

Oct. 31, 1967

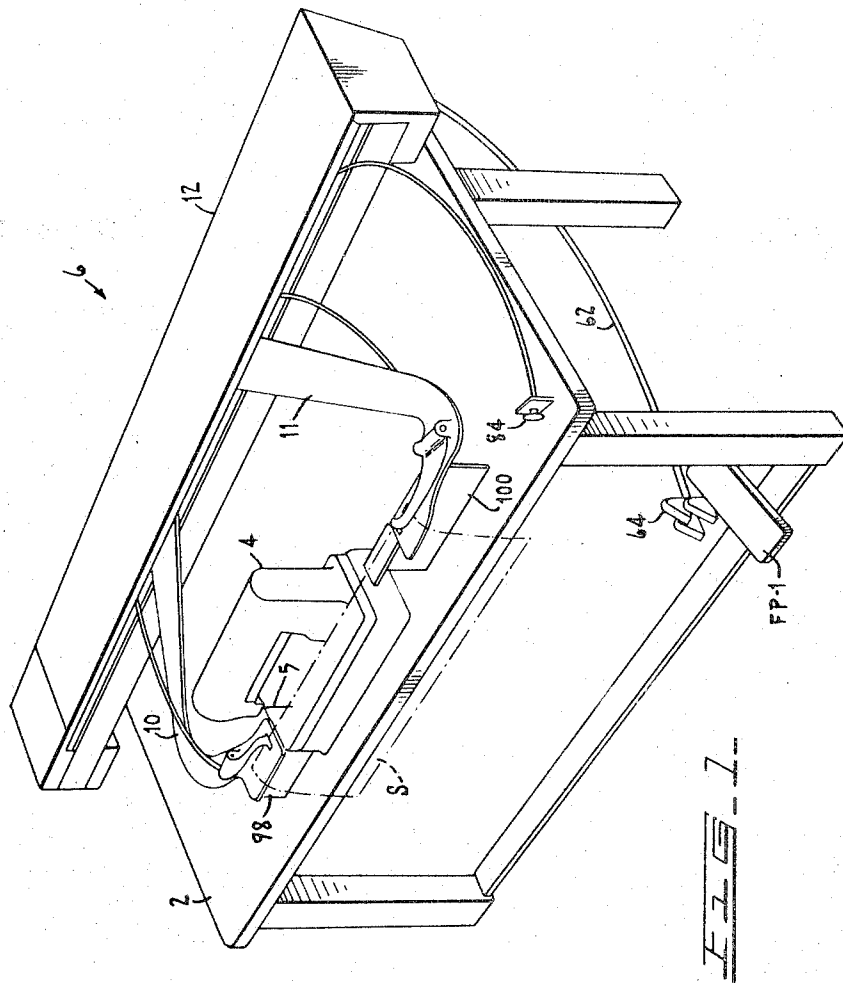
G. PERRELLA ET AL

3,349,732

INDEXING APPARATUS FOR SEWING MACHINES

Filed July 13, 1964

19 Sheets-Sheet 1



Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

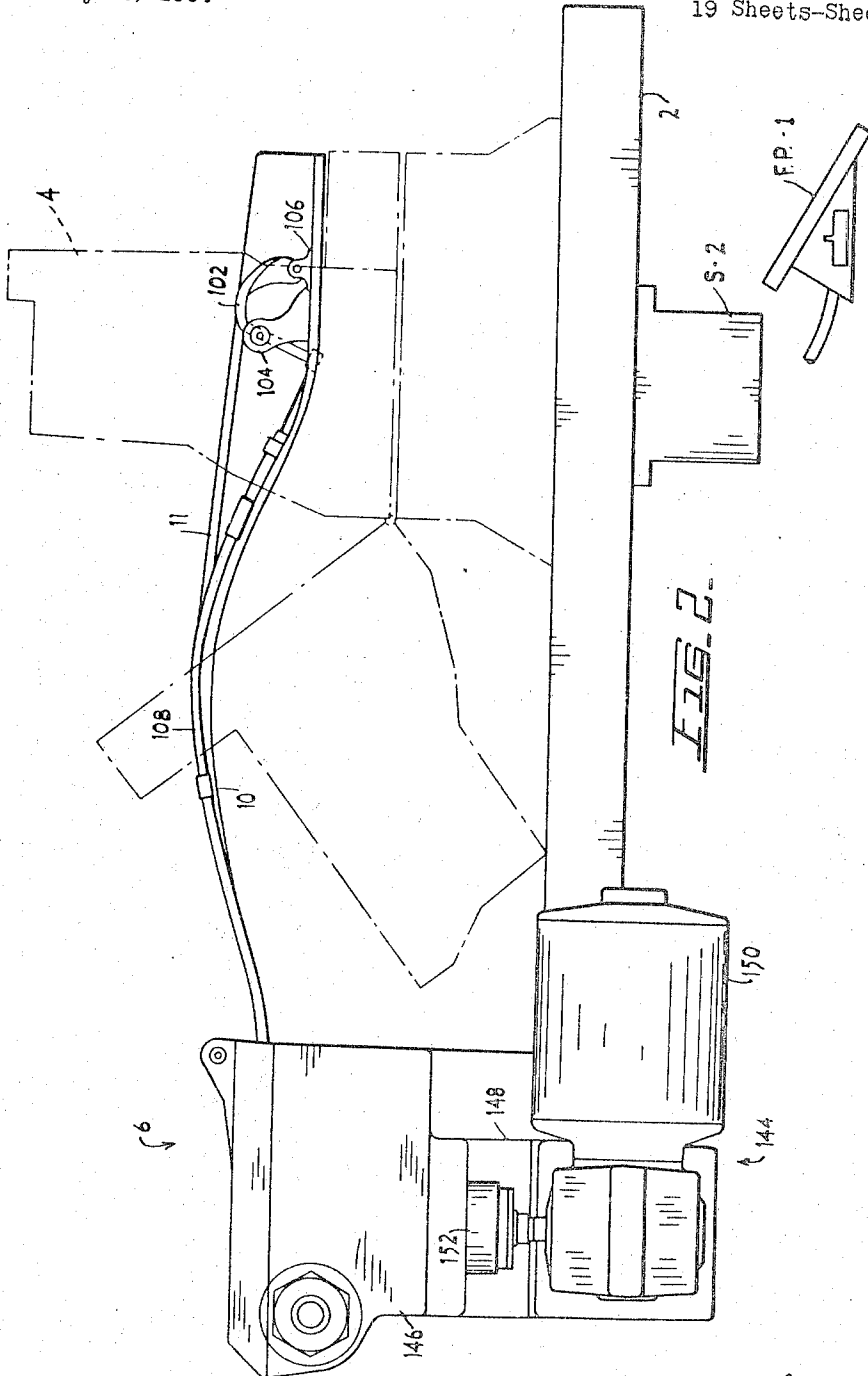
G. PERRELLA ET AL

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Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

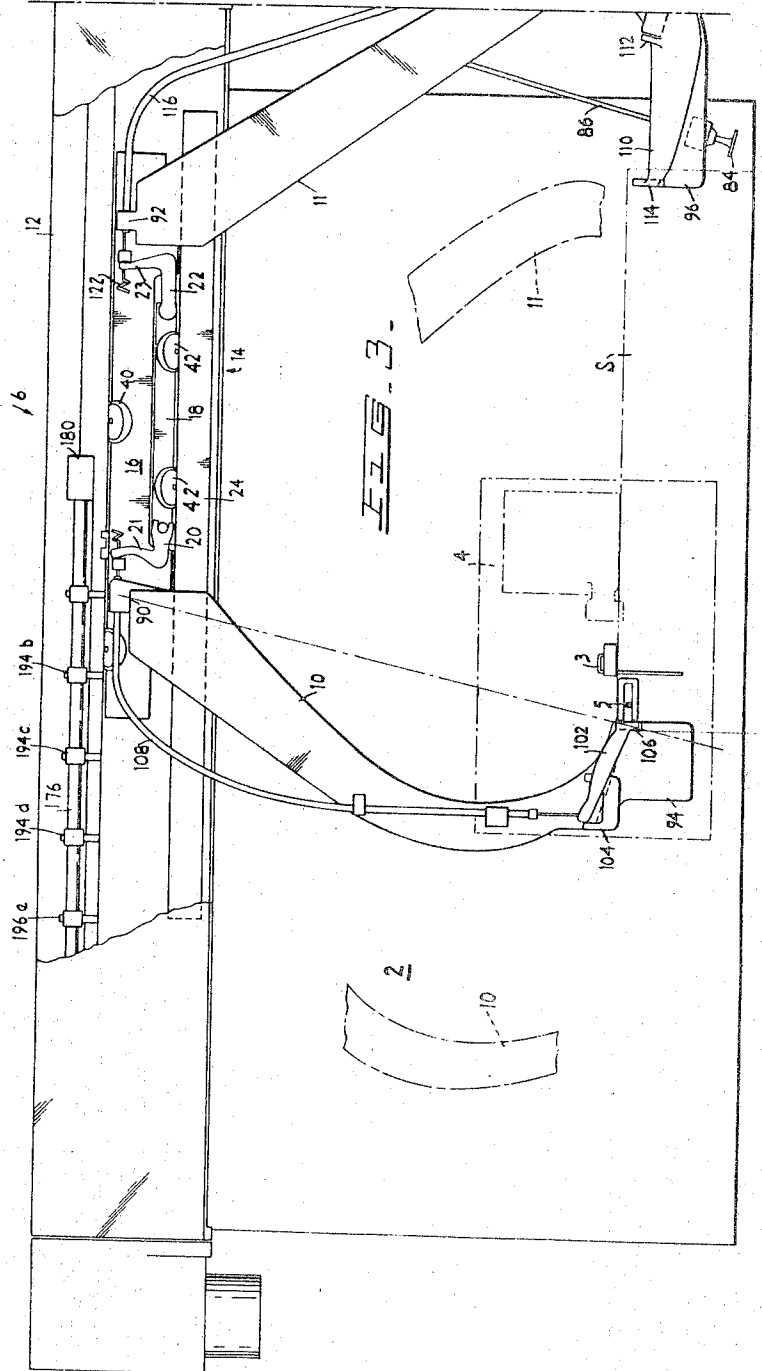
G. PERRELLA ET AL

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Filed July 13, 1964

19 Sheets-Sheet 3



Inventors
Gerardo Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

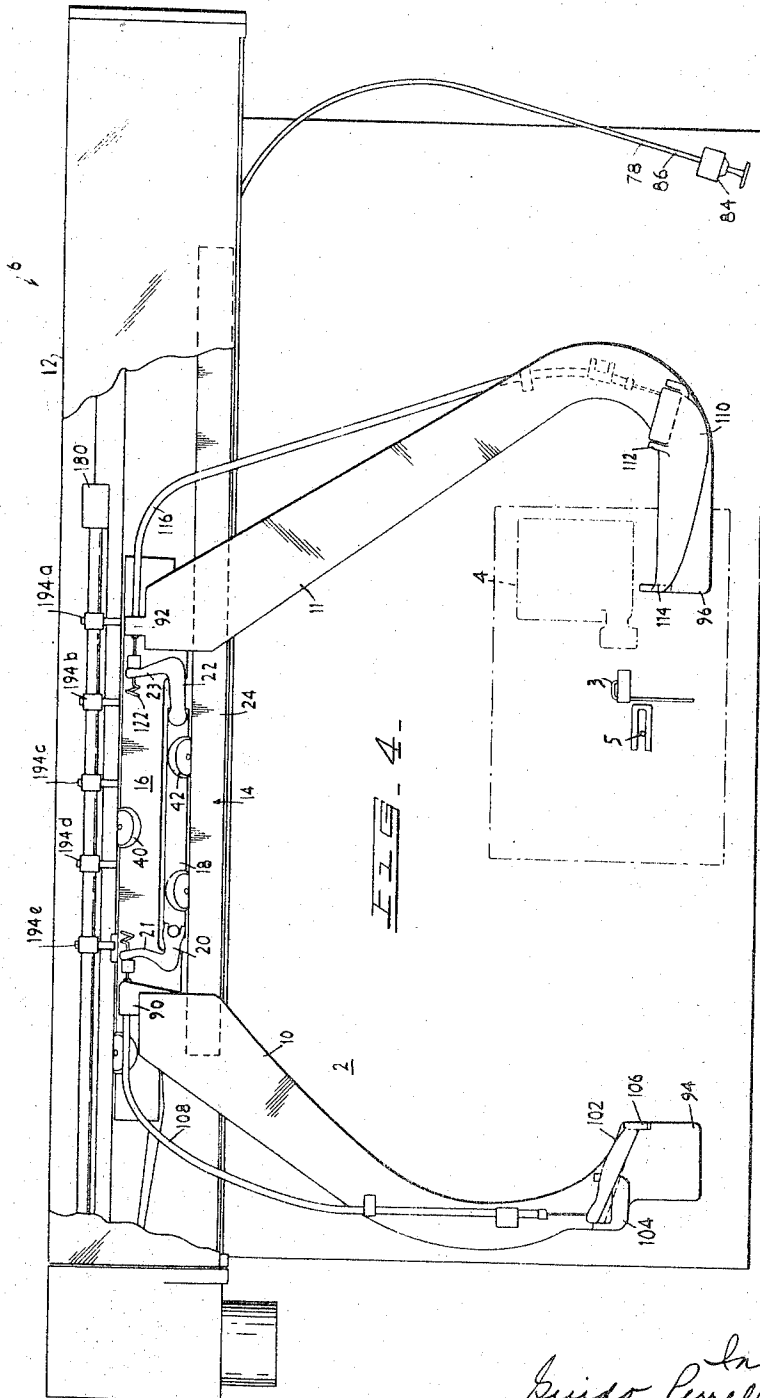
G. PERRELLA ETAL

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Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Leshman
Attorneys

