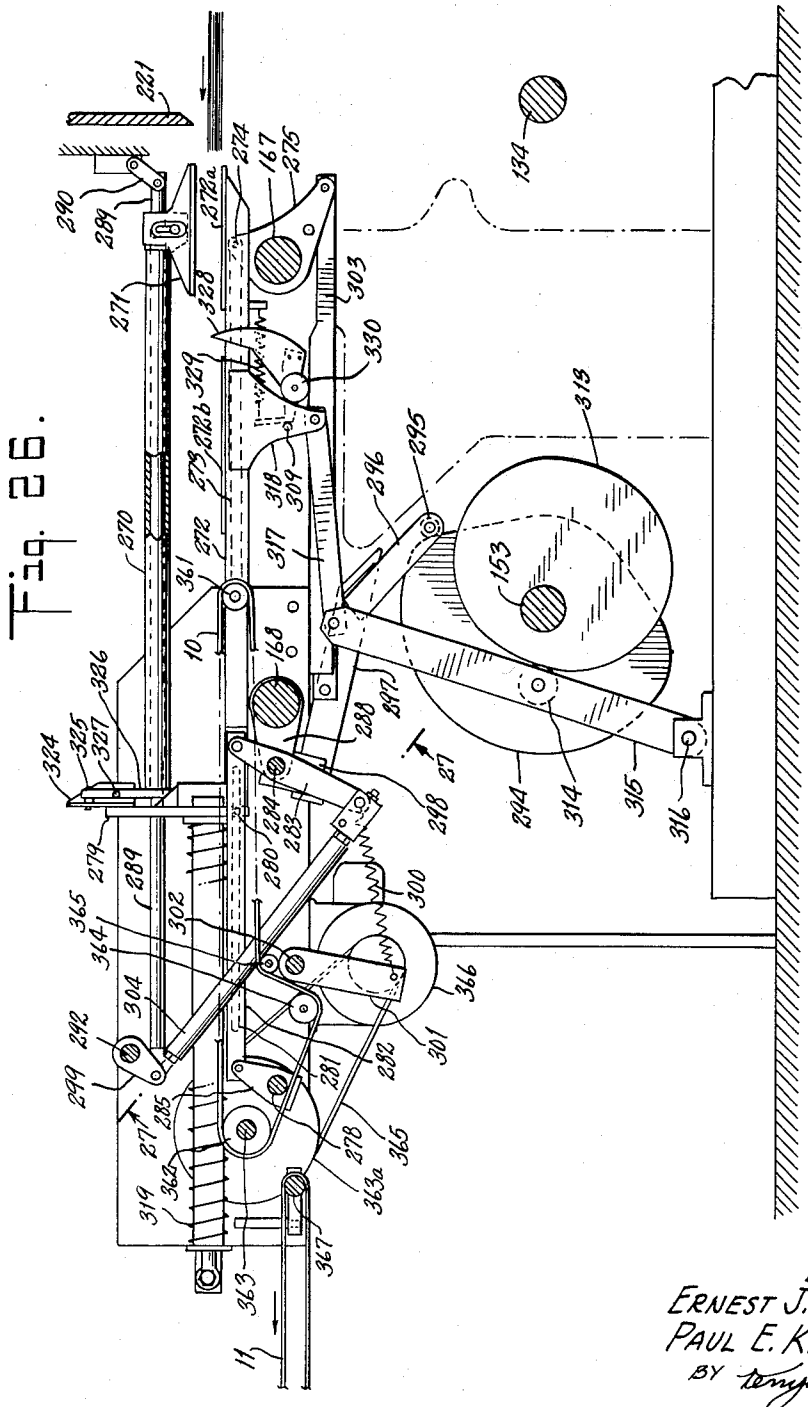
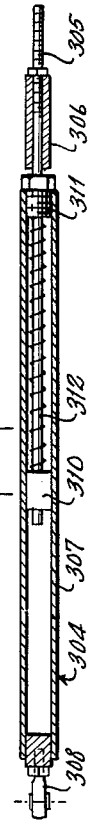


Fig. 27.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Merriam Marshall Merriam
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 21

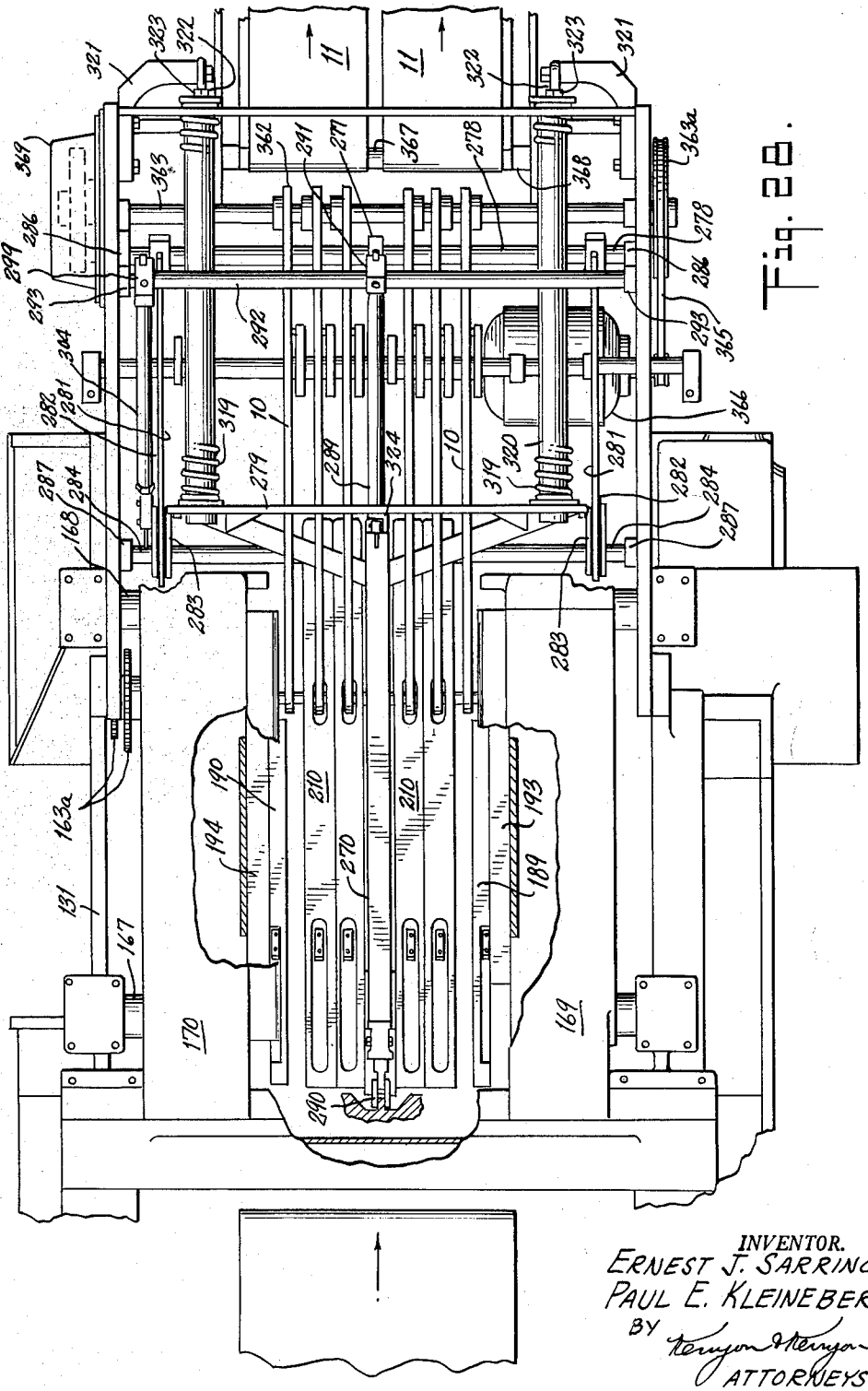


Fig. 28.

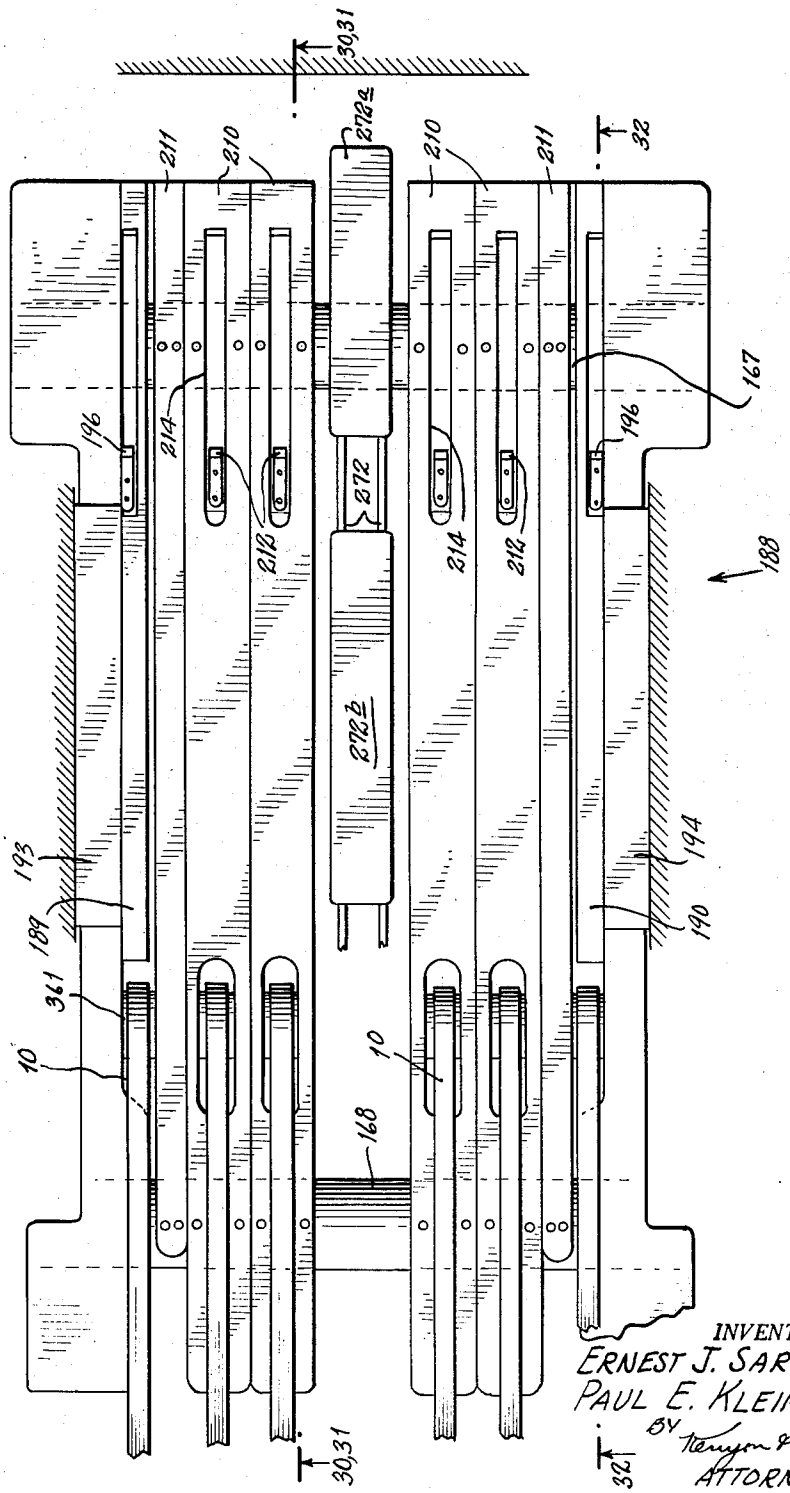
INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 22

Fig. 29.

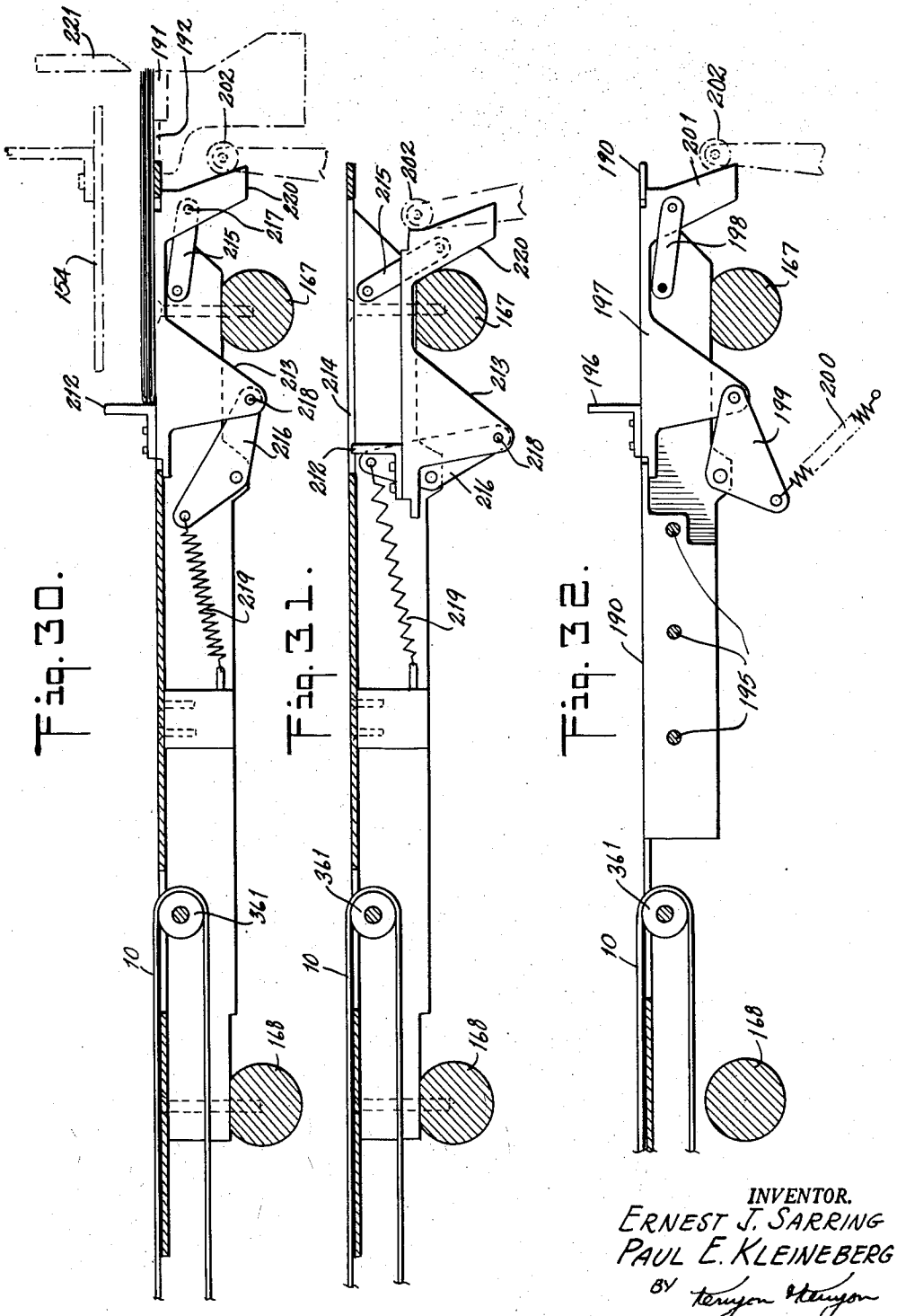


INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 23



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon
ATTORNEYS

Sept. 1, 1964 E. J. SARRING ETAL 3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Filed Dec. 6, 1960 24 Sheets-Sheet 24

Fig. 34.

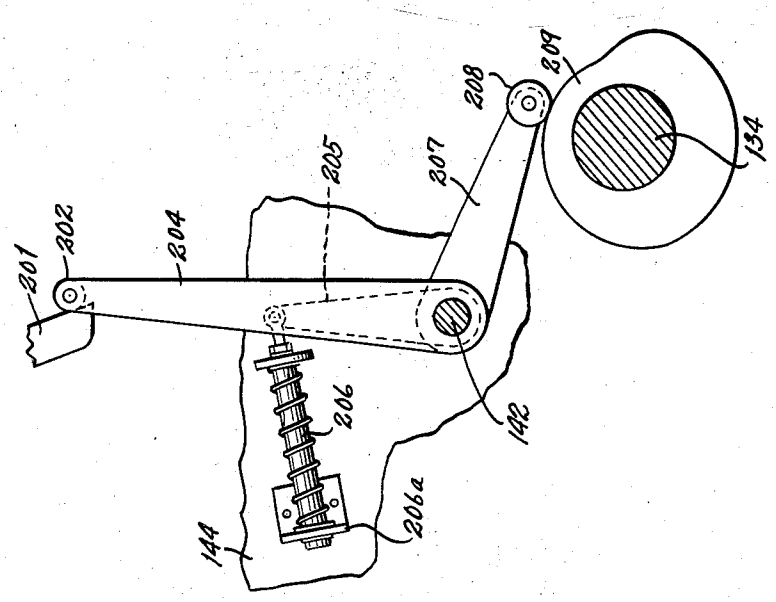
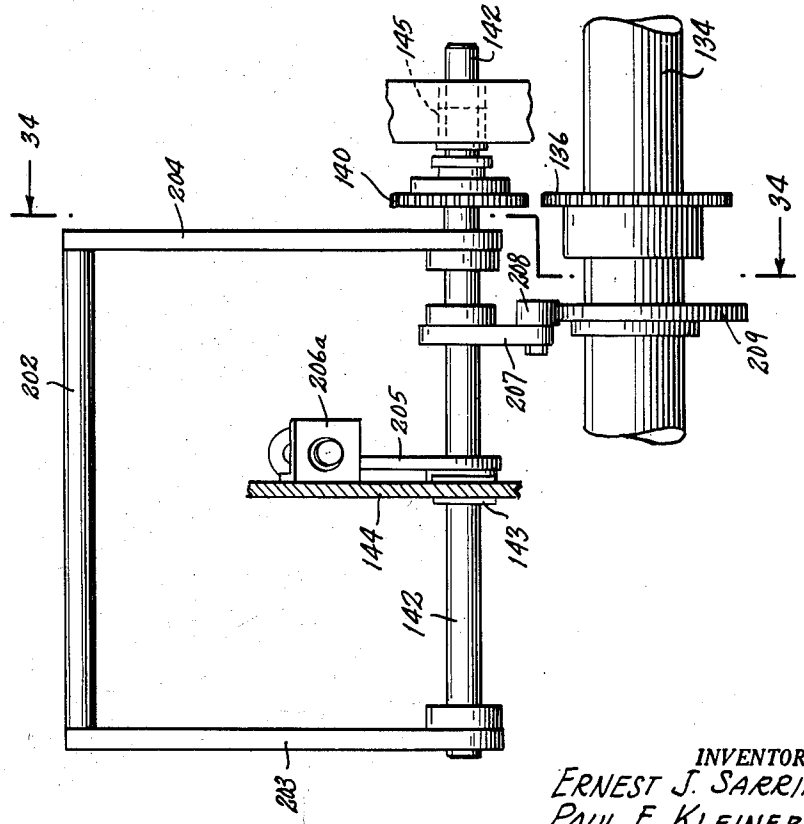


Fig. 33.