Oct. 31, 1967

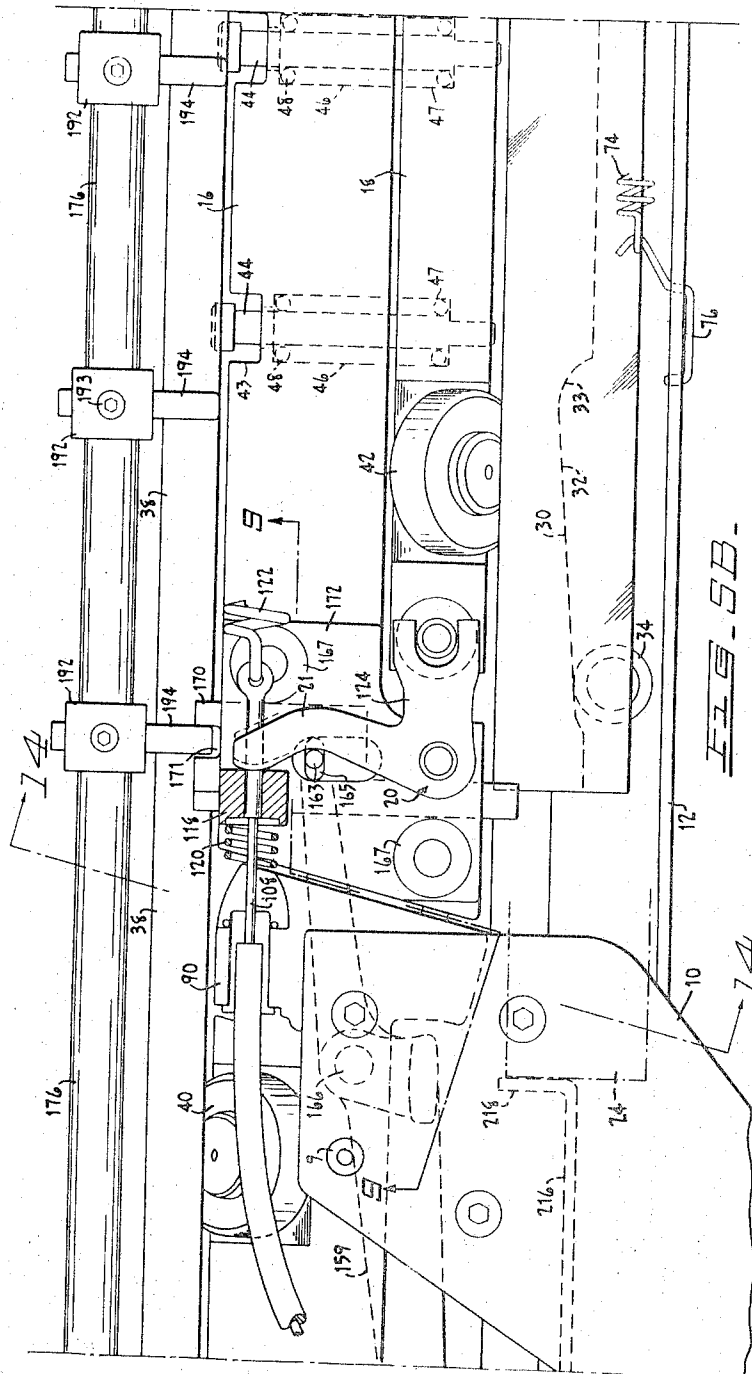
G. PERRELLA ET AL

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Inventors
Luigi Perrella
Frank Pickett
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

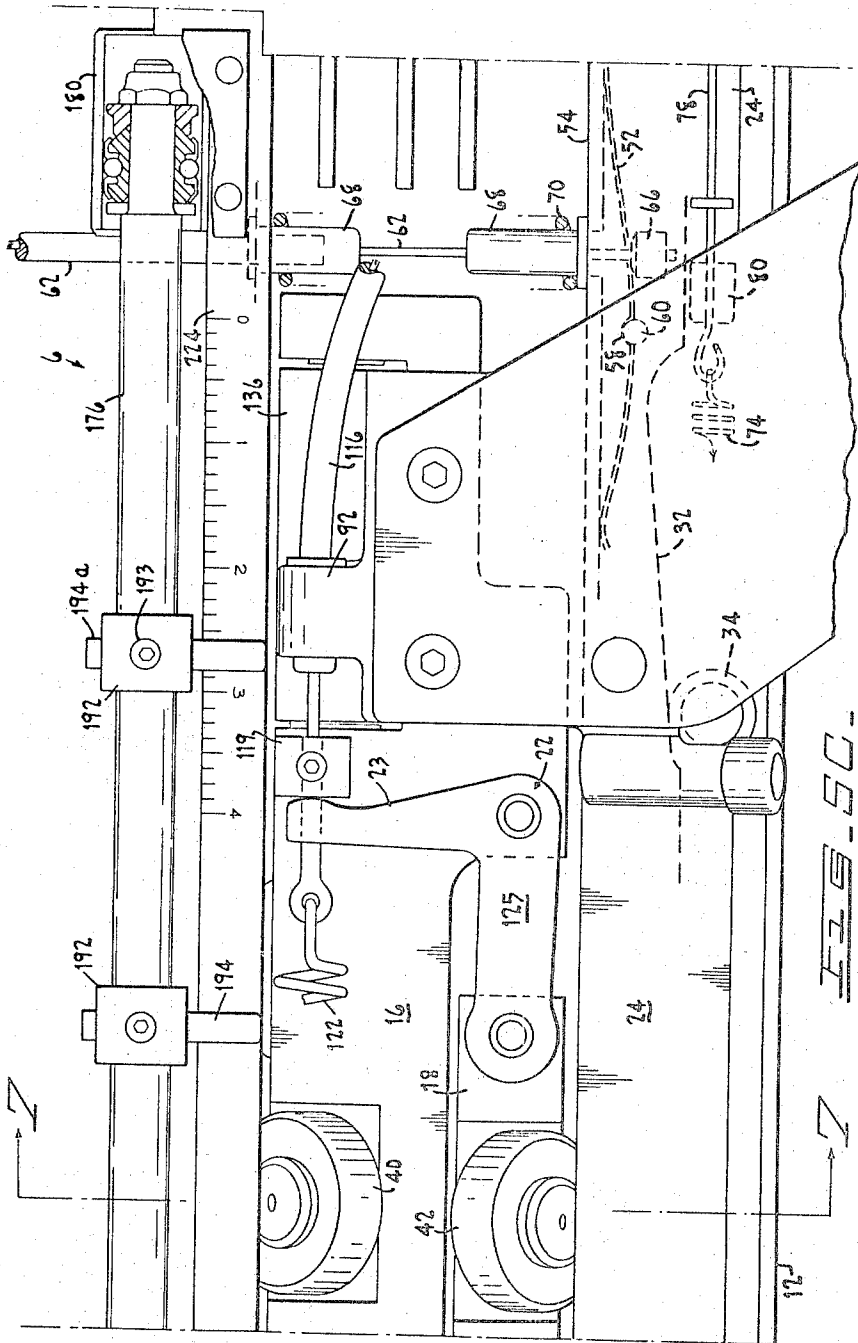
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Filed July 13, 1964

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Guido Perrella Inventors
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

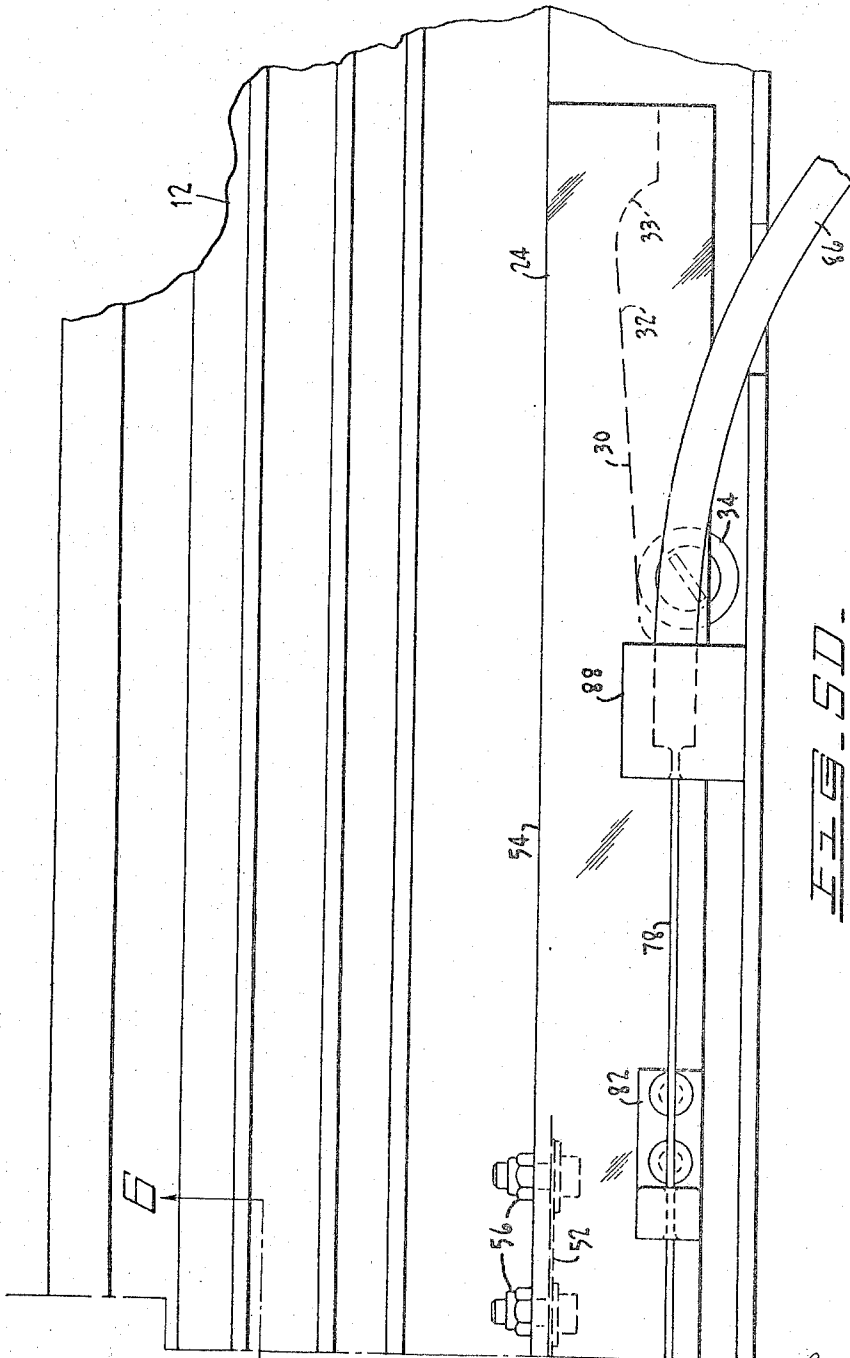
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Inventors
Guido Perrella
Frank Pickett
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