INVENTOR.
ERNEST J. SARRING
PAUL E. KLEINEBERG
BY Kenyon & Kenyon,
ATTORNEYS

United States Patent Office 3,146,650 Patented Sept. 1, 1964

3,146,650

AUTOMATIC CONTINUOUS BOOK TRIMMER

Ernest J. Sarring and Paul E. Kleineberg, Easton, Pa., assignors, by mesne assignments, to T. W. & C. B. Sheridan Company, a corporation of New York (incorporated in 1964), a wholly owned subsidiary of Harris-Intertype Corp., New York, N.Y., a corporation of Delaware

Filed Dec. 6, 1960, Ser. No. 74,187
17 Claims. (Cl. 83—91)

This invention relates to book trimmers such as are used in book binderies to trim the front, top and bottom edges of collated and bound signatures. This trimming produces books with flush edges.

In the case of books which are relatively thin, such as magazines, and the like, it is common to lift and handle two or more superimposed books which are treated as a unit or so-called lift, each lift being trimmed so that the two or more books are simultaneously trimmed and the work is speeded. In the case of thicker books each lift may comprise only one book.

As the name implies, an automatic book trimmer includes machinery for manipulating the lifts so as to align and hold them for trimming of their front, top and bottom edges, and of course for moving them from a supply location, through the trimmer and delivering them. There are various types of automatic trimmers. As indicated initially, the present invention is concerned with the continuous or in line type adapted to accept lifts from a supply and move them along through the trimming and to the delivery in a continuous manner without motion reversals. Thus such a trimmer may be placed in line with a flow of collated and bound signatures and although these may be accumulated by stacking they may continue to travel in a straight line through the trimmer and on to the delivery without change in traveling direction.

Because of its nature an automtic continuous book trimmer ordinarily includes a conveyor having upstanding lugs, which push each lift along to the first trimming location established by rectractable stops against which the advancing edges of the lift abut momentarily. This locates each lift for trimming one of its edges by a first knife. Then each lift must be moved to a second location, which would normally also be established by retractable stops and where two side knives are located to trim the sides of the lift, each lift then being delivered from the machine in one manner or another. The conveyor lug chains have lugs spaced far enough apart to space the lifts and give time for each lift to stop at the two trimming stations. A hopper in which the collated and bound signatures are stacked may be located to deliver lifts to the lugs of the lug chain conveyor.

Keeping the above in mind, a number of operational problems have existed which have prevented such a trimmer from operating at high speed with smoothness and accuracy of trimming. When the lug chain conveyor is speeded and its lugs engage a lift of books suddenly there is a tendency for the lugs to momentarily bounce the lift forwardly. As each lift is suddenly stopped at the first trimming station it tends to bounce backwardly from the retractable stops. Incidentally it is to be understood that these stops are retracted as required to permit further forward motion of the lifts. Book knives ordinarily have clamps which travel with the knives and engage and anchor the lift against motion during trimming but the sudden engagement of such a clamp with such a lift again tends to disarrange the lift in the case of high speed operations. During the transfer from the first to the second trimming station there is further danger of the lifts shifting unpredictably, and of course the second set of retractable stops again may introduce the bouncing problem. Further, as the knives at both stations operate the motor which drives the machine is intermittently loaded heavily and even hrough the system is provided with a fly wheel heavy shock and vibration is encountered.

The object of the present invention is to provide an automatic continuous book trimmer which is as free as possible from the above described operational troubles in every way.

Trimmers produced in accordance with this invention have now survived extended trial operational periods under practical operating conditions in different book binderies. Those skilled in this art have conceded that these trimmers operate with greater precision and smoothness than prior art commercially available trimmers in general. To illustrate the construction, principles and operation of these new trimmers one of them will now be described with the aid of the accompanying drawings in which:

FIG. 1 is a top view of the machine embodying the invention.

FIG. 2 is a view of the left hand side of the machine.

FIG. 3 is a partial top view showing the hopper.

FIG. 4 is a partly sectioned side view of the elements of FIG. 3.

FIG. 5 is a partly sectioned enlarged side view of details of FIG. 3, taken on the line **5—5** in FIG. 3.

FIG. 6 is a cross section taken on the line **6—6** in FIG. 5.

FIG. 7 corresponds to FIG. 5, with the parts in a different portion of the operational cycle.

FIG. 7*a* is a schematic perspective view showing parts otherwise difficult to illustrate.

FIG. 8 is a partly sectioned top view of the infeed table assembly.

FIG. 9 is a partly sectioned side view of FIG. 8, taken on the line **9—9** in FIG. 8.

FIG. 10 is a sectioned view taken on the line **10—10** in FIG. 8.

FIG. 11 is a cross section taken substantially on the line **11—11** in FIG. 9.

FIG. 12 is a cross section taken on the line **12—12** in FIG. 9.

FIG. 13 is a sectioned view taken on the line **13—13** in FIG. 8.

FIG. 14 is the same as FIG. 13 but with the parts at a different part of the operational cycle.

FIG. 15 is a partly sectioned view of the left hand side of the knife assembly.

FIG. 16 is a partly sectioned front view of the knife assembly taken on the line **16—16** in FIG. 15.

FIG. 17 is a partly sectioned view of the knife assembly, taken on the line **17—17** in FIG. 16.

FIG. 18 is a top partly sectioned view taken on the line **18—18** in FIG. 16.

FIG. 19 is a partly sectioned view of the left hand side knife assembly.

FIG. 20 is a partly sectioned view of the left hand side knife assembly.

FIG. 21 is a sectioned view taken on line **21—21** in FIG. 19.

FIG. 22 is a sectioned view taken on the line **22—22** in FIG. 19.

FIG. 23 is a sectioned view of the side knives' adjusting screw assembly.

FIG. 24 is a sectioned view of the side knives' adjustment mechanism taken on the line **24—24** in FIG. 23.

FIG. 25 is a partly sectioned view taken on the line **25—25** in FIG. 23.

FIG. 26 is a left hand side and partly sectioned view of the transport assembly.

FIG. 27 is a sectioned view taken on the line **27—27** in FIG. 26.

FIG. 28 is a top view of the book transport assembly and including the knife assembly and book delivery mechanism.

FIG. 29 is a top view of the book supporting table and delivery assembly.

FIG. 30 is a sectioned view taken on the line 30—30 in FIG. 29.

FIG. 31 is a sectioned view taken on the line 31—31 in FIG. 29.

FIG. 32 is a sectioned view taken on the line 32—32 in FIG. 29.

FIG. 33 is a back view of the drive assembly for the parts shown by FIGS. 30 to 32.

FIG. 34 is a side view taken on the line 34—34 in FIG. 33.

In the following the construction and operation of this book trimmer are described together insofar as is practical. This is done at first generally and subsequently in detail.

Thus, referring to FIGS. 1 and 2 the books are delivered to a hopper 1 which provides storage capacity above a hopper feed table 2. The hopper may be loaded with books manually or by automatic equipment. The books are stacked in the hopper each with its back or bound edge facing toward the back of the trimmer, which is the left hand end in FIGS. 1 and 2.

The books to be trimmed are stripped from the bottom of stack resting on the feed table, as a lift consisting of one or more books, and delivered between two pairs of pinch rolls 3, shown covered by a rectangular cover, which transfers them to an infeed lug chain conveyor 4 that carries the lift, accurately located laterally by side guides 4*a*, under overhead infeed pushers 5 which operate to push or jog and to then hold the lift with the bound edge against back stops 6. Thus the lift is positively located against the stops and held at rest momentarily against bouncing backwardly.

When the lift has been thus positioned, a clamp assembly 6*a*, described later, operates to hold the lift firmly in position while the front knife assembly 7 cuts the front edge or face of the book or books forming the lift. The infeed pushers 5 release gently just as this clamp assembly becomes active.

While this cut is being made, a transport device 8 clamps the product. As soon as this cut is completed and the clamp assembly releases the lift the transport device operates to positively move the lift to a second station between side knife assemblies 9. The clamp assembly 6*a* is timed to release prior to and independently of the knife starting its retraction stroke, and the transport device engages and starts to move the lift as the clamp assembly releases. At the second station, before the lift is released by the transport device, side clamps compress it and hold it in position. This position is accurately located relative to the side knives, because from the time the lift was first accurately located against the stops 6 it has been under constant control and never free from one or another of the clamping devices. The side knife assemblies 9 then operate to cut the head and foot edges of the books of the lift.

After this cutting or trimming, the transport device 8, by way of kicker fingers described later, operates to move the lift to speeder belts 10 which convey it to more slowly moving delivery belts 11 for convenient removal of the books from the machine.

The details of the foregoing and other features will now be described below in full.

The feed table assembly mounts the hopper 1 at the front end of the machine. The hopper's basic frame structure includes a pair of center frame plates 12, intermediate frame plates 13 and outer frame plates 14, which are rigidly held in parallel relation to each other by bars 15. The outer frame plates 14 are further braced by a channel member 16.

The books B are delivered to the hopper, each book with its back or bound edge facing the back or left of the machine. The books are kept in a vertical stack by front and rear guide plates 17 and 18 in combination with side guide rails 19. These guide plates and rails may be adjusted to closely confine books of varying sizes.

The lift of one or more books is delivered from the hopper by the reciprocating feed table surface 2, which forms the hopper bottom. This table surface, in detail, is constructed of outer table plates 20 which are aligned with the longitudinal axis of the machine and with the direction in which the book lift is delivered from the hopper. These table plates are joined together by transverse table cross pieces 21 which are in turn mounted on table bars 22 which are slidably mounted in sleeve bearings 23 located in the center frame plates 12.

Stripper fingers 24, mounted by a head 25, provide a positive delivery feed. This head 25 is formed of a U-shaped channel member 26 which fits over a center table plate 27, this plate being fastened between the U-shaped channel and a bottom plate 29, by a suitable fastening through a center slot 28. Side plates 30 are adjustably mounted on the sides of the U-shaped channel 26, and carry on their front or pusher edges the fingers 24 which may be shaped generally as shown to facilitate the separation of the lift being delivered from the books remaining stored in the hopper. The height of the stripper fingers above the feed table surface should be set approximately equal to the height of the lift which will be fed from the hopper with each stroke. This height depends on the number of books fed as one lift.

The front guide plate 17, previously referred to, is also a stripper plate. The lower edge of this plate defines the gate controlling the number of books stripped from below the stack of books to form the desired lift. This plate 17 may be adjustably fixed at varying heights as required to provide the gate height necessary.

The feed table reciprocation is effected by a four bar linkage consisting of an eccentric 30, linkages 31, 32 and the stationary central frame members 12 which take the reaction. The eccentric 30 is powered by a drive shaft 33, and links 34 connect the link 31 with the left hand cross piece 21 to which the centerplate 27 is connected.

A sprocket wheel 35 powers the drive shaft 33 through a dog clutch 36. This dog clutch is adapted and spring loaded to lock the sprocket wheel 35 to the drive shaft 33. This dog may be retracted by an electric solenoid 37 which through a linkage system 38, pivotally supported by a frame plate 13, connects the solenoid's armature connecting rod 37*a* with the dog clutch's end dog 39 to cause this dog to disengage. Deenergizing the solenoid allows the spring loaded dog 39 to reengage. The hopper feed can in this manner rapidly start and stop, and yet always operates in phase with the other operations of the trimmer because it is locked in phase by the dog clutch.

The lift is delivered from the hopper to the pinch rolls, noted previously at 3, which assist in transferring the lift to the lug chain conveyor 4 and thereby makes possible a relatively short stroke of feed table reciprocation and therefore high speed operation without excessive vibration and wear.

The above pinch rolls are mounted immediately behind the infeed table, with the table plates 20 and 27 spaced laterally to pass aside and between these rolls.

A guide 44 and the table plates 20 and 27 direct the books' back edges between the first upper pair of pinch rolls 45 and the lower pair 46. The upper rolls 45 are carried by a shaft 47 which is journaled near its outboard ends by vertically sliding pillow blocks 48. These pillow blocks are adjustable as to their lower sliding limits so that the working space between the upper and lower pairs of pinch rolls may be set to firmly grasp the top and bottom surfaces of each lift and propel it forwardly.

The normal spacing of these first rolls 45 and 46 is intermittently increased as each new lift feeds from the

hopper, to facilitate passing the lift through the rolls at high speed and to permit high roll pressures without damaging the backbone or leading edges of the books of the lift.

As schematically shown by FIG. 7*a*, the above action results from the lower pair of rolls 46 being mounted at fixed vertical locations. The upper pair of rolls 45 are mounted on the shaft 47 journaled by the vertically sliding pillow blocks 48. Strong springs 49 bias the pillow blocks 48 to their lowermost limits of movement. The shaft 33 rotates cams 50 which lift levers 51 at the appropriate times, these levers being connected by links 52 with the pillow blocks so as to force them upwardly against the bias of the springs 49.

A second set of pinch rolls is located a short distance behind the first set. Its upper pair of rolls 58 is carried by a stub shaft 59 that is journaled on swing arms 61 that pivoted so that the upper pair of rolls 58 may go up and down. The lower pair of rolls 62 in this second set are carried by a shaft 63 that is journaled by bearings fastened directly to the frame.

The shaft 63 is powered through a sprocket wheel 64, and turns a sprocket wheel 65, mounted on the left outboard end, which drives a sprocket chain 66 over the sprocket wheel 35, whereby to power the hopper drive shaft 33, a sprocket wheel 67 which drives the shaft 47, and rides over idler sprocket wheels 69, 70 and 71. The shaft 47 mounts sprocket wheels 72 which drives through a sprocket chain 73 a sprocket wheel 74 which turns the stub shaft 59. The upper rolls 58 of the second set of pinch rolls are turned by this stub shaft. Gravity aided by springs (not shown) urge the arms 61 dowwardly. However, these forces which bias the upper pinch rolls 58 downwardly do not exert as much force as that applied to the corresponding rolls of the first set. Therefore, there need be no provision for intermittently lifting these rolls 58.

The lift of books is delivered from the pinch rolls to the infeed lug chain conveyor 4 which carries the lift under the overhead infeed pushers 5 described in detail hereinafter.

The frame 81 of the infeed table attaches to the hopper assembly by a pin shaft 82 and to the knife assembly frame by a stay shaft 83. An infeed table surface 84 is mounted between them which guides and supports the lug chains 85, which form the conveyor 4, in grooves 86 so that their upper surfaces are flush with the table.

The lug chains are carried by sprocket wheels 87 on a first shaft 63 and by sprocket wheels 90 on a rear or second shaft 91 which is journaled by bearings 92. The chain is tensioned by idler pulleys 93 mounted on adjustably swinging arms 94 which pivot around a stay shaft 83.

The lugs 95, of the lug chains, are spaced somewhat further apart along the chains than the greatest distance between the front and back edge of any book which will be supplied to the trimmer. The book lift is centered along the feed table, between adjustable angle bars 96 which form the side guides 4*a* previously referred to.

The shaft 63 is powered through a sprocket wheel 64 by a sprocket chain 97, tensioned by an idler sprocket wheel 98 mounted on an adjustable arm 99 that pivots about the stay shaft 83, and is driven by a sprocket wheel 99*a* on the shaft 91. The shaft 91 is driven through a sprocket wheel 101.

Each lift is jogged or pushed gently into alignment for exact trimming, by the infeed pusher assembly 5 described in detail below.

The pusher fingers 102 straddle the infeed chains 85 above the lifts conveyed by these chains and are equipped with replaceable pusher tips 103 which are adapted to engage against the front edge of the lift of books being fed. These fingers are timed and controlled to lower behind the lift's front edge and to move forwardly slightly above and generally parallel to the infeed table surface 84 to jog or push the lift against the back stops 6 and

momentarily hold the lift there so that it will be settled against the stops accurately until gripped by the clamp assembly 6*a*.

The pusher fingers 102 are rigidly connected to a single overhead rod 104 through clamping sleeves 105 which permit the arms to be adjusted with appropriate radial extension.

The rod 104 mounts rolls 107 at both ends which ride in horizontal channel guides 108 and 108*a* attached rigidly to the infeed table frame.

The forward and back strokes of the overhead rod 104 is controlled by a cam 109 mounted on the shaft 91 through the power train consisting of a roll 110, lever arm 11 which pivots about the stay shaft 83, adjustable linkage 112, lever arm 114 pivotally attached to a shaft 115, adjacent to a lever arm 116, to which it is attached by a beveled pin 117. Cam 109 is loaded by compression spring assembly 109*a* which extends between lever arm 114 and the frame. The lever arm 116 is rigidly keyed to the shaft 115 and connects to a linkage 118 which is pivotally connected to an end of the rod 104. A corresponding lever arm 116*a* is keyed to the left side of the shaft 115, and connects through a linkage 118*a* with the other end of the rod 104.

The head 119 of the pin 117 is normally urged into a depression in the lever arm 116 by a spring (not shown) mounted around the pin shank 120 between the head and an abutment mounted on the lever arm 114. A book jam or other trouble which prevents a book lift from being easily fed by the overhead pusher fingers 102 will cause an abnormal load to be placed on the lever arm 114 and the shear force generated on the shaped pin head 119 between the lever arm 114 and the lever arm 116 will cause it to disengage by moving toward the left (see FIG. 12). By so doing, the pin's left end strikes a hinged plate 121 loaded by a spring 122, and then causes it to move outwardly on a hinge pin 123 to actuate a limit switch 124, which by proper controls, stops the machine.

A lever arm 125 is rigidly attached to the right end of rod 104 so as to rotatively oscillate it and thus the pusher fingers 102. The other end of the arm 125 mounts a roller 126 which rides in a channel 127 that is pivotally attached through the channel guide 108 to the frame of the infeed table assembly. The channel member 127 is loaded by a spring 128 to press a height adjusting follower 129 against a cam 130.