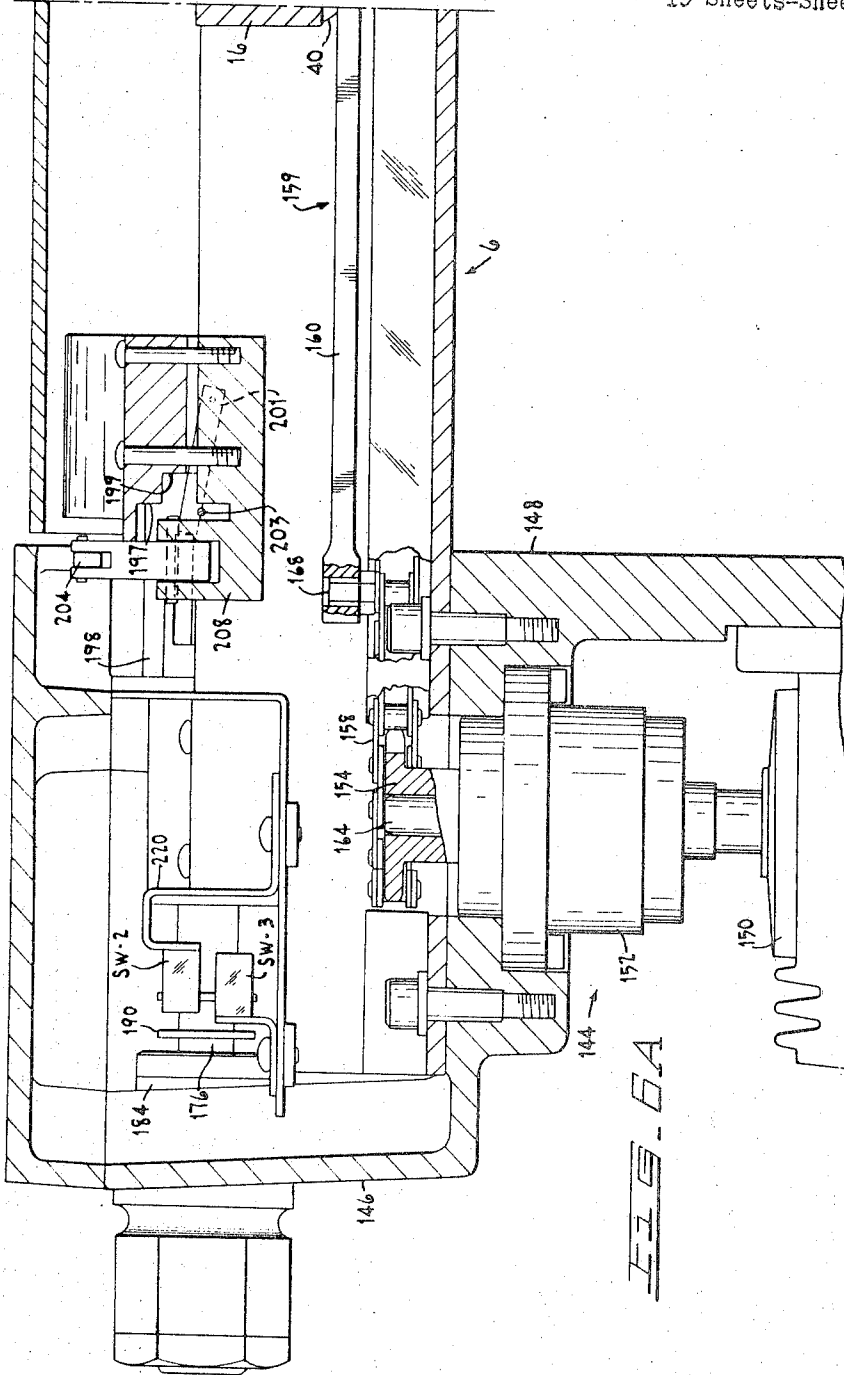
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Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

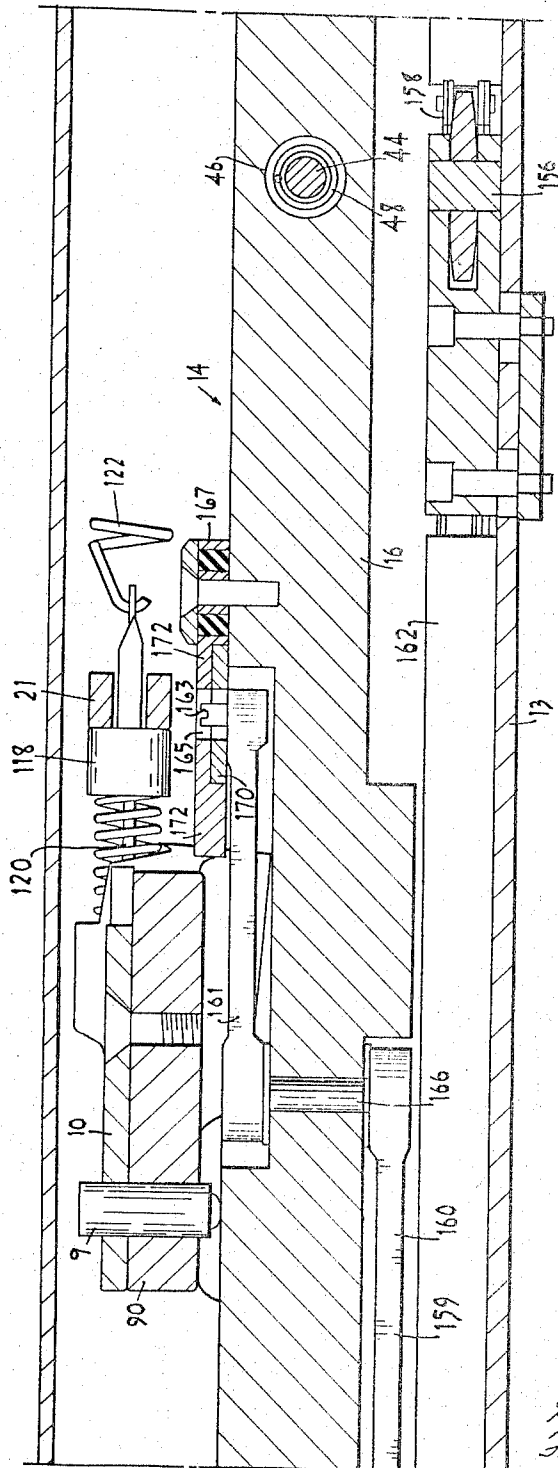
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Inventors
Luigi Perrella
Frank Pickett

By *Cushman, Barby & Cushman*
Attorneys

Oct. 31, 1967

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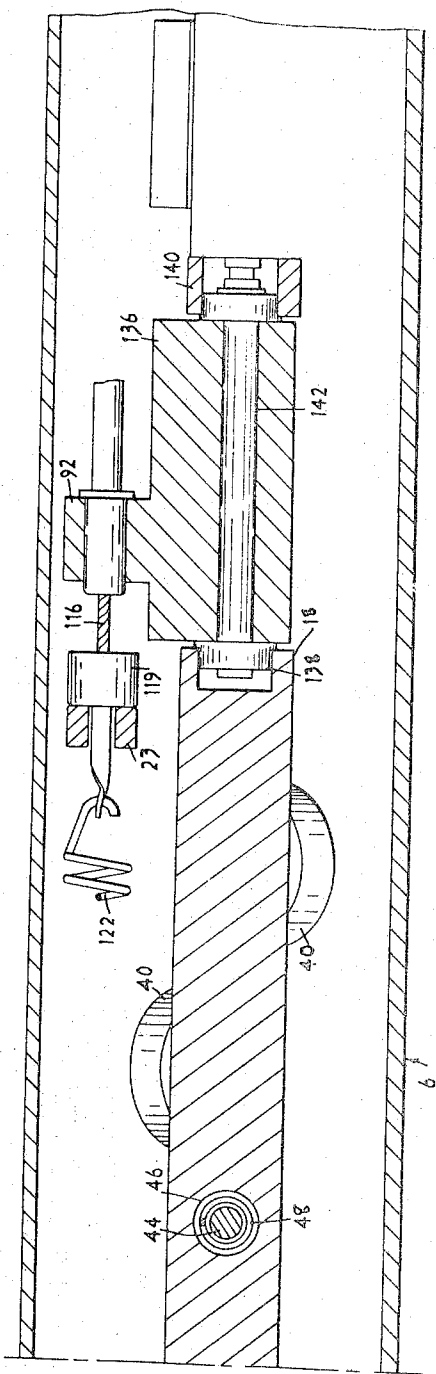


FIG. 6C.

Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

G. PERRELLA ET AL

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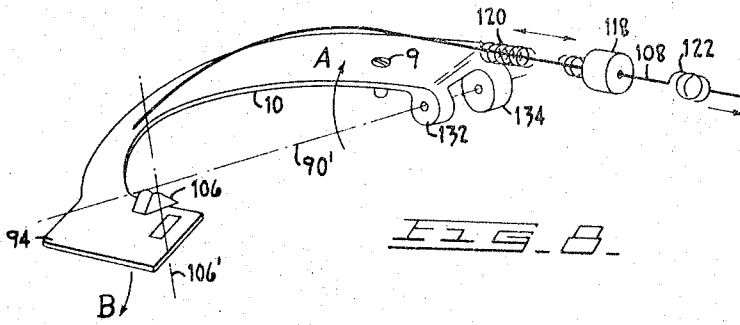


FIG. 8

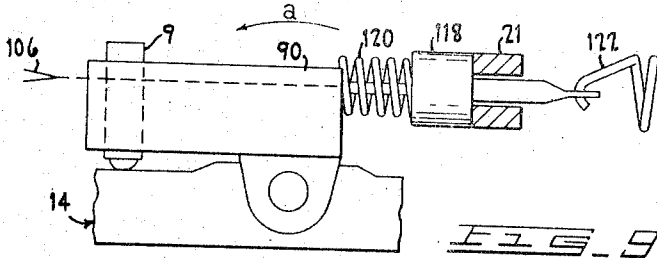


FIG. 9

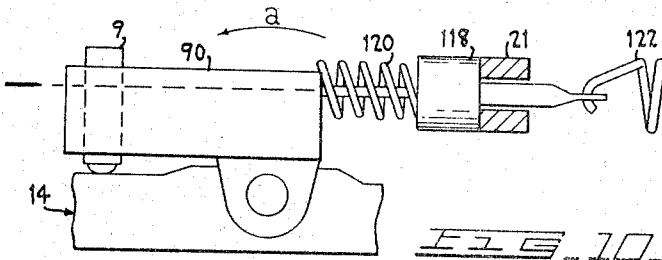


FIG. 10

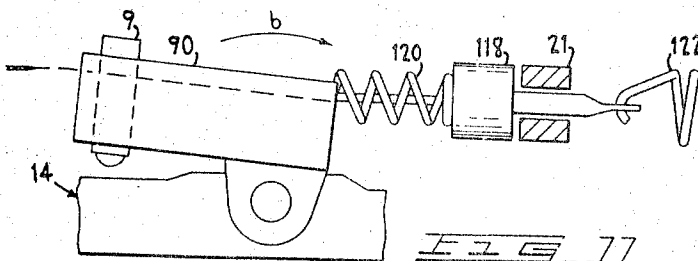


FIG. 11

Inventors
Guido Perrella
Frank Ricker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

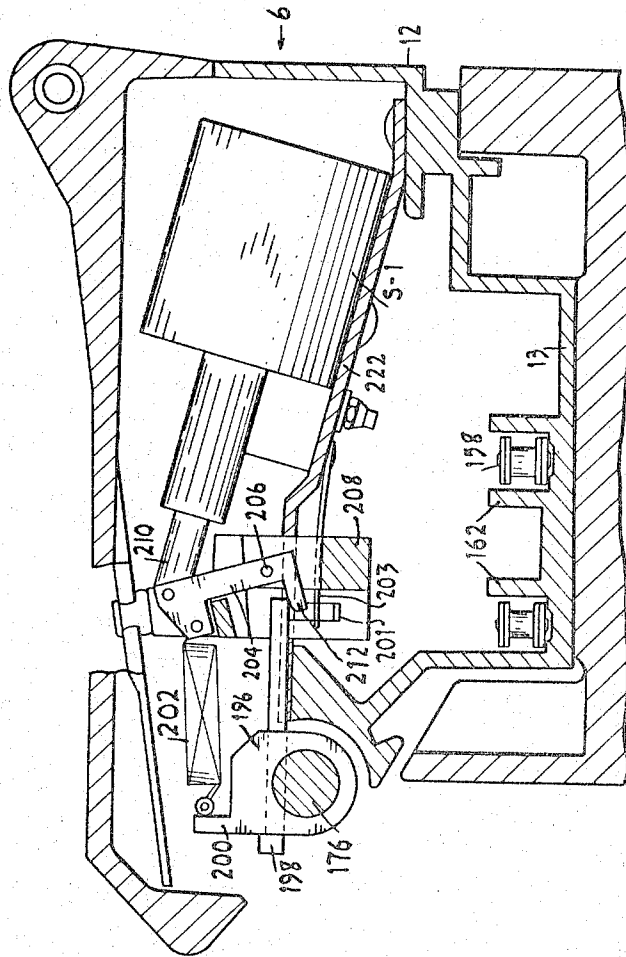
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Inventors
Guido Perrella
Frank Picker
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

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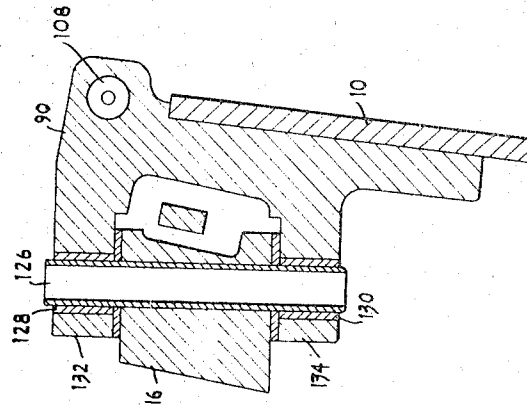