The main and stationary frame 131 of the knife assembly may be cast in sections and bolted together. This frame directly supports a front knife drive shaft 134 journaled by bearings 135. This shaft carries a sprocket wheel 136 which drives the shaft 91 of the infeed table assembly by the chain 100 which rides idler pulleys 138, journaled by bearings mounted directly to the frame, and 140, which is journaled by a bearing 141 on a shaft 142 which is, in turn, journaled by bearings 143 in a vertical center frame plate 144 and by bearings 145 in the left side of the frame 131.

The shaft 134 carries a front knife drive crank 146 and a counter weight 147 at its left outboard end, and a front knife clamp drive cam 148 centrally located.

As for itself the shaft 134 is driven through a gear 149 which is driven through the power train consisting of gear 149*a* mounted on a jack shaft 150 which is journaled by bearings 151, mounted by the frame 131, gear 152 mounted on a side knife drive shaft 153 that is journaled by bearings 154 also mounted by the frame 131, and pinion 155 carried by a clutch and brake shaft 156 that is journaled by bearings 157 mounted on the frame 131. A brake 158 is attached at the left outboard end of the shaft 156, and the clutch 159 is attached to the right end. The clutch is mounted on the hub of an inertial fly wheel 160 driven by a belt 161 through a motor gear box and drive pulley assembly 162 (see FIG. 1).

The side knife drive shaft 153 turns a pulley 163 that powers a lubrication oil pump (not shown), sprocket

wheels 163*a* that power the rear delivery belts 11, side knife drive cams 165, and side knife eccentrics 166.

Horizontal stay shafts 167 and 168 are transversely fastened between the sides of the frame 131 to provide ways for the movable side frames 169 and 170 of the right and left side knife assemblies, respectively. An adjusting screw mechanism permits these side knife frames and assemblies to be moved transversely in and out from a center plane to accommodate runs of books of different dimensions from head to foot. This mechanism includes three screw shafts 171, 172 and 173, respectively mounting sprocket wheels 174, 175 and 176 which are interconnected by a chain 177 that is tensioned by an idler sprocket 178 mounted on an adjustably positioned arm 179. The screw shafts are rotatably journaled in bearings 180, 181 and 182, respectively, which are mounted in the center frame plate 144. They are restrained from axial movement through the center plate by the hubs of the sprockets 174, 175 and 176 on one side and by collars 183, 184 and 185 on the other. The right and left outboard ends of the screws are threaded with nut portions 186 rigidly mounted in borings 186*a* in the right and left side knife frames 169 and 170.

The left end of the screw shaft 173 extends through the side knife frame and is shaped to receive an operating crank. This may be done in various known ways and is not shown.

A work table 188 to support the product while it is trimmed and transported, includes side work table pieces 189 and 190 placed immediately behind the front lower knife 191, and a front knife table filler 192, and adjacent to the right and left side lower knives 193 and 194 respectively. These table pieces are fastened by bolts 195.

Each of these table pieces incorporates a backstop 196 adjustably positioned along a rigid link 197 to accommodate products of various widths. This link is mounted at the end of swing arms 198 and 199 which pivotally mount to the table pieces 189 and 190. A tension spring 200 biases the backstops 196 in its up position as shown in FIG. 32.

The backstops 196 are cam controlled to lower and allow the lift of books to be transported over and past them into location for the side knife trimming operation, and then to rise for the next lift stopping and jogging operation in the following manner. Rigid links 197 have cams 201 contacted by a long roller 202. This roller 202 is mounted between oppositely disposed lever arms 203 and 204, respectively, which extend upwardly from the shaft 142 to which they rigidly attach. The shaft 142 is journaled as previously described and is powered for rotation in one direction, through a rigidly attached lever arm, 205, by a compression spring 206 attached between the lever arm and an abutment 206*a* on the center plate 144. The shaft 142 is rotatably powered in the other direction through a rigidly attached lever arm 207, cam roller 208 and control cam 209 which is turned by the main front knife drive shaft 134.

Table inserts 210 and fillers 211 are used to fill in the table surface between the side table pieces 189 and 190, when they, with the side knife frames and assemblies, are moved apart to accommodate larger books.

The table fillers 211 are flat surfaced bars, shaped below to rest on the stay shafts 167 and 168 to which they are bolted when in use. They may be of several widths to permit filling out the table surface with any desired spacing of the side knife assemblies.

The table inserts 210 are likewise adapted to form a part of the work table top, and in addition are provided with backstops 212 which operate on rigid links 213 through slots 214 in the top surface of the inserts. The links 213 are supported on swing arms 215 and 216 which mount pivotally to the inserts at 217 and 218, and are spring loaded in an up position by a tension spring 219 attached between an extension of the swing arm lever 216 and the insert.

A cam 220 on the rigid link 213 is operated by the long roller 202 to control the backstops 212 similarly to the backstops 196, with which they are normally aligned.

As soon as the book lift has been jogged against the backstops 196 and 212, the pressure pads, described later, of the front knife assembly descend to press the book lift with moderate pressure against the work table surface and thereby hold it firmly in aligned position. These pressure pads engage the book just prior to the infeed pushers leaving contact with the book's front. The high pressure clamps, described later, then lower to firmly hold the lift compressed in position while its front edge is trimmed.

The front knife assembly is supported by the main frame 131 generally above the front knife drive shaft 134.

The front knife 221 is bolted to a heavy knife bar 222 which mounts to the frame through swing arms 223 and 224, which together with ways 225 and 226, align the bar to swing past the front lower knife 191. These ways are machined on the inner surfaces of the frame adjacent to the knife. Preferably, separate castings 227 and 228 lie on opposite sides of the plane in which the knife moves and bolt together through a joint 227*a* which may be shimmed to adjust to the spacing of the ways. The lower knife 191 is mounted level with the work table and is adjustable forward and backward by set screws. The upper knife 221 is tipped so the load of cutting is picked up smoothly by its shear action, and released smoothly by the same tipped effect and by the increased shear that has been developed during the cut as the knife rotates about the pivotal mountings of the swing arms. Thus this tipped or angled knife works very smoothly.

The knife is powered through the swing arm 224 which is driven by a link 229. That link is attached to the swing arm 224 with pivotal freedom in both the plane of the link, and in the vertical plane perpendicular to it.

The lower end of the link 229 by a self-aligning bearing 230 is connected to the crank 146. The counter weight 147 acts to counteract the knife acceleration with a center of mass offset approximately 180° from the offset of the crank throw.

A clamp bar 233 rides up and down immediately behind the knife 221 and the knife bar 222, which parts guide the clamp bar on one side, the clamp bar on its other side riding against a frame way 234. This clamp bar carries a clamp pad 235 adapted to contact and hold the product under heavy pressure during the cutting operation.

The clamp bar 233 is operated through draw rods 236, one on either side of the throat of the front knife assembly, and each attached to a cross head bar 237. Vertical rods 238 screw into that bar, and are slidably mounted to the frame by bearings 239 and 240. Blocks 241 are fixed to and adjustably threaded along each rod 238 just below the bar 237. The blocks mount a cross shaft 244 which carries a cam follower 243 that rides the cam 148 turned by the front knife drive shaft 134. A pair of side plates 245 attach to the blocks 241 on either side of the bar 237, and these side plates support plates 246 forming an arm 247. That arm pivots about a block 248 which may be slid along ways 249 by a screw 250. This relocates the fulcrum of the arm and adjusts the clamp pressure supplied by a strong spring 251 to the clamp pads.

Cam 148 determines the distance between the upper and lower limits of the clamp reciprocation, and provides positive control of the upward stroke of the clamp pads to accurately time the release of the product to the transporter after the knife has completed its cut. This clamp action is independent of the knife, and permits full spring pressure to be used with a short clamp stroke. In operation this short clamp stroke is adjusted so that the upper limit of clamp reciprocation is just high enough to provide clearance between the clamp pads (and also the auxiliary clamp pads, which are described below) and the product or work to be located on the table support underneath them. The stroke is long enough so that by this same ad-

justment the lower limit of reciprocation is below the top surface of the product or work so that the clamp pads are pressed firmly against it by spring pressure on their downward or clamping stroke. The cam **148** may leave the follower **243** during this portion of its cycle.

Because the limits of clamp reciprocation are adjustable, it is possible to use a relatively short clamp stroke which minimizes vibration and wear by permitting lower clamp speeds, even with rigid stroking, and this structure lessens the impact shock between the cam controlled descending clamp pads and the work aligned beneath them.

The reciprocation limits of the front knife clamp pads above the work table may be adjusted by rotating vertical rods **238**. These rods are threaded to the bar **237** and the blocks **241** by a combination of thread pitch and direction such that rotation will adjust to the spacing between the bar and the blocks. Flats **252** are provided on the rods to facilitate this rotation, and the rods are interconnected by spur gears **253** to keep the cam roller assembly aligned. This adjustment is independent and does not affect the clamping pressure supplied to the clamp pads by spring **251**. The reciprocation limits of the side knife clamp pads are similarly adjustable by means of the adjustable draw bar assembly **336**.

Both side knives as well as the front knife have generally corresponding auxiliary pressure pads which operate before the high pressure knife clamps engage the lift. Therefore, in the following description of certain details concerning the front knife auxiliary pad, use is made of the side knife auxiliary pressure pad shown by FIG. 17 to describe the corresponding details of the front knife pad by reference numerals applied to this pad, at least to some degree.

The auxiliary pressure pads **254** operate in advance of the main clamp pads **235** to hold the lift in aligned position without disturbance when it is hit by these main clamp pads. These pads **254** are carried by the main clamp bar. A block **255** is attached to the main clamp bar by bolts **256**. A tongue **257** bolts to the pad **254** and rides in a channel of the block's rearward face. The pads **254** are replaceable and may be suitably surfaced and shaped for the particular product to be cut. Preferably, the pads should contact a substantial portion of the top surface of the book lift but should not engage its bound or back edge.

A cup **258** lifts over the blook **255** and retains a lining **259**, preferably rubber adapted to frictionally engage the tongue **257**. The lining is urged against the tongue by a leaf spring **260**, which is held under adjustable pressure by bolts **261**, which also hold the cup **258** in position.

In operation, the pads **254** ride up with the main clamp bar until an adjustable screw **262**, mounted to the front knife frame, contacts the tongue **257** to hold it stationary at some predetermined height while the main clamp continues to rise. Descending with the main clamp, the pads therefore first encounter and then firmly but lightly compress the product with a force adjustable by the pressure of the leaf spring **260** and a choice of linings with different coefficients of friction. These pads **254** engage the lift before the heavy pressure clamps do and before the finger tips **103** leave the back edge of the lift.

The back of the infeed table is hinged to form a gate **262***a* that is opened during the cut by the front knife to allow the knife to pass by the lower knife and the trimmed material to fall below the table level where it may be conveniently removed. This gate is controlled by a cam **263** which rotates with the rear or second infeed table shaft **91**. This cam operates a cam follower **264** mounted on a lever arm **265** which pivots around a stay shaft **83** and attaches to a rod and spring guide **266** at its upper end. That rod extends through a guide **267** which attaches to the underside of the infeed table, and pivotally connects to the table gate. A compression spring **268** extends between the gate **262** and the guide **267** to load the cam follower and hold the gate in its up or closed position during the product feed. It yields to protect the machine from damage should the knife and gate operation accidentally become dephased and the knife descend before the gate is lowered.

The transport assembly described below operates to positively grip and hold the product in aligned position. As soon as the front knife cut is complete, the cam driven clamp and pressure pads rise and the transport assembly moves the books to the second station on the work table where they are trimmed by the side knives.

This transport assembly in detail includes an upper horizontal tubular bar **270** which carries a replaceable clamp jaw **271** which is vertically adjustable so that it just clears the compressed lift when the upper clamp bar **270** is in its raised position and presses down firmly upon the books when lowered. A lower horizontal bar **272** rises just above the work table surface, retracts just below it with a vertical motion considerably less than that of the upper clamp. A lower clamp jaw **272***a* and a removable book support pad **272***b* are fixed to the top of the bar **272**.

A slide **273** extends for the length of the lower bar and is attached at its forward end by a pin **274** to the top portion of a lever **275** which pivots about the stay shaft **167**. The slide is pivotally attached at its back end to a lever **277** which is rigidly attached to a shaft **278**.

The back of the upper bar **270** is rigidly attached and braced to a transport end piece **279**. The end piece **279** mounts rollers **280** at each lower side which run in channels **281** of rigid channel bars **282**. At their front, these channel bars **282** are pivotally attached to lever arms **283** which mount rigidly upon a shaft **284**, and at their back they are pivotally attached to lever arms **285** which mount rigidly with the shaft **278**. The shaft **278** is journaled by bearings **286** carried by the frame, and the shaft **284** is journaled by bearings **287** also carried by the frame, and that shaft **284** is braced from the stay shaft **168** by a bracket and bearing assembly **288**.

The upper bar **270** is carried by a slide **289** which pivotally mounts forward to lever arms **290** which are pivotally mounted to the back of the front knife frame. At the rear the upper slide bar **289** pivotally mounts to a lever **291** which is rigidly attached to a shaft **292**. That shaft is journaled by bearings **293** attached to the frame.

The vertical or clamping stroke of the bars is controlled by a cam **294** turning on the side knife drive shaft **153**. A cam follower **295** is mounted on a lever **296** which is rigidly attached to a lever **297** which is rigidly attached by a lever **298** to the shaft **284**. A tension spring **300** that connects between a projection **301** on a stay shaft **302** and to the lever **283** serves to load the cam. Movement of the cam follower thus rotates the shaft **284**. A bar cam **303** is fastened and driven by the arm **297**. The shaft **284** rotates the lever arm **283**, which is interconnected by the channel bars **282** and lever arms **285** to rotate the shaft **278** and thereby the lever arm **277**. Rotation of the lever arms **275**, **283**, **285** and **277** clockwise lowers the lower bar, and counter-clockwise rotation raises it.

As the shaft **284** rotates to power the lower bar **272** in one vertical direction, it powers the upper bar in the other. Lever **283** rotates lever arm **299** through a spring link assembly **304**. The lever arm **299** is rigidly attached to the shaft **292** which turns the lever arm **291**, and through the slide bar **289**, the lever arms **290**. The rotation of the lever arms **290** and **299** moves the upper bar assembly in a vertical direction.

The spring link assembly **304** is adapted to provide positive lift on the upper bar. Compression is transmitted from the lower end of the lever **283** through a spring guide rod **305**, through a block **306**, and the tubular main body portion **307**, to an upper mounting piece **308**. At the same time, the assembly provides a spring powered clamp pressure on the downward stroke to compensate for small variations in book thickness and

density. The tubular body portion 307 carries a guide block 310 attached to one end of the spring guide rod 305 which is reciprocatively journaled through a bearing 311. A spring 312 mounts between the bearing 311 and the guide block 310.

The forward and back stroke of the upper clamp jaw 271 and the lower bar 272 is controlled by a cam 313 which operates a cam follower 314 carried by a lever arm 315 which pivotally mounts to the frame at 316. The upper end of the arm is connected by a rigid link 317 to a downwardly projecting bracket 318 that attaches to the lower bar 272.

The lower bar 272 is attached directly to the transport end piece 279. The upper bar and clamp are powered from the bracket 324 on the upper portion of the end piece 279. This bracket 324 carries retaining ways for a roller 325 which is attached to an upward projection 326 of the upper bar, and which rolls about an axis parallel to the bar to keep it vertically aligned. The bracket also carries ways for a roller 327 which rotates about a horizontal axis perpendicular to that of the roller 325, to power the forward and back stroke.

The transport return stroke is powered and the cam follower is loaded by compression springs 319. These springs extend between the end piece 279 and collar 323 on guides 320 which at one end extend through openings in the end piece, and at the other end carry a threaded rod 322 which attaches to brackets 321 that mount rigid with the frame. A nut and collar 323 threads along the rod 322 to adjust and lock the compression pressure of the spring. Alternatively, the transporter may be powered and the cam follower loaded by a spring between the lever arm 315 and the frame.

During the back stroke of the transport assembly, kicker fingers push the completely trimmed product from the second or side knife work location on to speeder belts for removal from the work table.

A pair of kicker fingers 328 are located along each side of the lower bar 272 in front of the support pad 272*b* and are pivotally mounted to the bracket 318 at 309 to project just back of the backstops when the transporter is in its forward position. A tension spring 329 urges the kicker fingers into a normally retracted position. They rise with the lower bar 272 as the lever arms 297 and 275 rotate about shafts 284 and 167 respectively, to raise the rigid cam bar 303. This acts through a roller 330 to rotate and thereby raise the fingers.

Before the transport clamp jaw and lower bar release the product or lift transported to the side knife work location, the auxiliary pressure pads of the side knife clamp descend to hold it securely in position.

The side knife frames 169 and 170 are supported as described before and in addition are joined through bearings 331 to the side knife drive shaft 153. These bearings are adapted to slide along the drive shaft with adjustments to the side knife spacing as are the side knife, and clamp, cams. The side frames 167 and 170 are fastened to the front knife housing 227 through screws 371 in slots 372.

The side knife frames carry side clamp bars 332, with clamp pads 333, between ways on the inner half of the frame and the side knife backing plate. These are powered through rigid links 334 from lever arms 335 which are powered by a draw bar 336 from rocker arms 337, by a pivot at 338. The rocker arms 337 pivot about bearings 339 mounted in the side knife frames outwardly of the adjusting screw shaft 172. They are controlled through cam rollers 341 by the cams 165, which turn with the side knife drive shaft 153.

The clamps are set by compression springs 343 which are carried in boxes 344 swung on arms 345 from pivots 346 at the outer ends of the rocker arms 337. The springs bear at their upper end against collars 347 which thread on eye bolts 348 that pivot on pin shafts 349 carried by brackets 350 mounted to the side knife frames.

The side knife auxiliary pressure pad assemblies are constructed, carried and operated similarly to those of the front knife assembly, and are given similar numerals as indicated before.

The side knife blade is tipped and mounted to the side knife bar 351 similarly to the front knife blade.

The knife bar 351 is swung on pivots 352 and 353 by swing arms or links 354 and 355, from the frame. They are guided and aligned to the lower knives 194 by ways on the inner and outer pieces of the side knife frame. The spacing of these ways may also be adjusted by shimming the joint between the two frame pieces.

The side knife is powered through a rear downward projection 357 of the bars 351, which pivotally attaches to the outer strap 358 about the eccentric 166 which is turned by the shaft 153 by means of splines which permits a longitudinal sliding movement.

The product is delivered from the work table by the speeder belts 10 which overlap the rear portion of the table and extend through the transport end piece 279 proximate to the slower delivery belts 11.