FIG. 14-

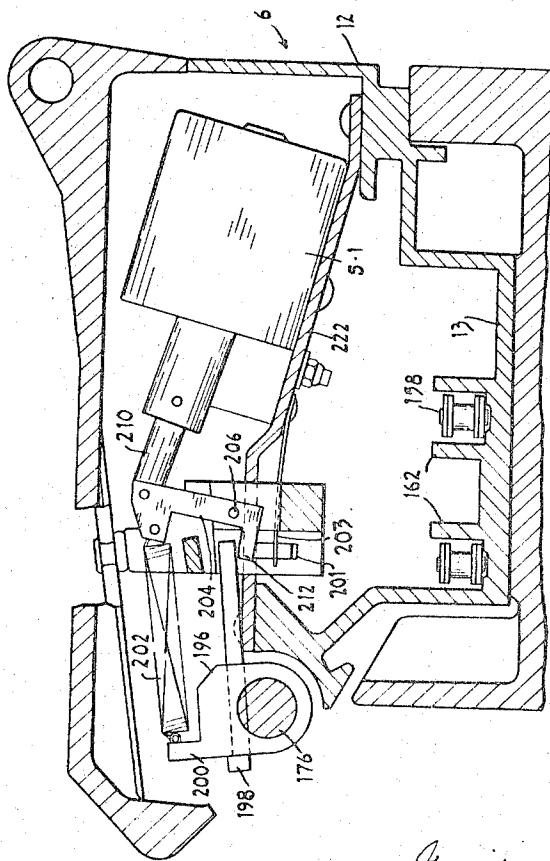


FIG. 13-

Inventors
Guido Perrella
Frank Picher
By *Cushman, Derty & Cushman*
Attorneys

Oct. 31, 1967

G. PERRELLA ETAL

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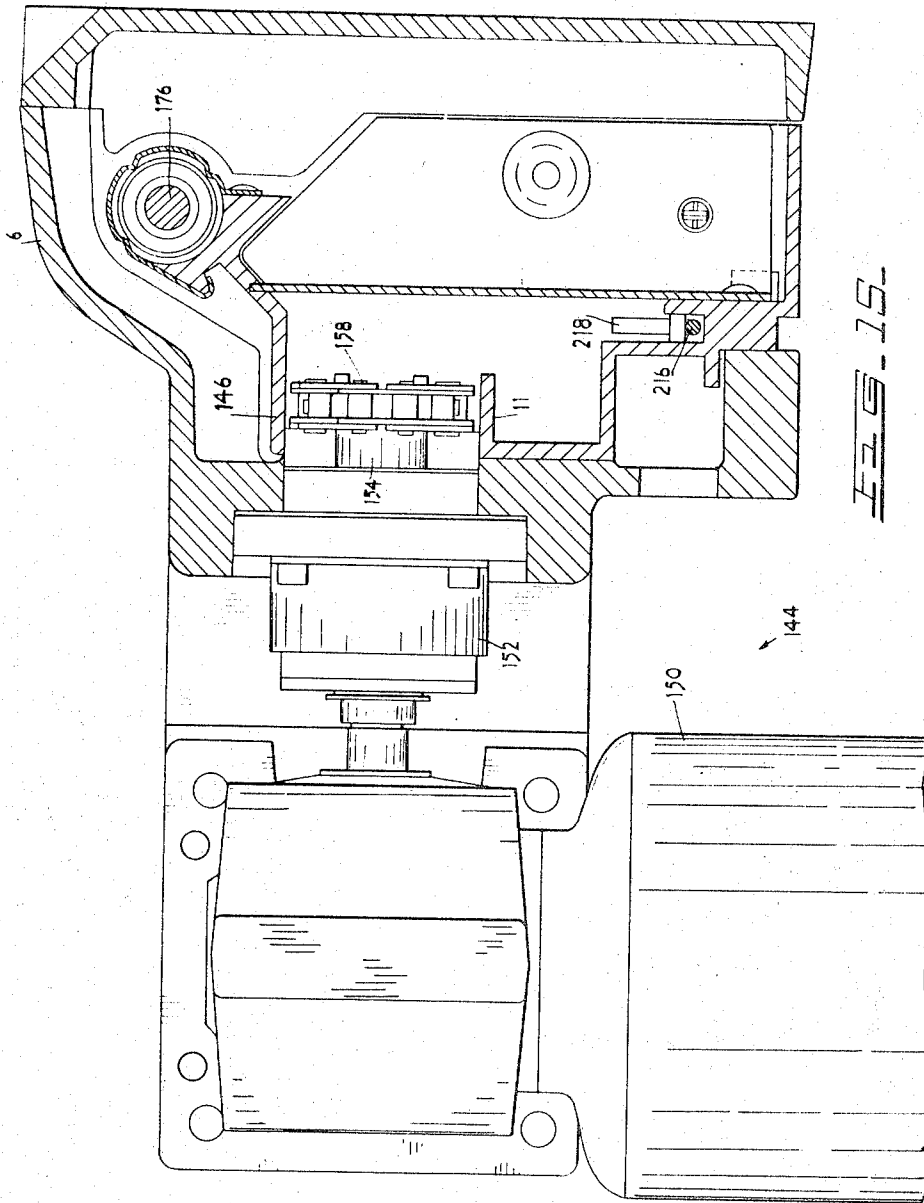


FIG. 15.

Inventors
Guido Perrella
Frank Pickett
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

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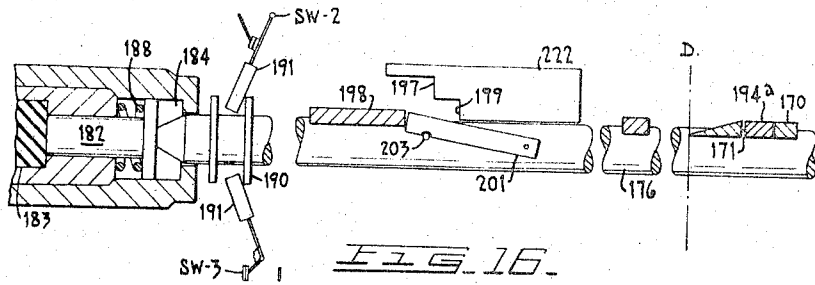


FIG. 16.

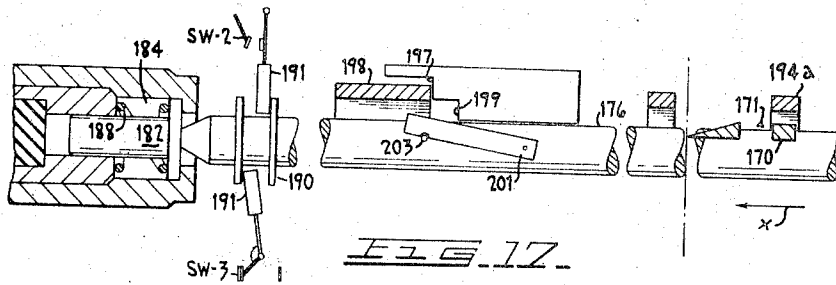


FIG. 17.

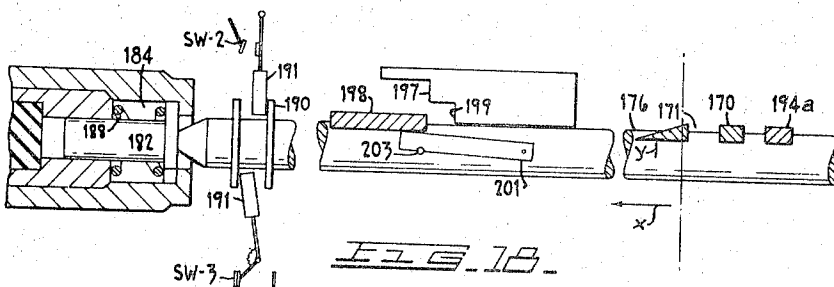


FIG. 18.

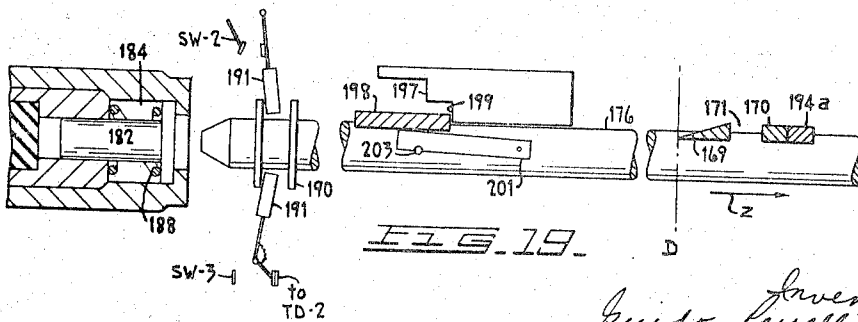


FIG. 19.

*Guido Perrella
Frank Pickes
By Cushman, Darby & Cushman
Attorneys*

Oct. 31, 1967

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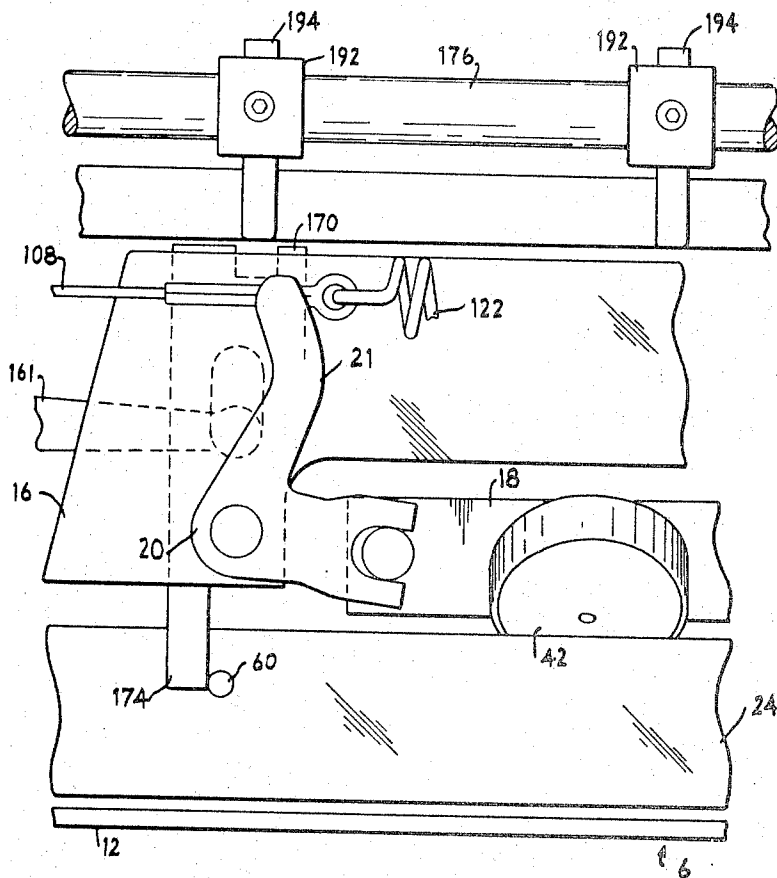


FIG. 20.

Inventors
Guido Perrella
Frank Pickes
By Cushman, Darby & Cushman
Attorneys

Oct. 31, 1967

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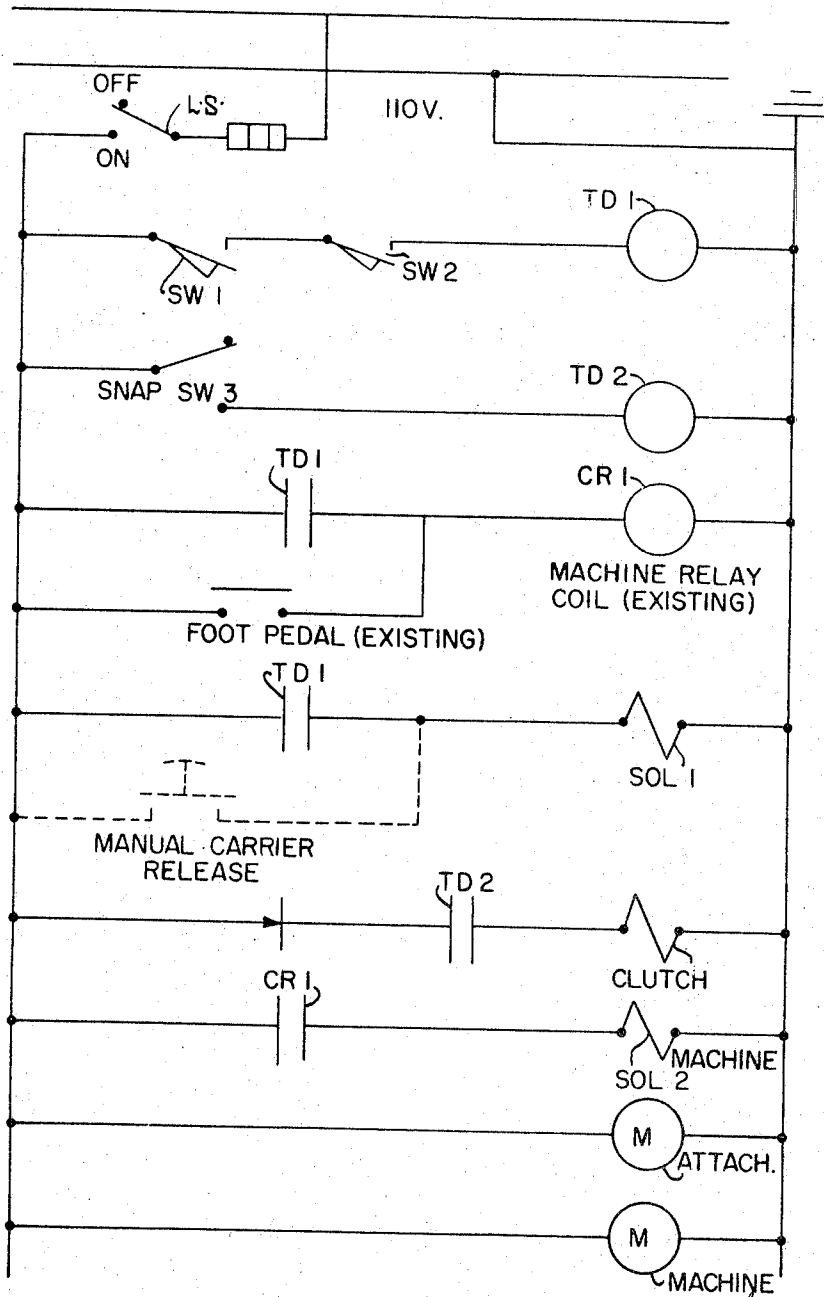


FIG. 21

Inventors
Guido Perrella
Frank Picher
By Cushman, Darby & Cushman
Attorneys

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INDEXING APPARATUS FOR
SEWING MACHINES

Guido Perrella, Montreal, Quebec, and Frank Picker,
St. Bruno, Quebec, Canada, assignors to Dynacast Ltd.,
Montreal, Quebec, Canada

Filed July 13, 1964, Ser. No. 382,048

Claims priority, application Canada, Mar. 31, 1964,
899,130

19 Claims. (Cl. 112—65)

This invention relates to an indexing apparatus for sewing machines and more specifically, to an automatic indexing apparatus adapted for use in combination with buttonhole sewing machines to provide the latter with means for sequentially sewing a plurality of spaced buttonholes in a workpiece such as shirts, dresses and the like.

Indexing devices or attachments for buttonhole sewing machines are known, U.S. Patent No. 2,465,232 of Mar. 22, 1949, to Jones et al. being one example of such prior devices. However, known devices of the prior art have not altogether been successful and, as a result, have not enjoyed wide acceptance in the garment trade.

One disadvantage of prior indexing attachments is that, although they fed a workpiece to a sewing machine in sequential steps, they did not complete a full reciprocating cycle, i.e., a return stroke to a start position after a series of buttonhole sewing operations. Such attachments usually comprise a slidable carrier or work table having means adapted to hold a garment thereon and to move the latter under the sewing mechanism of the machine, automatically stopping at each predetermined buttonhole location. At the completion of the last buttonhole, such a carrier has had to be manually returned to its start position.

A further disadvantage of prior indexing devices is that they have been designed mainly for attachment to and for operation with machines for sewing "lateral" buttonholes in workpieces, i.e., with the longitudinal axis of the buttonhole normal to the vertical axis of the lapels or breast edges of suit jackets etc. In such cases, the workpiece or garment was moved to the sewing mechanism in a direction transverse to the longitudinal axis of the sewing machine. In most cases, the needle of the mechanism sewed in an aligned path with the said longitudinal axis whereby the buttonholes were sewn into the garment normal to the edge thereof. Obviously, therefore, the above described prior attachments are not readily adaptable for the sequential sewing of aligned "vertical" buttonholes in garments such as shirts, dress fronts, raincoats and the like where longitudinal axes of buttonholes are parallel with the vertical axis of the garment. The main reason being, of course, that such garments must be fed in alignment with the longitudinal axis of the path to be traversed by the sewing mechanism of the machine and in order, therefore, for prior indexing devices to be applicable for aligned sewing, they necessarily would have to operate their reciprocal work tables directly toward and away from the longitudinal axis of the sewing machine. It will be evident from a perusal of the prior art that such an application would not be possible.

The abovementioned patent to Jones et al. somewhat overcomes the problem of sewing aligned buttonholes, but this patent recites the sewing of such buttonholes in a tape that may be applied to a shirt front at a later stage and the tape easily can be fed away from the region of the sewing machine after the buttonholes are sewn.

A still further disadvantage of known indexing attachments is that they usually have been placed directly in front of their associated sewing machines whereby periodic routine maintenance on the machine has been extremely difficult to carry out. Moreover, the prior attach-

ments usually were so integrally interconnected mechanically with their associated machines that the latter had to be rendered inoperative if the attachment suffered a mechanical breakdown. This disadvantage has been obviated to a certain extent by the indexing attachment disclosed in our copending U.S. patent application Ser. No. 328,312 filed on Dec. 5, 1963, now Patent No. 3,322,083.

The object of the present invention therefore, is to provide automatic indexing apparatus for buttonhole sewing machines, which apparatus is designed to overcome the above disadvantages of the devices of the prior art. Moreover, the device of the present invention is not an "attachment" insofar as this term is accepted in relation to the prior art in that the present device is disposed remote from its associated sewing machine and is not mechanically connected thereto. Moreover, it will be appreciated from the description of the present invention, that the latter in no way interferes with manual or independent operation of its associated machine.

The problem of sewing aligned buttonholes in workpieces such as shirts has now been overcome with the introduction of a new type of sewing machine wherein the needle and sewing mechanism thereof are offset from the body of the machine to a sufficient degree that a workpiece may be fed parallel to the longitudinal axis of the machine and therefore in alignment with the like axis of the needle. For the purpose of illustration, and by way of example, it is to such a machine that the apparatus of the present invention is applied.

According to its broadest aspect, the present invention relates to the combination with the sewing mechanism of a buttonholing machine, of an indexing apparatus to provide said sewing mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a workpiece; said apparatus comprising a frame having a carriage slidably mounted therealong; drive means to impart reciprocal movement to said carriage along said frame; indexing means to control said drive means and sequentially to stop said carriage during movement thereof at a plurality of selected locations on said frame; and a pair of guide arms on said carriage extending outwardly from said frame and being provided with means for clamping a workpiece therebetween; said arms and clamping means terminating adjacent opposite sides of said sewing mechanism and being adapted to transmit movement of said carriage to said workpiece relative to said sewing mechanism and to transmit movement of said sewing mechanism and said workpiece to said carriage.

The invention is illustrated, by way of example, in the accompanying drawings in which:

FIG. 1 is a perspective view of the present invention operatively mounted adjacent a buttonhole sewing machine;

FIG. 2 is an end view of the apparatus shown in FIG. 1; FIG. 3 is a plan view of the apparatus showing the integers of the present invention;

FIG. 4 is a plan view similar to FIG. 3 showing the integers of the device at a final buttonholing position; FIG. 5 is broken down into several enlarged plan views of the present invention;

FIG. 6 is similarly broken sectional views in elevation taken along line 6—6 of FIG. 5;

FIG. 7 is a cross sectional view taken along the line 7—7 of FIG. 5;

FIG. 8 is a fragmentary perspective view of the tensioning arm and its associated integers;

FIGS. 9, 10 and 11 are fragmentary sectional views, taken along the line 9—9 of FIG. 5B, and show the operation of the integers illustrated in FIG. 8;

FIGS. 12 and 13 are views in cross section taken along the line 12—12 of FIG. 5;

FIG. 14 is a view in cross section taken along the line 14—14 of FIG. 5;

FIG. 15 is a cross sectional view taken along the line 15—15 of FIG. 5;

FIGS. 16, 17, 18, 19 and 20 are fragmentary plan views of the indexing control mechanism in sequential operation; and

FIG. 21 is a schematic diagram of the electrical control circuit of the present invention.

Although the present invention is applicable to a variety of makes of buttonhole sewing machines, the present description will include the newer type of machine designed specifically for shirt work and which is known in the trade as the "baby" Reece.

Two basic types of sewing methods are widely used in sewing machines of the trade. In the first type, the work is held stationary on the machine platen whilst the needle and needle shaft traverse the predetermined buttonhole path. In other words, the needle, as well as moving in a vertical plane, moves also in a predetermined horizontal path so as to sew the outline of the buttonhole. In the second type, however, the needle moves only in its operating vertical plane and the work is held between a presser foot and platen that move in a horizontal path with respect to the needle. Therefore, in forming a buttonhole with a machine of the first type, the needle moves and the work or garment is stationary, whereas in the second type, the needle is held stationary and the work is moved. The "baby" Reece machine, as described in combination with the present invention, is of this second type.

General construction

As shown in FIGS. 1 to 4, a table 2 serves to support a buttonhole sewing machine 4 and an indexing apparatus generally indicated at 6. A foot pedal switch FP-1 serves to energize a machine solenoid (not shown) to commence a normal sewing operation. The apparatus 6 is provided with a pair of extending arms 10 and 11 having garment clamps thereon adapted to retain a work-piece or shirt S in tension therebetween.

Due to the offset sewing head of the machine 4, the shirt S may be fed alongside the machine 4 or parallel to its longitudinal axis so as to be disposed under the presser foot 3 and needle 5 as shown.

Referring now to FIGS. 3 and 4 of the drawings, the apparatus 6 comprises a casing or frame 12 having a carriage, generally indicated at 14, slidably mounted for reciprocal movement therein. The carriage 14 comprises a pair of elements constituted by a main carrier body 16 and a pressure block 18 pivotally secured thereto by connecting members in the form of elbows 20 and 22. A locking rail 24 is slidably mounted for longitudinal movement in the frame 12 between an outer wall thereof and the carriage 14. As shown in FIG. 7, the locking rail 24 is substantially Y-shape in cross section, so as to form a V-shaped trough or track 26 on one side 28 that is adjacent the carriage pressure block 18. Moreover, a central longitudinal girder 30 of the locking rail 24 is formed to provide a plurality of second tracks 32, shown in pecked lines in FIG. 5B, by means of which the rail 24 may longitudinally be shifted therealong on rollers 34. It will be noted that the tracks 32 are sloped or angularly disposed with respect to the sides of the rail 24 and the frame 12 whereby the rail 24 may assume a locking position as shown in FIG. 3 or an unlocking position as shown in full in FIG. 4 and in phantom in FIG. 5B.

It may be seen more clearly from FIG. 7 that the frame or casing 12 is provided with a V-shaped track 36 extending substantially throughout the length of the side wall 38. The track 36 is adapted to receive a plurality of rollers 40 rotatably mounted on the carrier body 16.

Furthermore, track 26 on the locking rail 24 receives rollers 42 rotatably mounted on the carriage pressure block 18.

It will be seen from FIG. 5B that the carriage elements 16 and 18 are provided respectively with aligned sockets 46 and 47. Each pair of sockets 46, 47 serves to enclose a coil spring 48 which applies a separating force to the elements 16 and 18. Moreover, stripper bolts 44, adapted to guide the springs 48, extend centrally through sockets 46 and 47 and threadably engage the pressure block 18. It will additionally be noted from referring to FIG. 5B that the carrier body 16, adjacent the head of the stripper bolts, is provided with notches 43. Now if, for reasons of maintenance or the like, the carriage 14 must be removed from the frame 12, the rail 24 may be drawn to its locked position (FIG. 5B) so that the heads of the bolts 44 stand proud of the carrier body 16 as shown; suitable spacers (not shown) are then inserted in the notches 43 and between the bolt heads and the body 16; and the rail 24 is shifted to its unlocked position shown in pecked lines (FIG. 5B) to facilitate the removal of the carriage 14.

Locking means for the rail 24 is provided so as to retain the carriage 14 in the inoperative and operative positions shown respectively in FIGS. 3 and 4. Turning now to FIGS. 5C and 7, the rail locking means, generally indicated at 50, comprises a leaf spring 52 one end of which is secured to an exterior wall 54 of the frame 12 by means of bolts 56. The spring 52 is provided substantially centrally with a vertically disposed notched portion 58 adapted to receive therein the lower end of a roll pin 60 provided in the locking rail 24. A spring release cable 62, extending from a foot pedal 64 (FIG. 1), is operatively connected to the spring 52, adjacent its notched portion 58, by means of a cable clamp 66. The cable 62 passes through a side wall of the frame 12 and is retained adjacent the bottom wall 13 thereof by means of a pair of sleeves 68. A coil spring 70, acting on the wall 54 and a flange 72 of the frame 12, serves to retain the cable 62 in its locking position in FIG. 5.

The locking rail 24 is subjected to a force acting against its retention provided by the locking means 50, the force being adapted to shift the rail to its unlocked position of FIG. 4 and being applied by coil springs 48 in the sockets 46 and 47. It will be appreciated that, when the locking means 50 release the rail 24, the separating force between the elements 16 and 18 provided by springs 48 bear on the rail 24 and the latter is moved thereby along its sloped tracks 32 until it reaches its unlocked position. Additionally, the rail 24 may manually be returned to its locked position by means of a hand pull 84 illustrated in FIG. 1. A coil spring 74 is connected at one end, by means of a hook 76 to the frame or casing 12 and at its other end to a cable 78 fastened to the rail 24 by means of a cable retainer 80 and a wire block 82. The cable 78 extends to the hand pull 84 (FIG. 1) and is provided with a sheath 86 one end of which is connected to the rail 24 by means of a casing block 88.

Moreover, it will presently be shown from the following description that closing of the work piece clamps is effected when the foot pedal 64 is depressed which pulls the release cable 62 against the tension of its associated spring 70 and the leaf spring 52 is drawn inwardly by the clamp 66 on the end of the cable 62 thereby removing the holding action of the notch 58 from the roll pin 60. The pressure of the coil springs 48 then forces the rail 24 away from the carriage 14 and along its associated rollers 34, the rail being shifted from its position shown in FIG. 3 to that of FIG. 4 and coming to rest when the end walls 33 of the tracks 32 abut the periphery of the rollers 34.

Garment clamps

As shown in FIGS. 1 to 4 inclusive, the indexing apparatus includes a pair of arms 10 and 11, adapted to

guide a work piece, such as a shirt S, under the presser foot 3 and needle 5 of the machine 4. Arm 10 is pivotally connected at its inner end to the carriage 14 by means of a hinge arm 90 whilst arm 11 is pivotally connected to the carriage 14 by a hinge arm 92. The outer ends of arms 10 and 11, that are adjacent the ends of the sewing machine, terminate respectively in substantially flat plates 94 and 96 that are approximately coplanar to the presser foot 3 of the machine. A pair of vertically disposed plates 98 and 100 terminate at their top edges approximately $\frac{1}{8}$ of an inch from the underside of the arms 10 and 11 and act as security rests for the said arms so as to prevent bending or breaking of the latter when they accidentally may be subjected to excessive weight on their upper surface.

Arm 10 is provided on its plate 94 with a garment clamp 102 freely mounted at one end in a pivot block 104 and having at its other end a clamping shoe 106. Clamp 102 is connected to an actuating cable 108 extending inwardly to the carriage 14 and being guided in the hinge arm 90. It is shown in FIG. 5B that the cable 108 is further guided adjacent its terminal end by a forked arm 21 of the elbow 20. Arm 11 is provided on its plate 96 with a garment clamp 110 freely mounted at one end in a pivot block 112 and having at its other end a clamping shoe 114. Clamp 110 is connected adjacent the pivot block 112, to an actuating cable 116 extending inwardly to the carriage 14 and having its casing retained in the hinge arm 92. Cable 116 is guided adjacent its inner terminal end by a forked arm 23 on the elbow 22. As shown in FIGS. 5B and 6B, cable 108 is provided with a fastening block 118 secured thereto between the forked arm 21 of the elbow 20 and the hinge arm 90. A coil spring 120, enclosing the cable 108, is disposed between the fastening blocks 118 and the hinge arms 90 so as to effect an outwardly pushing force on the hinge arm 90. Cable 116 is similarly provided adjacent its inner terminal end with a fastening block 119 secured thereto and positioned between the forked arm 23 of the elbow 22 and the hinge arm 92 as shown in FIGS. 5C and 6C.

The inner terminal ends of the cables 108 and 116 respectively are connected to the ends of a coil spring 122 and it will be appreciated that a pulling action is thereby exerted on the cables 108 and 116 by the springs 120 and 122 to firstly close their respective associated garment clamps 102 and 110. Secondly, springs 120 and 122 apply tension on hinge arm 90 to pivot the latter about its associated shaft 126 (FIG. 14), so as to apply tension or a stretching action to the shirt S as will presently be described. Moreover, a pushing action exerted on the ends of the cables 108 and 116, against the tension of the springs 120 and 122, will serve to slacken tension on the shirt S and then to open the clamps 102 and 110. Accordingly, by referring to FIG. 5B it will be seen that elbow 20, in addition to its free arm 21, is provided with a further arm 124 pivoted at one end to the main carrier body 16 and at its other end to the pressure block 18. Similarly, as shown in FIG. 5C, elbow 22 is provided with a further arm 125 pivoted at one end to the carrier 16 and at its other end to the pressure block 18. Therefore, as shown in FIGS. 3 and 5, when the body 16 and pressure block 18 of the carriage 14 are brought into closing relation by the locking rail 24, the forked arms 21 and 23 of the elbows 20 and 22 will be pivoted outwardly thereby to force apart the fastening blocks 118 and 119 and their associated cables 108 and 116 against the tension of the springs 120 and 122 to firstly swing hinge arm 90 about its shaft 126 and then to open the garment clamps 102 and 110.

It was previously mentioned that the plates 94 and 96 on the ends of the arms 10 and 11 are approximately coplanar with the presser foot 3 of the sewing machine. However, as shown in FIG. 6C, arm 11 is secured to its associated hinge arm 92 which is integral with a block

136 that is pivotally mounted to one end of the carrier 16 by means of bearings 138 and 140 therein, pivotally secured to each end of a shaft 142 fast in the block 136. This provides the clamping end of arm 11 with a limited amount of free vertical movement that may be required when, during travel of the arm 11, it must pass over the drive housing (not shown), of the sewing machine 4.

Now it is most important that, when a work piece is clamped between the arms 10 and 11, a sufficient amount of tension should be applied to the work piece so that crimping thereof does not occur when it is repeatedly stopped and started under the presser foot 3 during each buttonholing operation. Although both the arms 10 and 11 provide means to guide the work piece past the machine 4, arm 10 also acts as a stretching element thereby to provide to the work piece the desired amount of tension as abovementioned.

Accordingly, it will be seen from FIG. 14 that the hinge arm 90 of the stretching arm 10 is pivotally mounted to the carrier body 16 by means of a roll pin 126 fast in the carrier 16 and pivotally secured at each end in bearings 128 and 130 provided in depending portions 132 and 134 of the hinge arm 90. As shown in FIGS. 3 and 8, the rotational axis 90' of the arm 90 about its pin 126 passes over and intersects the vertical pivotal axis 106' of the work piece clamping shoe 106 so that if the hinge arm is subjected to a pulling force it will pivot about its pin 126 in the direction of arrow *a* (FIG. 8), which will cause the clamping or outer end of the arm 10 to swing outwardly and away from the machine 4 substantially in the direction of the arrow *b* thereby to provide the stretching action.

It has been pointed out that the opening and closing of the carriage elements 16 and 18 by the rail 24 against the force of springs 48 effects opening and closing of the garment or work piece clamps 102 and 110 by means of the forked arms 21 and 23. The latter act on the blocks 118 and 119 in the opening action and the tension of the coil spring 122 pulls the cables 108 and 116 in the closing action. The rotational movement of the arm 90 on its roll pin 126 is, however, limited in the opening action by means of an adjustable stop member in the form of a set screw 9 in the arm 10 and which acts against the upper face of the carrier body 16 as shown in FIG. 6B.

Referring now to FIGS. 8 to 11 inclusive, and in particular to FIG. 9, it will be seen that when the carriage elements are in their closed position of FIG. 5B, the forked arm 21 acts against the tension of spring 120 by means of the fastening block 118 thereby causing work piece clamp 102 to open as well as providing sufficient force against spring 122 to pivot the hinge arm 90, in the direction of arrow *a*, about its pin 126 so that the stop member 9 engages the carrier body 16 as shown. However, subsequent to the release of the locking means 50 by means of the cable 62, the coil springs 48 force the rail 24 toward its phantom position of FIG. 5B along its sloped tracks 32 as well as effecting opening of the carriage elements 16 and 18. Now as the rail 24 moves off to its unlocked position, the elbow 20 begins to pivot inwardly its forked arm 21. As shown in FIG. 10 the coil spring 122, at this intermediate stage, progressively pulls on the cable 108 to close the work piece clamp 102. However, it will be noted that, although coil spring 120 is somewhat decompressed, it is still receiving sufficient force from fastening block 118 and the forked arm 21 to keep arm 10 pivoted in the direction of arrow *a* so that the stop member 9 remains in contact with carrier body 16.

When the rail 24 finally retracts to its fully unlocked position as shown in phantom in FIG. 5B, the stretching arm 10 and its operative integers assume positions substantially as shown in FIG. 11. At this stage it will be appreciated that the coil spring 120 is fully decompressed due to the fact that carriage elements 16 and 18 are fully opened by the force of their spring 48 and that

elbow 20 is pivoted to a sufficient degree so that its forked arm 21 no longer engages fastening block 118, as shown also in phantom in FIG. 5B. Therefore, the full pulling force of the coil spring 122 is now brought to bear on cable 108 which, as shown in FIG. 11, rotates the hinge arm 90 about the axis 90' of its associated pin 126 in the direction of arrow *b*. Accordingly, the clamping or outer end of arm 10 reacts also in the direction of arrow *b* shown in FIG. 8 to apply, in effect, a pulling or stretching action on the shirt or work piece held between the clamps 102 and 110.

It will be evident that, when the rail 24 is brought back to its locked position and the carriage elements 16 and 18 are thereby brought into closing engagement, the forked arm 21 gradually will exert outward pressure on the fastening block 118 and spring 120 firstly to release the stretching action on the work piece by swinging the hinge arm 90 and its arm 10 in the direction of arrow *a* until stop member 9 again engages carrier element 16 (FIG. 10). Finally, when carriage elements 16 and 18 are fully closed, forked arms 21 and 23 bring sufficient force against the coil spring 122 to effect opening of the work piece clamps 102 and 110 as shown in FIG. 9.

Drive means and index control

The device 6 includes driving mechanism adapted to reciprocate the carriage 14 in the casing or frame 12 as well as an indexing control adapted sequentially to stop and restart the reciprocal movement of the carriage 14 at predetermined positions whereby a plurality of spaced buttonholes may be sewn into a garment held between the arms 10 and 11.

Looking firstly at the driving mechanism, the latter is generally indicated at 144 in FIGS. 2 and 15 and is shown in greater detail in FIGS. 5A and B and 6A and B. One end of the frame 12 comprises a drive box 146 and a flange 148 extending downwardly therefrom serves as a mounting plate for an electric ratio motor 150 such, for example, as a "Boston" model M-109. An electric clutch unit 152 transfers driving torque from the motor 150 to the carriage 14 through a driving sprocket 154, idle sprocket 156, roller chain 158 and connecting rod 159. Driving sprocket 154 is mounted for rotation in the bottom wall of the drive box 146 and sprocket 156 is rotatably mounted in the bottom wall 13 of the frame 12 as shown in FIG. 6B, which wall 13 also provides tracks 162 for guiding the chain 158 during its travel (FIG. 15). The drive sprocket 154, by means of a shaft 164, is connected to the electric clutch 152 which is engaged and disengaged by switch means as will be presently described.

As shown in FIGS. 5A and B and 6A and B, the connecting rod 159 comprises a lower arm 160 and an upper arm 161 interconnected by a roll pin 166 rotatably mounted in the carrier body 16. The lower arm 160 is pivotally connected at one end to the roller chain 158 by means of a dowel pin 168 and the upper arm 161 terminates at one end in pin 163 positioned in a slot 165 in an index finger 170 that is slidably secured in a guideway 172 resiliently mounted by damper 167 to the carrier body 16, one end of the finger 170 being formed as a bar 174. It will presently be described that the index finger 170 sequentially is engaged by a plurality of indexing tongues thereby to abruptly bring the carriage 14 to a full stop at predetermined positions. As the speed of the carriage 14 on the frame 12 is substantial, the dampers 167 are adapted to absorb the initial shock of the stopping action thereby to prevent possible breakage of the finger 170 or its associated elements.

It will be appreciated that, when the rail 24 is in the unlocked position of FIG. 4, the drive means 144 may reciprocate the carriage 14 backward and forward on the frame 12, and, when the connecting rod 159 is brought round the drive sprocket 154 to reverse the direction of the carriage 14, the upper arm 161 of the rod 159, in pivotal movement, slides the finger 170, by means of the

pin 163 in slot 165, in its guideway 172 so that the bar 174 protrudes from the carrier 16 as shown in FIG. 20 whereby, when the carriage 14 is drawn in its reverse direction, the bar 174 will engage the roll pin 60 in the rail 24 thereby drawing the latter back toward its locking position where the pin 60 is engaged by the notched portion 58 of the leaf spring 52.

The device 6 includes an indexing control adapted sequentially to stop and restart the carriage 14 and its associated guiding arms 10 and 11 at a plurality of predetermined positions with respect to the sewing machine 4 so that the buttonholes may be sewn into the garment in sequential order.

As shown in FIGS. 3 to 5 inclusive the mechanical elements of the index control comprises an index shaft 176 mounted for limited longitudinal movement in spindle bearings 178 and 180, bearing 178 being mounted on the rear wall of the frame 12 and bearing 180 being mounted in the drive box 146. Referring to FIG. 5A, one end of the index shaft 176 protrudes from the bearing 178 to abut a plunger 182 slidably mounted in a socket 184 in the end wall of the drive box 146. The head of the plunger 182 is adapted to close off an aperture 186 in the socket 184 by means of a collar spring 188 and the plunger seat abuts a rubber shock damper 183 also provided in the socket 184. However, the end of the shaft 176, under force, may enter the aperture 186 by depressing the plunger 182 against the tension of the collar spring 188 which, when the force is removed, bears against the head of the plunger 182 to force the shaft 176 outwardly. The longitudinal movement of the shaft 176 is possible due to its free mounting the bearings 178 and 180 and it will be noted that the shaft 176, adjacent its terminal end between the bearing 180 and the socket 184, is provided with a pair of peripheral flanges 190 adapted, during longitudinal movement of the shaft, to actuate switch means in the drive box 146 in a manner presently to be described.

Now the shaft 176 is spaced from and parallel with the carriage 14 and extends substantially throughout the length of the casing or frame 12. A plurality of collar clamps 192 are spaced on and adjustably secured to the shaft 176 by Allen screws 193 and each clamp 192 retains an index tongue 194 adapted to arrest reciprocal motion of the carriage 14 by engaging a notch 171 in the index finger 170 slidably mounted on the carrier body 16. As shown in FIGS. 5A, 12 and 13, that portion of the shaft lying immediately outside the drive box 146 is provided with a further collar 196 retaining a control tongue 198. It may be seen from the plan view of FIG. 5A that the collar 196 has a flange 200 to which is connected one end of a coil spring 202, its other end being hooked to the upper end of an arm 204 pivotally mounted by a roll pin 206 between a pair of guide plates 208. The upper end of arm 204 is further pivotally connected to a rod 210 of a solenoid S-1 and the lower end of arm 204 is provided with a lip 212 engaging the underside of the control tongue 198. It will be noted from FIGS. 12 and 13 that when the solenoid S-1 is energized and its rod 210 is drawn inward, the arm 204 will pivot about the pin 206 causing the lip 212 to lift upwardly the control tongue 198 as shown. Due to its connection with the shaft 176, the control tongue 198, in its upward movement, partially rotates the shaft 176 thereby causing all the index tongues 194 to raise and especially the one that, at that particular instance, is engaging the slotted index finger 170 whereby the carriage 14 is freed from retention by the shaft 176.

As shown in FIGURES 5A and 6A, the solenoid S-1 is mounted on a plate 222 and that portion of the latter which extends over the chain 158 which is adjacent the shaft 176, is provided with two stepped portions or shoulders 197 and 199. Moreover, a pawl 201 is pivotally mounted adjacent one end to the plate 222 and its other end, as shown in FIG. 6A, is upheld by a hair spring 203 which is adapted to bring the free end of the pawl 201

into abutting engagement with the terminal side edge of the control tongue 198. The function of the pawl 201 and the shoulders 197 and 199 of the plate 222 will subsequently be described during the operational sequence of the indexing apparatus.

The sequential operation of the drive mechanism and the above described mechanical index elements are electrically controlled as shown in the schematic control circuit illustrated in FIG. 21 of the drawings. The circuit employs three switches, SW-1, SW-2 and snap switch SW-3; two time delay relays, TD-1 and TD-2; two solenoids S-1 and S-2; one coil relay CR-1 and a foot pedal switch FP-1 which, together with relay CR-1 and solenoid S-2 is present with the sewing machine 4 in its routine manual operation.

Switch SW-1 is normally open and, as shown in FIG. 5, is retained in this position by a coil spring 214 connected at one end to a wall of the drive box 146 and at its other end to a switch actuating rod 216. The latter extends outwardly from the drive box 146 into the casing 12 and has an angled end portion 218 that is engaged by one end of the rail 24 when the latter is shifted thereto when unlocked from the leaf spring 52, whereby the rod 216 is shifted to close switch SW-1 by means of a lever arm 217. Closing of this switch renders the remaining switches operative.

Switch SW-2 is normally open and is operatively connected to solenoid S-1 through a time delay TD-1 and is also connected to the sewing machine solenoid S-2 through the machine relay coil CR-1. The latter may be actuated by SW-2 through TD-1, or for manual operation of the machine, through the foot pedal FP-1 (FIG. 1).

Switch SW-2 is mounted on a plate 220 in the drive box 146 as shown in FIGS. 5A and 6A and is provided with an actuating arm 191 the free end of which is thrown by the peripheral flanges 190 on the shaft 176 when the latter is shifted longitudinally into the socket 184.

As shown in FIG. 6A, snap switch SW-3 is mounted in consort with switch SW-2 and is adapted, through a time delay TD-2 to effect engagement or disengagement of the electric clutch 152 thereby releasing the carriage 14 from connection with the motor 150. SW-3 also is actuated by an arm 191 when thrown by the flange 190 as the shaft 176 is shifted longitudinally outwardly or inwardly of the socket 184 as will presently be described.

The operative role of solenoid S-1, when energized by switch SW-2, has already been described with reference to its action on the control tongue 198 by means of the lever arm 204. As shown in FIGS. 5, 12 and 13, solenoid S-1 is mounted on the plate 222 in the casing 12 outside the drive box 146.

Solenoid S-2 is mounted to the underside of the sewing machine table as shown in FIG. 2 and, together with its control relay CR-1, is incorporated in the sewing machine circuitry. Energization of S-2 by switch SW-2 or foot pedal switch FP-1 effects operation of the machine 4 in a buttonholing operation.

Operational sequence

The manner in which a plurality of aligned buttonholes are sequentially and automatically sewn into a garment such as a shirt will now be described with reference to FIGS. 3, 5, 12 and 13 and in particular FIGS. 16 to 20 inclusive. Initially, the spacing of the buttonholes to be sewn are preset by adjusting the distance between the collars 192 and tongues 194 on the shaft 176 according to a tape scale 224 provided on the rear wall of the frame 12, (FIG. 5C). A general line switch LS (FIG. 21) is closed to energize the motor of the sewing machine 4 as well as the motor 150 of the apparatus drive means 144. The attachment is now ready for operation.

FIGURES 16 to 19 inclusive schematically show the operative relation between the mechanical and electrical elements of the indexing means of the present invention.

The degree of movement of the index finger 170, and therefore the carriage 14, in relation to the shaft 176 and tongues 194 may be followed with reference to the carriage "start" line indicated at D-D.

Now with the device 6 in its idle or rest position of FIG. 16, it will be noted that the notch 171 of the finger 170 is engaged by the first tongue 194a thereby interconnecting the carriage 14 with the shaft 176; the terminal end of the shaft 176 has entered aperture 186 in socket 184 and thrust inwardly the plunger 182 against the tension of spring 188; flanges 190 on shaft 176 have closed switch SW-2 and opened switch SW-3; and the shaft 176 is held in this position by the edge of the control tongue 198 being engaged by the pawl 201 on plate 22. Although switch SW-2 is closed, it cannot operate its solenoids S-1 and S-2 due to the fact that, at this idle point, switch SW-1 is open.

The operator now places the ends of a shirt on the plates 94 and 96 of the guide arms 10 and 11 under the presser foot and needle of the sewing machine 4. Foot pedal 64 is depressed, pulling the release cable 62 so as to draw away the leaf spring 52 from locking engagement with the roll pin 60 in the rail 24. The latter is shifted along its angled or sloped tracks 32 by the pressure of the coil springs 48 thrusting apart the carriage elements 16 and 18, rollers 42 on the latter applying this pressure to the rail 24. Concurrently, and as previously described, spring 122 effects pivotal movement to the arm 10 and hinge arm 90 to apply the desired tension to the work piece.

Now as shown in phantom line in FIG. 5B, the rail 24, upon reaching its unlocked position, abuts the end 218 of rod 216 moving the latter forward against the tension of spring 214 to close the switch SW-1 by means of its lever arm 217.

Bearing in mind that SW-2 is closed (FIG. 16) time delay TD-1 after approximately .2 second energizes solenoids S-1 and S-2, the latter through CR-1. As shown in FIGS. 13 and 17, actuation of solenoid S-1 operates arm 204 to raise control tongue 198 from engagement with pawl 201 as well as raising tongue 194a from its position in the notch 171 of the finger 170 whereupon spring 188 in socket 184 forces the end of shaft 176 outwardly so that control tongue 198 abuts shoulder 197 on the plate 222 and the tongue 194a rests on top of the finger 170.

Now with the indexing integers disposed as shown in FIG. 17 and the sewing of the first buttonhole about to start, it will be appreciated that the carriage 14 is at this time freed, both from the driving means 144 and the index tongue 194a and shaft 176. Moreover, because of its connection with the work piece through the arms 10 and 11, the carriage 14 will move in response to and in consort with the shirt S as it traverses the outline of the buttonhole under the moving force of the sewing machine platen and presser foot 3. Therefore, as the sewing operation gets under way, the carriage 14 is drawn in the direction of arrow X as one side of the buttonhole is sewn into the shirt S and as the carriage reaches approximately point Y (FIG. 18), tongue 194a drops down behind the rear terminal edge of the index finger 170 and control tongue 198 drops fully onto the top of pawl 201.

As shown in FIG. 19, the carrier 14 subsequently is reversed in its movement in the direction of arrow Z when the second side of the buttonhole is being sewn into the shirt S. On this return stroke the rear terminal edge of the index finger 170 engages the tongue 194a as shown and draws the latter, together with the shaft 176, in a rearward movement until control tongue 198 engages shoulder 199. The peripheral flanges 190 on the shaft 176 now reverses the lever arm 191 as illustrated to close snap switch SW-3 which energizes TD-2. Time delay TD-2 allows sufficient time (approximately 2 seconds) for the machine to sew the end or "lock" stitch into the buttonhole. As the sewing machine completes

the operation, SW-3 effects engagement of the electric clutch 152 whereby the drive means 144 pulls the carriage forward until the sharp forward edge 169 of the finger 170 directs tongue 194b in the notch 171. This forward action takes the carriage to point D (FIG. 16) where pawl 201 engages tongue 198 and wherein the flanges 190 open snap switch SW-3 to effect disengagement of the clutch 152. Lastly, switch SW-2 is also closed at this time to effect actuation of solenoids S-1 and S-2. However, TD-1 provides a delay of approximately .2 second for the carriage 14 to stabilize after being abruptly stopped by the tongue 194.

The operation of sewing this second and the remaining buttonholes is repeated in the sequential method described above beginning with the illustration of FIG. 16, where the carrier 14, at each location, is firstly stopped and then released for movement responsive to the reciprocal action of the sewing machine 4.

Turning now to FIG. 4 and the fragmentary view of FIG. 20, it will be seen that after the last buttonhole has been sewn into the shirt S and the last index tongue 194e has been passed by the finger 170, the journalled end of the connecting rod 159 is drawn round the sprocket 154 by the chain 158 and the carriage 14 returns firstly to the location of FIG. 3, then to its idle position of FIG. 16. As the connecting rod 159 is moved to the return run of the chain 158, it pivots about the roll pin 166 in carrier body 16 so that the pin 163 on the upper rod 161 pulls the notched end of the index finger 170 into the confines of the body 16, removing that end of the finger 170 from any contact with the tongues 194 during the reverse stroke.

Concurrently, however, the catch bar 174 on the other end of the finger 170 is thrust outwardly as shown in FIG. 20 so that, as the carriage 14 nears the end of its reverse stroke, the bar 174 engages the roll pin 60 in the rail 24 so that the latter is drawn backward along its angled or sloped tracks 32 on rollers 34 until the notch 58 in the leaf spring 52 snaps over the lower end of the pin 60 to lock the rail 24 in its position of FIG. 5C. Moreover, as the rail 24 is drawn away by the bar 174, spring 214 shifts the actuating rod 216 from engagement with lever arm 217 so that switch SW-1 is reopened, cutting the indexing circuit. Finally, and in concurrent action with the opening of SW-1, body 16 and pressure block 18 of the carriage 14 are drawn together by the rail 24 whereby arms 21, 23 of the elbows 20 and 22 are thrust outwardly in pivotal movement against the fastening blocks 118 and 119 to actuate the cables 108 and 116 in an opening movement of the garment clamps 102 and 110 and to release the stretching action of arm 10 whereby the shirt S drops out of the shoes 106 and 114 and away from the attachment which is now in the position of FIG. 16 and is ready to receive another garment.

It will be appreciated that, at any stage of the sequential sewing operation, the rail 24 may be drawn back manually by means of the hand pull 84 on the rail cable 78, at which time SW-1 automatically would be opened.

If the sewing machine 4 requires routine or other maintenance, the guide arms 10 and 11 of the device 6 may be shifted to the positions indicated in chain lines in FIG. 3 whereby the head of the sewing machine may be swung open as shown in the chain lines of FIG. 2. Moreover, in case of mechanical breakdown of the indexing device 6, the guide arms 10 and 11 may be moved to the chain line positions of FIG. 3 and the machine 4 may therefore be operated independently.

Although the apparatus forming the present invention has been described in operative combination with one particular type of buttonholing machine, it will be appreciated that it is also applicable to other types of sewing machines such as the models used for sewing transverse buttonholes or machines for sewing buttons onto garments. In applying the device of the present invention to the type of sewing machine incorporating a

needle that traverses the buttonhole periphery together with a stationary platen and presser foot, it would require only a minor modification to the device so that its carriage would not be freed at each buttonhole location.

We claim:

1. In combination with the sewing mechanism of a buttonholing machine, an indexing apparatus to provide said mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a workpiece; said apparatus comprising a frame having a carriage slidably mounted therein, said carriage including first and second elements, rollers on said elements for reciprocal movement of said carriage in said frame; connecting members securing together said first and second elements, drive means to impart said reciprocal movement to said carriage; indexing means to control said drive means and sequentially stop said carriage during said movement at a plurality of selected locations in said frame and then disconnect said carriage from said drive means; and a pair of guide arms having means for clamping a workpiece under tension therebetween at opposite ends of the workpiece to more positively grip and control the workpiece at a sewing position and during a sewing operation, said arms being secured to said carriage and extending outwardly from said frame and being actuated by said carriage elements upon rotative movement therebetween, said arms terminating adjacent opposite sides of said sewing mechanism and transmitting said carriage movement to said workpiece relative to said sewing mechanism during indexing of said workpiece and transmitting movement of said sewing mechanism and said workpiece to said carriage during the sewing operation of said buttonholes.

2. In combination with the sewing mechanism of a buttonholing machine, an indexing apparatus to provide said mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a workpiece; said apparatus comprising a casing remote from said machine having a carriage slidably mounted therein, said carriage including first and second elements; connecting members pivotally securing said elements together, rollers on said elements for reciprocal movement of said carriage in said casing; said elements being movable to open and closed positions normal to the direction of said reciprocal movement; a rail in said casing slidably mounted adjacent said carriage, said rail having a track on one side thereof to receive a plurality of said carriage rollers and angled wall portions on another side thereof for angular longitudinal movement of said rail to and from closing and opening engagement with said carriage elements; drive means in said casing to impart reciprocal movement to said carriage; a pair of guide arms secured to said carriage and extending outwardly from said casing; said arms terminating in clamps disposed adjacent opposite sides of said sewing mechanism and being adapted to retain a workpiece therebetween, said arms being actuated by opening and closing movement of said carriage elements; indexing means to control said drive means and sequentially stop said carriage during its reciprocal movement at a plurality of selected locations in said casing and then disconnect said carriage from said drive means, said locations corresponding to buttonhole locations on said workpiece; spring means in said carriage elements to effect said normal movement thereof to said open position and to effect angular longitudinal movement of said rail to its open position; and means on said carriage to shift said rail to closing engagement with said elements thereby to open said work piece clamps; said arms and work clamps transmitting reciprocal movement of said carriage to said work piece relative to said sewing mechanism during indexing of said workpiece and transmitting movement of said sewing mechanism and said workpiece to said carriage during the sewing operation of said buttonholes.

3. The combination according to claim 2 wherein one of said arms is a work piece stretching arm pivotally

secured to said carriage; and wherein movement of said carriage elements relative to one another effects movement of said stretching arm relative to the remaining arm thereby to apply tension to said work piece.

4. The combination according to claim 2 wherein said drive means comprises a motor; transmission means; clutch means interconnecting said motor and transmission means; and a connecting rod pivotally secured at one end to said transmission means and at its other end to said carriage; said clutch means being engageable and disengageable with said motor in response to said indexing means.

5. The combination according to claim 2 wherein said indexing means comprises a plurality of tongues adjustably connected to said casing; an index finger on said carriage adapted sequentially to be engaged by said tongues thereby to arrest movement of said carriage; first switch means adapted to energize said indexing means; second switch means to effect operation of said sewing mechanism and to effect disengagement of said tongues from said index finger; and third switch means to effect actuation of said drive means.

6. An indexing apparatus for operation with sewing mechanism of a buttonholing machine and adapted to provide said mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a work piece; said apparatus including a carriage; first and second elements in said carriage; means for at times locking said carriage elements together, drive means for imparting reciprocal movement to said carriage; a pair of guide arms having clamps adjacent the ends thereof for retaining a work piece under tension therebetween, said arms being secured to said carriage and extending outwardly therefrom and being actuated by said carriage elements upon relative movement therebetween; and indexing means to control said drive means and sequentially stop said carriage during said reciprocal movement at preselected locations and then disconnect said carriage from said drive means; said arms and clamps being disposed adjacent opposite sides of said sewing mechanism so as to clamp therebetween a workpiece at opposite ends thereof; said arms and clamps transmitting said carriage movement to said workpiece relative to said sewing mechanism during indexing of said workpiece and transmitting movement of said sewing mechanism and said workpiece to said carriage during the sewing operation of said buttonholes.

7. An indexing apparatus for operation with sewing mechanism of a buttonholing machine and adapted to provide said mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a workpiece; said apparatus comprising a frame having a drive box and a pair of roller tracks; a reciprocal carriage; rollers on said carriage to provide reciprocal movement thereof on said tracks; said carriage including a pair of elements movable normal to the direction of said reciprocal movement; said carriage elements comprising a body portion and a pressure block pivotally connected thereto; members having forked arms pivotally connecting said pressure block to said body portion; one of said roller tracks comprising a rail mounted for angular movement to locked and unlocked positions relative to said carriage elements; spring means in said elements adapted to impart said normal movement to said body and pressure block and thereby to shift said rail from its locked position to its unlocked position; drive means in said drive box adapted to impart said reciprocal movement to said carriage; indexing means to control said drive means and sequentially stop said carriage during reciprocal movement thereof at preselected locations on said tracks and then disconnect said carriage from said drive means; and a pair of guide arms having clamps adjacent the ends thereof for retaining a workpiece therebetween and for gripping the workpiece at opposite ends thereof to more positively control the workpiece during a sewing opera-

tion; said arms being secured to said carriage and extending outwardly from said frame, said ends and clamps being disposed adjacent opposite sides of said sewing mechanism and transmitting said carriage movement to said workpiece relative to said sewing mechanism during indexing of said workpiece and transmitting movement of said sewing mechanism and said workpiece to said carriage during the sewing operation of the buttonholes.

8. The apparatus according to claim 7 including cables connected to said workpiece clamps, the forked arms of said connecting members acting on said clamp cables whereby movement of said body and said pressure block relative to one another pivots said forked arms to effect opening and closing of the workpiece clamps.

9. The apparatus according to claim 7 wherein one of said guide arms is pivotally secured to said carriage to provide a work piece stretching arm; said clamping means comprises a plate on the terminal end of said stretching arm and the remaining arm, a clamp having a shoe portion mounted on each said plate; actuating cables extending inwardly from said clamps, spring means interconnecting the inner ends of said cables and being adapted to effect closing of said clamps by said cables; and wherein the pivotal axis of said stretching arm intersects the vertical axis of its associated clamping shoe whereby closing of the latter by said cable and spring means imparts rotational movement to said stretching arm to apply tension to said work piece.

10. The apparatus according to claim 7 wherein said indexing means comprises a shaft mounted for limited longitudinal movement on said frame; a plurality of tongues adjustably mounted on said shaft; an index finger resiliently mounted on said carriage for reciprocal movement by said drive means relative to said tongues, said finger being adapted sequentially to be engaged by said tongues thereby to arrest movement of said carriage; first switch means being adapted to effect operation of said indexing means; second switch means being adapted to effect operation of said sewing mechanism and sequentially to effect disengagement of said tongues from said index finger; and third switch means being adapted, upon completion of a sewing operation, to effect engagement of said clutch.

11. The apparatus according to claim 10 wherein said first switch means is adapted to be actuated in response to said normal movement of said carriage elements; said second switch means is adapted to be actuated by said shaft in response to the limited movement thereof in one direction; and the third switch means is adapted to be actuated by movement of said shaft in another direction.

12. An indexing apparatus adapted for operation with sewing mechanism of a buttonholing machine, said apparatus being adapted to provide said mechanism with means automatically to effect a plurality of spaced, sequential buttonhole sewing operations to a garment; said apparatus comprising a frame having a carriage and rail mounted therein, said carriage having a pair of elements movable to open and closed positions relative to one another and comprising a body and pressure block, connecting members having forked arms pivotally securing said body and pressure block together, rollers on each said element for reciprocal movement of said carriage in said frame, the body rollers engaging said frame and the pressure block rollers engaging said rail mounted for angular movement to open and closed positions relative to said carriage elements; spring means in said elements to move the rail to said open position; drive means in said frame to impart said reciprocating movement to said carriage and comprising a motor, a roller chain, a drive sprocket and an idler sprocket for circulating said chain, a rod connecting said chain to said carriage and a clutch interconnecting said drive sprocket to said motor; indexing means including a notched finger resiliently mounted on said carriage and a shaft mounted for limited longitudinal movement on said frame, a plurality of

tongues adjustably secured to said shaft, each tongue being adapted sequentially to engage and disengage said finger; first switch means to effect operation of said indexing means; second switch means sequentially to effect disengagement of said tongues from said finger and to actuate said sewing mechanism; third switch means to effect engagement and disengagement of said clutch; and a pair of guide arms pivotally secured to said carriage and extending outwardly from said frame, said arms terminating in workpiece clamps being adapted to be disposed adjacent opposite sides of said sewing mechanism; and being adapted to retain a work piece in tension therebetween; and cable means connected at one end to said clamps and at their other ends to spring means to effect opening of said clamps; said arms and clamps being adapted to move said work piece relative to said sewing mechanism in response to movement of said carriage during the indexing of said workpiece and to reciprocate said carriage in response to movement of said work piece imparted thereto by said sewing mechanism during the sewing of each of said buttonholes.

13. The apparatus according to claim 12 including releasable means for locking said rail in its closed position, and a catch pin on said rail adapted to be engaged by said index finger when said rail is in its open position whereby said carriage draws said rail to its closing position relative to said elements for engagement by said locking means.

14. The apparatus according to claim 13 wherein release of said locking means effects opening of said carriage elements by said spring means thereby to shift said rail to its open position and to pivot said carriage connecting members and said forked arms whereby said cable spring means closes said work piece clamps and pivots one of said guiding arms to apply tension to said work piece.

15. The apparatus according to claim 13 wherein said carriage elements are closed upon drawing of said rail into engagement with said locking means thereby pivoting one of said guiding arms to release tension from said workpiece, and to pivot said forked arms to actuate said cable means for opening of the work piece clamps.

16. The apparatus according to claim 14 wherein said rail closes the first switch means when shifted to its open position thereby to energize said indexing means and effects opening of said switch when drawn to its closed position to de-energize said indexing means.

17. The apparatus according to claim 12 wherein said second and third switch means are actuated by said shaft during limited longitudinal movement thereof; and the frame is adapted to be positioned remote from said sewing machine.

18. In an indexing apparatus for operation with a but-

tonhole sewing machine, said apparatus including a carriage; drive means to impart reciprocal movement to said carriage, indexing means to control said drive means and sequentially stop said carriage during movement thereof at a plurality of selected locations and then disconnect said carriage from said drive means; means to hold and guide a workpiece relative to said machine connected to said carriage thereby to transmit movement thereof to said workpiece relative to said machine during indexing of said workpiece, and movement imparted by said machine to the workpiece, to said indexing apparatus during the sewing operation of a buttonhole; said guide means including a pair of arms connected, at one end thereof, to said apparatus, and extending outwardly therefrom terminating in free ends adjacent said sewing machine; each said free end having at least one workpiece clamp thereon for retaining a workpiece therebetween; at least one actuating member on each arm operatively connected at one end to the associated said clamp and, resilient means connected to the other end of said member biasing said clamps to a closed position; elements secured to said actuating members, adjacent said resilient means, operating to open said workpiece clamps upon actuation of said elements by said indexing apparatus; one of said arms being a stretching arm, adapted, upon closure of said clamps on said workpiece, to move relative to the remaining arm thereby to apply tension to said workpiece.

19. Indexing apparatus according to claim 18 including hinge means pivotally connecting said stretching arm to said apparatus, the pivotal axis of the hinge means intersecting the pivotal axis of the clamp on said stretching arm whereby closing of said clamps by said spring means effects pivotal movement of said stretching arm relative to the remaining arm thereby to apply tension to said workpiece; and opening of said clamps by said indexing apparatus effects pivotal movement of said stretching relative to said remaining arm to release tension on said workpiece.

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JORDAN FRANKLIN, *Primary Examiner.*

PATRICK D. LAWSON, *Examiner.*

H. H. HUNTER, *Assistant Examiner.*