The speeder belts are carried at their forward ends by pulleys 361 which are mounted behind each side work table pieces 189 and 190 on the machine frame, and also in each table insert piece 210, so that the number of speeder belts used will vary with the width of the product being run.

The belts 10 are carried at their rear by pulleys 362 carried by a shaft 363 which is rotatably journaled to the frame. They are tensioned by idler pulleys 364 and 365 which clamp at adjustable angular positions.

The shaft 363 is driven through a pulley 363*a* and belt 365 from a second motor and pulley assembly 366.

The slower delivery belts 11 receive the product from the speeder belts and deliver it at a convenient speed either to a subsequent handling stage or to a hopper as may be desired. These belts 11 are carried by pulleys 367 having shafts mounted by bearings 368, and pulleys 369 mounted on a rear shaft 370, both shafts being rotatably journaled to the frame. Power may be supplied to the pulleys 367 through a reduction gear assembly 369 which is chain driven from the pulley assembly 163*a*.

All of the mechanical connections which operate the various parts, when the main drive shaft 156 receives rotary power, have been described by the foregoing. The manner in which the various parts connects with this drive shaft, such as, cam and eccentric contours, linkage designs, relative timing, etc. are of importance.

With the stack of untrimmed books B in the feeding hopper, the stripper finger 24 advances at first slowly but with a rapid acceleration so that when the forward portion of a lift has just cleared the first set of pinch rolls 45 and 46 and the latter quickly clamp together, the linear speed of the lift is substantially the same as the peripheral speed of these rolls. Furthermore these rolls grip the lift very tightly. The lift continues onwardly to the pinch rolls 58 and 62 and for an instant both sets of pinch rolls are driving the lift. The speed of the parts just described are such that the lift is now moving substantially at the traveling speed of the lug chain 85. Therefore, as the lugs 95 engage the trailing edge of the lift there is substantially no bouncing or dearranging action imparted to the lift. Thus the lift is carried onward smoothly, accurately and without damage, having started from a condition of rest in the hopper.

With the trimmer operating at high speed the lift would engage the retractable stops 196 and 212 with substantial impact force so as to possibly bounce backwardly with the result that the lift would not be precisely oriented at the first or front trimming station for trimming by the front knife. Here the fingers 102 come into play, their general motion being indicated by the arrows in FIG. 10. The finger tips 103 move in behind the rapidly advancing lift and rapidly accelerate to substantially the latter's traveling speed so that when the lugs disengage

from the lift the latter is carried onwardly by these fingers. The action is such that the fingers not only push or jog the lift squarely against the retractable stops but pause and momentarily hold the lift pressed against these stops. In this manner the lift is mechanically and positively restrained from bouncing backwardly.

During the above momentary pause the front knife's main clamp and auxiliary pressure pad assembly descends. This auxiliary pressure pad is shaped and dimensioned to engage substantially the entire top of the lift while staying clear from the book back portion and while providing sufficient clearance for the action of the transport mechanism which goes to work at a later period. The latter clearance is provided by either slotting the pad or making it in sections. The finger **102** does not start to leave the lift until shortly after the auxiliary pressure pad has engaged the lift and started to press it downwardly on the table of the trimmer. Therefore, the lift is not only jogged accurately into position but it is held in that positively and mechanically by the auxiliary pressure pad. The lift is always under positive control; it is never free to shift after being first oriented, until all trimming is effected.

A further function of the auxiliary pressure pad is to flatten the lift smoothly in case it has any tendency to be curved or buckled in any direction. Thus even if the fingers **102** might tend to buckle the lift the auxiliary pressure pad smoothes out this condition while the fingers are leaving the lift.

With the lift firmly anchored the main clamp pad which is rapidly moving downwardly under the force supplied by the energy stored in its spring actuating means, and under the control of its control cam, engages the lift close to the knife and clamps the lift with great firmness. During this action the auxiliary pressure pad keeps the lift anchored so that the impact of the main pressure pad does not dearrange the lift. Immediately thereafter, the front knife makes a smooth sliding cut so as to trim the trailing edge of the lift which is of course the front of the book or books forming the lift.

While the lift is thus clamped immovable the previously described transport mechanism has been advancing and prior to the release of the book by the front knives' clamps the transport's jaws **271** and **272***a* firmly clamp the lift. With the lift thus continuously under positive control, the front knife's clamp and pressure pad rise without any danger of the lift shifting from position. The clamp and pad rise even before the heavy knife is reversed and returned upwardly.

As soon as the lift is free from the front knife's clamp the transport mechanism starts its transport operation to bring the lift to the side knives' trimming station where the transport mechanism hesitates while maintaining its clamp on the lift. This occurs as soon as the front knife completes its cut and prior to its rising substantially.

The auxiliary pressure pads and the main clamps of the side knives, which substantially duplicate in principle those of the front knife descend at this time but the transport mechanism's clamp does not release the lift until after these auxiliary pressure pads, which in this case cooperatively substantially embrace the upper surface of the lift as described before, have engaged the lift and anchored it firmly. The side knives then cut in the fashion of the front knife. Thereafter the lift, being completely trimmed, may be safely released so that the kicker fingers **328** may remove the lift by kicking it onwardly to the high speed belts which quickly get the trimmed lift out of the way of the next advancing lift.

The main difference between the first and side knife pressure pads is that the front one may be a single unit suitably contoured to provide an open space for the action of the transport clamps, whereas the side knife pads are separate from each other but actuated simultaneously, or substantially so, to act like a single unit. These side pads are interspaced to provide clearage for the transport clamps and its kicker means. Both side knives cut substantially simultaneously.

With the above in mind, the crank actions or their equivalents which operate the front and side knives are designed and interconnected so that the front knife is driven through its cutting stroke out of phase with the side knives which are driven in synchronism together through their cutting strokes. This reduces the power consumption peak that would result from all knives cutting simultaneously.

Further, the transport's control cam is timed to release the transport's powering spring, which provides the forward transport motion, during the times the front and side knives are being driven through their respective cutting strokes. The release of the transport's spring energy drives its control cam and this energy is transmitted through the various interconnections to help drive the knives through their cutting strokes. Conversely, while the knives are being raised through their return strokes, when little power is required by the knives, the transport's spring is being compressed and is thus receiving and storing energy.

Still further, the knives' clamp assemblies are spring biased downwardly in all cases and as the knives go upwardly, requiring little energy, these clamp springs are being compressed so as to receive and store energy. This requires power during the time the knives require little energy and thus further smooths the power demand curve of the machine. The clamp assemblies must descend shortly prior to the knives being driven through their cutting strokes and thus their releasing springs tend to over drive the trimmer to some extent.

The previously described fly wheel on the machine's main drive shaft may be smaller than would otherwise be required. This concept of connecting this shaft through the spring power storing elements and to the knives, out of phase with each other and with the knives dephased, as described above, produces a very smooth running trimmer. This permits the trimmer to be run quietly at the high operating speeds permitted by the positive book lift control provided by the novel construction featuring this invention.

It is to be understood that although the front and side knives are dephased, they operate close together in time and in succession, the transport moving forwardly while the side knives cut and while quickly thereafter the front knife cuts. The transport goes backwardly to transport the lifts and compress its transport spring driving means when or after the knives return upwardly.

We claim:

1. An automatic continuous book trimmer including front and side trimming knives arranged in series to form front and side trimming stations and means for causing their triming actuation and a table for supporting a book lift at said stations and for transport therebetween so that by locating the lift on the table at the front trimming station for trimming and thereafter transporting the lift over the table to the side trimming station the front and side edges of the lift are trimmed, means for continuously feeding a succession of interspaced book lifts to said table at said front trimming station, a stop having means for raising it momentarily above said table's top so that each lift is engaged by the stop to locate the lift at said front trimming station and for then retracting the stop to permit the lift to be transported to said second trimming station, fingers means having means for causing the finger means to push and momentarily hold each lift against said stop while the latter is raised, first lift holding means for momentarily clamping the lift prior to its release by said finger means and during the triming actuation of said front trimming knives and thereafter releasing the lift, a book lift transport means having clamp members and means for reciprocating said clamp members between said trimming stations and for causing said members to clamp each lift at said front trimming station prior to its release by

said holding means and remain clamped on the lift while said clamp members move back to said side trimming station and momentarily holding said clamp members there and thereafter releasing said clamp members for forward motion, second lift holding means for momentarily clamping each lift prior to its release by said transport's clamp members and during the trimming actuation of said side trimming knives and thereafter releasing the lift, and means for removing each lift from said side trimming station after said side trimming knife actuation.

2. The book trimmer of claim 1 in which said means for feeding said lifts to said table at said front trimming station comprise a conveyor chain means having interspaced book lift engaging lugs and means for successively removing the book lifts laterally from a stack thereof and accelerating each lift substantially to the traveling speed of the conveyor chain means and then feeding each thereto successively in front of the chain's lugs for engagement of the latter with the lift in each instance and with substantially no speed differential therebetween.

3. The book trimmer of claim 1 in which said means for causing said trimming knives' actuation is timed to actuate sad front and side knives out of phase but close in time together, and said transport and said first and second lift holding means including spring energy storing means for causing a portion of their respective operating cycles in each instance by releasing the spring energy, a drive shaft for receiving power, and means for connecting said shaft to said trimming knife actuating means and through said storing means to said transport and said first and second lift holding means so that said shaft transmits energy to said storing means at times other than while said knives' actuating means are causing said knives to trim a book lift.

4. The book trimmer of claim 1 in which said first and second book lift holding means comprise in each instance a main clamp means for clamping under pressure the lift to the table during trimming actuation of the knife associated therewith and an auxiliary pressure pad means having means for advancing it into contact with and pressure on the top of the lift ahead in time of the contact therewith by said main clamp means, the said pressure of said auxiliary pressure pad means being less than that of said main clamp means.

5. The book trimmer of claim 4 in which said auxiliary pressure pad means is shaped to contact at least the major portion of the top of the book lift while being free from the bound backs of the book or books comprising said lift.

6. The book trimmer of claim 1 in which said finger means are located offset adjacent to and above said first trimming station and have means for guiding it to travel downwardly and then substantially parallel to the feed travel path of the book lifts fed to the first trimmer station for pushing and holding a lift against said retractable stop, and to thereafter move backwardly and momentarily upwardly, to permit the passage of the next lift fed by said feeding means.

7. The book trimmer of claim 1 in which said first book lift holding means is interconnected with said lift transport means by means timed to release said first holding means and start the transport means motion towards said second trimming station promptly after trimming actuation of said front knife and prior to completion of the latter's return stroke, said knife being reciprocatory.

8. A machine including at least two reciprocatory knives having cutting and return strokes and arranged in series for successively cutting work moved from one to another of said knives, a reciprocatory transport means moving between a work receiving position at one of said knives and a work delivering position at another of said knives, spring means for biasing said transport means for movement to one of its said positions, rotary power means, means for connecting said power means to said knives to reciprocate them substantially out of phase with each other during their cutting strokes at least, and means for connecting said power means to said transport means for moving it against the bias of said spring means from its said one position to its other at times other than during the time said knives are beng reciprocated to the limit of their said cutting strokes, and thereafter releasing said transport means for opposite movement by said spring means.

9. An automatic continuous book trimmer including front and side trimming knives arranged to form a first and a second trimming station and means for causing their trimming actuation; a table for supporting a book lift at said stations; means for transporting a book lift therebetween so that by locating the lift on the table at the first trimming station for rimming and thereafter transporing the lift over the table to the second trimming station for trimming the front and side edges of the lift may be trimmed; means for continuously feeding a succession of interspaced book lifts to said table at said first trimming station, a stop having means for moving it momentarily to above said table's top so that each lift is engaged by the stop so that it may be located at said first trimming station and for then removing the stop to permit the lift to be transported to said second trimming station; finger means having means for causing the finger means to push and momentarily hold each lift against said stop while the latter is moved into position above the table top, first trimming station holding means for momentarily clamping the lift prior to its release by said finger means and during the trimming actuation of said first trimming knives and thereafter releasing the lift; a book lift transport means having clamp members and means for reciprocating said clamp members between said trimming stations and for causing said members to clamp each lift at said first trimming station prior to its release by said trimming station holding means and to remain clamped on the lift while said clamp members move back to said second trimming station and momentarily holding said clamp members there and on the book lift and thereafter releasing said clamp members from the book lift and moving them forward; second trimming station holding means for momentarily clamping each lift prior to its release by said transport's clamp members and during the trimming actuation of said second trimming knives and thereafter releasing the lift, and means for removing each lift from said second trimming station after said second trimming knife actuation.

10. An automatic continuous book trimmer for receiving book lifts, supplying them to trimming stations under positive control, and then delivering them in trimmed condition all in a manner suitable for use as part of an automated continuous production line which includes front and side trimming knives arranged to form first and second trimming stations; actuating means for the trimming operation of said knives at said stations; support means for holding a book lift at said first and second stations; feed means for supplying a succession of interspaced book lifts to said support means for the first trimming station; a first station stop and means for moving the stop into the path of each book lift for engaging the book lift so that it may be accurately positioned at the first trimming station and for then moving the stop out of the path of each book lift so that the book lift may be transported past the first station to a second station; finger arm means having means for causing the finger arm means to positively position each book lift against the first station stop means; clamping and positive grip transporting means for clamping the book lift securely in place while it is positioned against the first station stop means and for holding it there with the first station support means while the first station trimming operation is performed and then with said positive grip transporting the book lift to the second station support means and holding it there while the second station trimming operation is performed and only thereafter releasing the book lift; and

means for delivering the book lifts from said second station support means.

11. The book trimmer of claim 10 in which said clamping and positive grip transporting means and said actuating means are interconnected through spring energy storing means so that energy is supplied to said spring storing means while said knives are not being powered toward and for said trimming operation.

12. The book trimmer of claim 10 in which said actuating means for causing the said trimming operation of said knives at said stations is timed to actuate said front and side knives out of phase but close in time together; and in which there are provided spring energy storing means for powering a portion of the operating cycle with a drive shaft for receiving and delivering power; means interconnecting said shaft to said clamping and positive grip transporting means, to said spring energy storing means, and to said front and side trimming knives so that said shaft transmits energy to said storing means at times other than while said knives' actuating means are powering said knives toward and for the trimming operation and receives energy from said storing means to assist in causing said knives to move for trimming whereby the power input to the book trimmer is modulated.

13. The book trimmer of claim 10 in which said finger means are located offset adjacent to and above said first trimming station and have means for guiding it to travel downwardly and then substantially parallel to the feed travel path of the book lifts fed to the first station for pushing and positioning a lift against said movable stop, and to thereafter move backwardly and upwardly to permit the passage of the next lift fed by said feeding means.

14. A machine including a reciprocatory knife and drive means for causing its operation; a support for work to be cut by said knife; a reciprocatory clamp for holding work to be cut by said knife in position on said support and operating means for causing its operation; common motor means for supplying energy to both said drive and to said operating means; and spring modulating power means interconnecting said knife drive means, said clamp operating means, and said common motor means so that energy is supplied to said spring modulating power means from said common means while said drive means is not powering said knife for cutting and so that energy is supplied from said spring modulating power means while said drive means is powering said knife for the cutting operation.

15. The machine of claim 14 in which said spring modulating power means are incorporated in said clamp operating means so that the clamping operation supplies energy to assist in accelerating and moving the knife for the cutting operation and receives energy from the common powering means at other times.

16. An automatic continuous book trimmer for receiving book lifts, supplying them to trimming stations under positive control, and then delivering them in trimmed condition all in a manner suitable for use as a part of an automated continuous production line which includes at least two work stations arranged in series, a reciprocatory knife mechanism at each of said work stations with means for causing said knives to trim book lifts positioned at said first and second stations, feed means for supplying a succession of interspaced book lifts to a first station, means for aligning the book lifts at said first station, clamping and holding means for securing each book lift at the first station in its aligned position while it is operated upon by the reciprocatory knives at the first station thereafter and while continuing to securely hold the book lift moving it into a position at the second work station having a predetermined relationship to the book lift's position at the first work station and continuing to securely hold it in position at the second station during the operation of the reciprocatory knife at said second station and thereafter releasing the book lift, and means for delivering the book lifts from the second work station.

17. An automatic continuous book trimmer including front and side trimming knives arranged to form first and second trimming stations, means for causing their trimming actuation; means for feeding a succession of interspaced book lifts to said first trimming station, means for aligning each book lift in position for trimming at said first station, first trimming station holding means for clamping the book lift in its aligned position during the trimming actuation of the trimming knives at said first station and for thereafter releasing the lift; a book lift transport means having clamp members and means for reciprocating said clamp members between said trimming stations and also having means for causing said members to clamp each lift at said first trimming station before it is released by said first trimming station holding means and for remaining clamped on said lift while the transport's clamp members are moved back to said second trimming station and for thereafter releasing said book lift so that the transport can be moved forward; second trimming station holding means for clamping each lift in position at said second trimming station before it is released by the transport's clamp members and during the trimming actuation of the trimming knives at said second station and thereafter releasing the lift, and means for removing the lift from said second trimming station after the knives at said second station have been actuated.

References Cited in the file of this patent

UNITED STATES PATENTS

602,882	Smith	Apr. 26, 1898
1,076,726	Welch	Oct. 28, 1913
1,200,802	Berry	Oct. 10, 1916
1,494,594	Diamond	May 20, 1924
1,811,483	Valiquette	June 23, 1931
2,017,462	Kleineberg	Oct. 15, 1935
2,325,030	Bellar	July 27, 1943
2,438,023	Sirp	Mar. 16, 1948
2,482,685	Moyer	Sept. 20, 1949
2,562,950	Roessel et al.	Aug. 7, 1951
2,776,004	Carlson	Jan. 1, 1957
2,866,641	Cote	Dec. 30, 1958
2,886,642	Cote	Dec. 30, 1958
2,927,792	Goss	Mar. 8, 1960
3,003,381	Biel	Oct. 10, 1961

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,146,650 September 1, 1964

Ernest J. Sarring et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 3, for "hrough" read -- though --; column 6, line 14, for "11" read -- 111 --; column 9, line 46, for "blook" read -- block --; column 11, line 57, for "167" read -- 169 --; column 13, line 19, after "that" insert -- position --; column 14, lines 54 and 70, for "triming", each occurrence, read -- trimming --; column 15, line 23, for "sad" read -- said --; column 16, line 14, for "rimming" read -- trimming --; column 18, line 8, after "station" insert -- and --; column 18, line 58, strike out "2,886,642 Cote ------ Dec. 30, 1958".

Signed and sealed this 15th day of December 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents