April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 2.

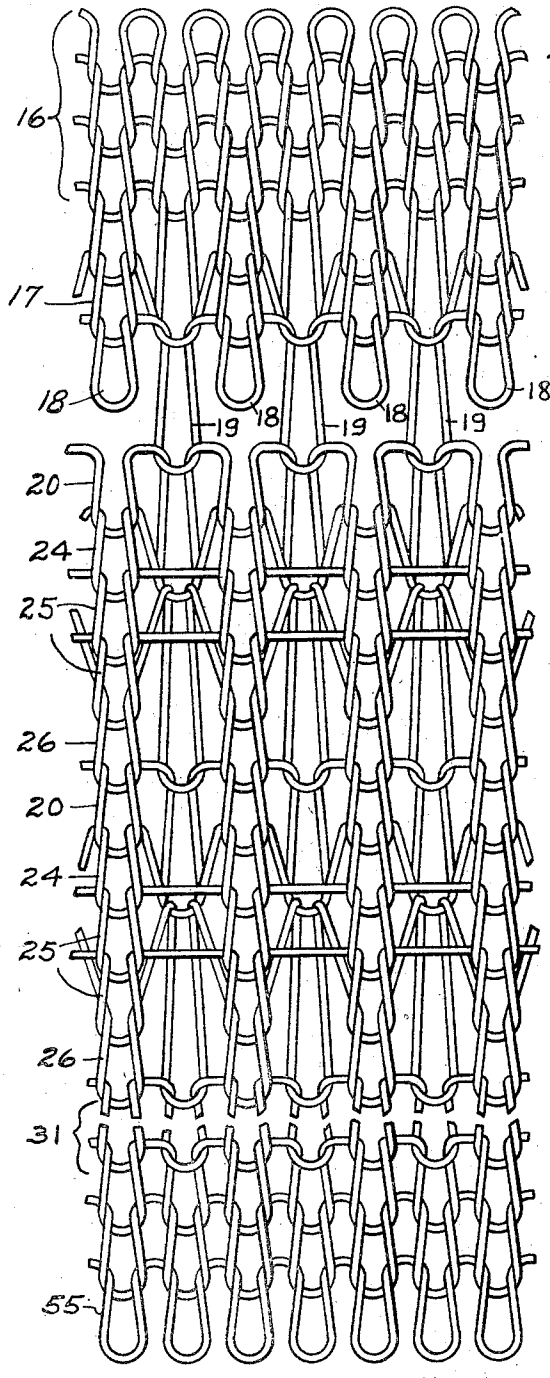
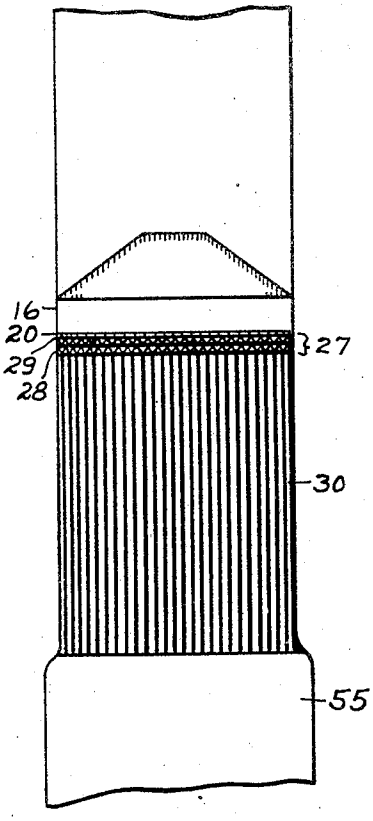


FIG. 1.



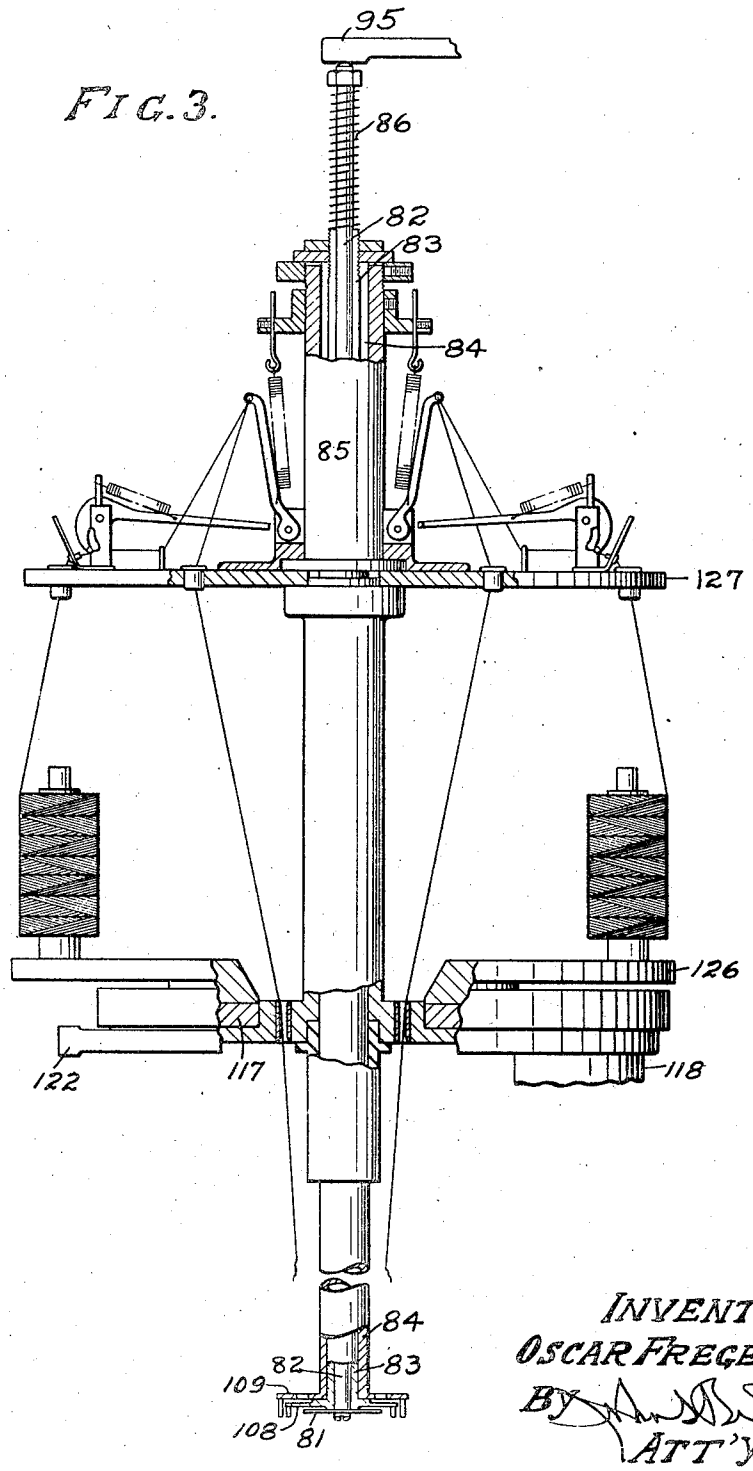
INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y.

April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 3.



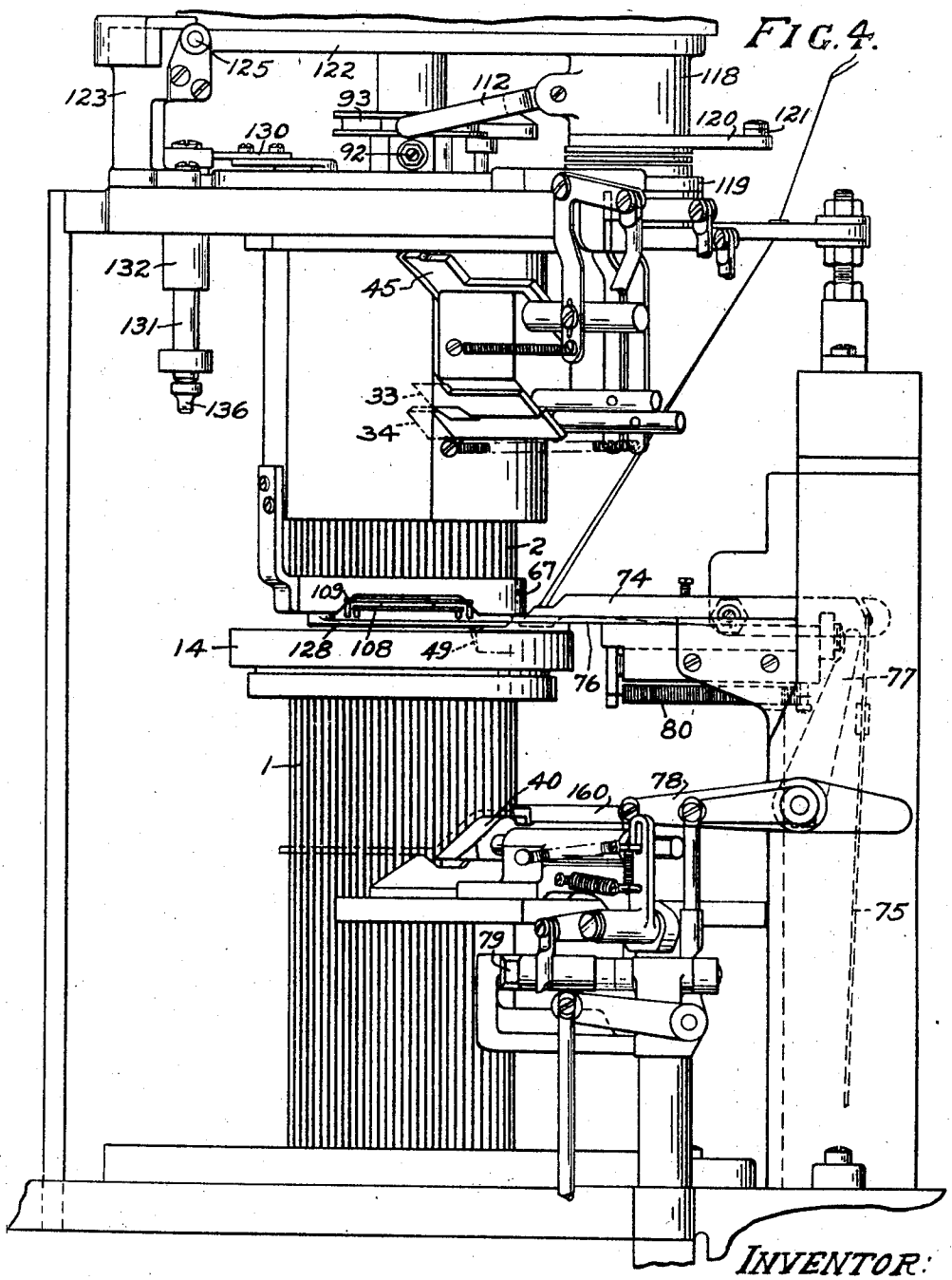
INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y.

April 27, 1948. O. FREGEOLLE 2,440,333

KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 4.



INVENTOR:
OSCAR FREGEOLLE,
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FIG. 5.

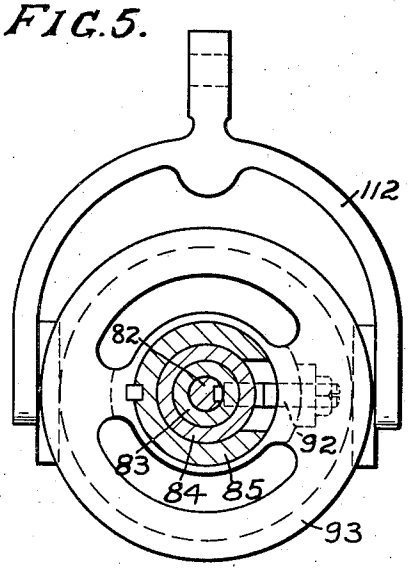


FIG. 7.

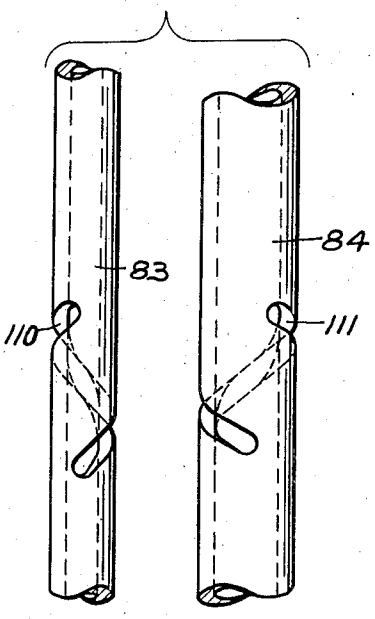


FIG. 6.

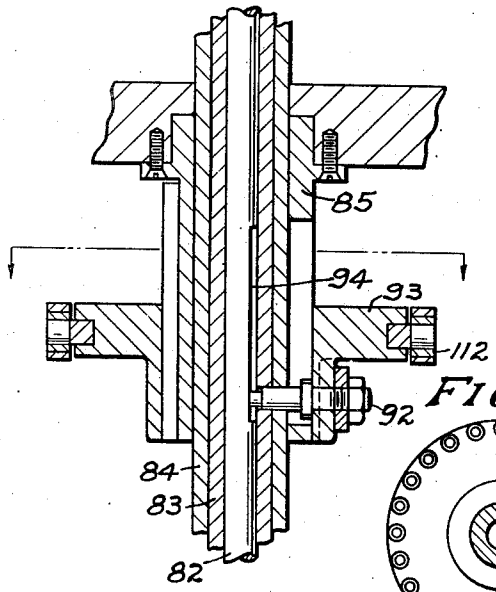


FIG. 8.

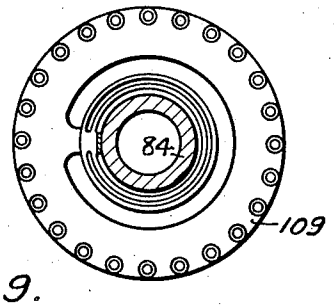
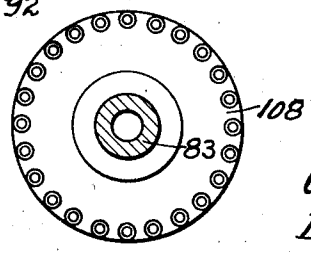


FIG. 9.



INVENTOR:
OSCAR FREGEOLLE,
BY
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April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 10.

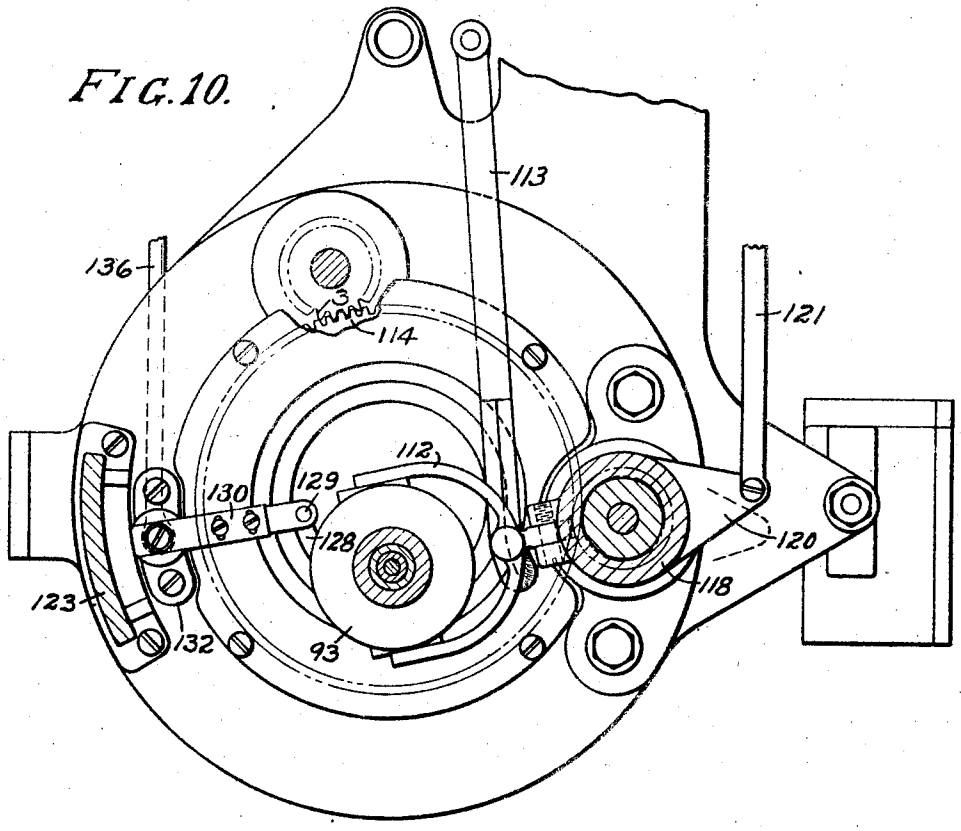
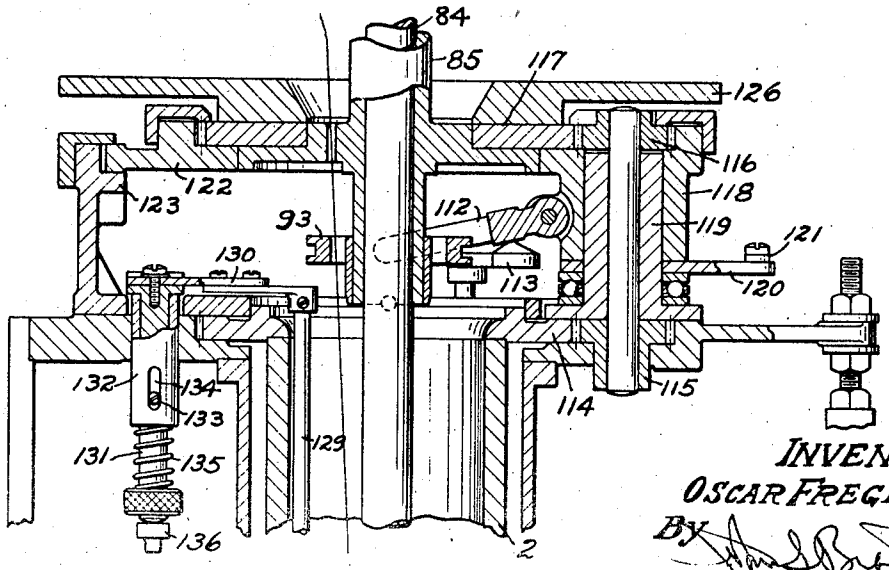


FIG. 11.



INVENTOR:
OSCAR FREGEOLLE,
BY
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April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 12.

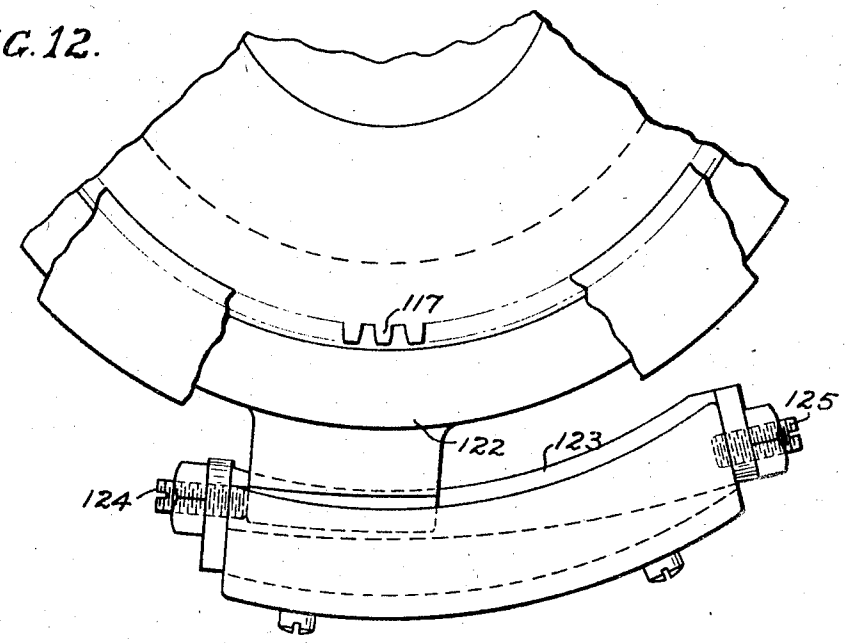


FIG. 14.

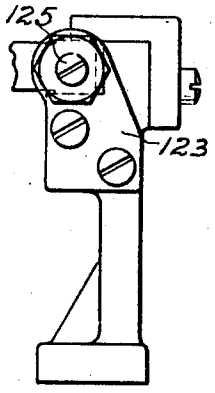
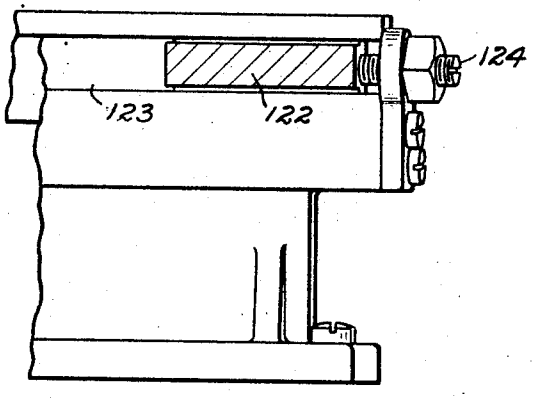


FIG. 13.



INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y

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FIG. 16.

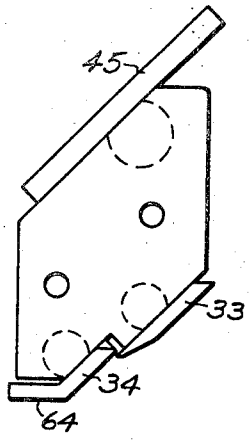


FIG. 15.

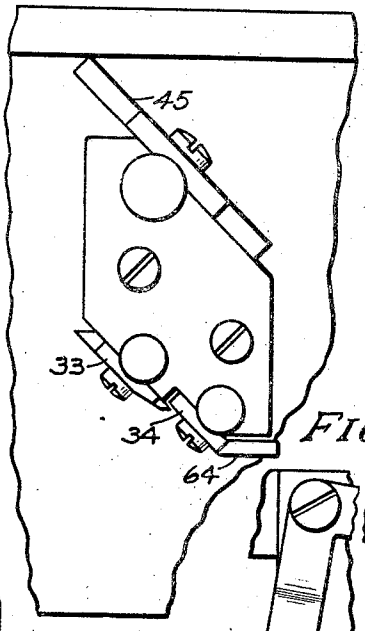


FIG. 17.

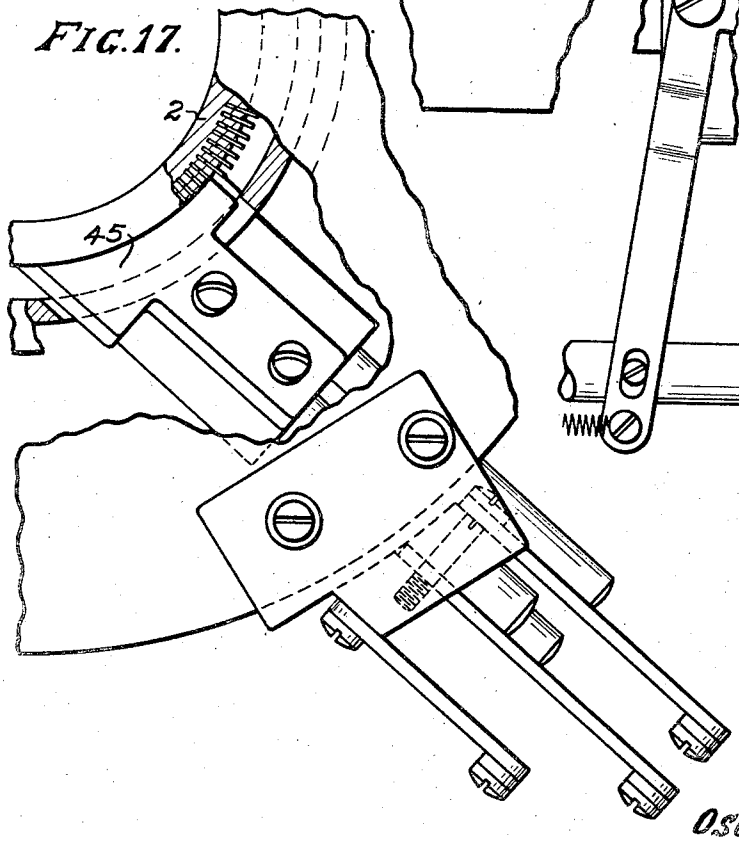
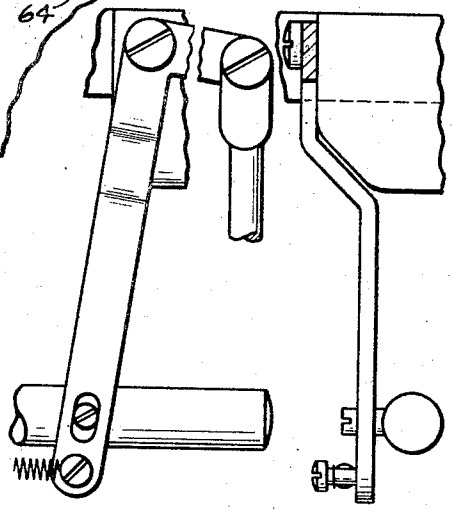


FIG. 18. FIG. 19.



INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y.

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FIG. 22.

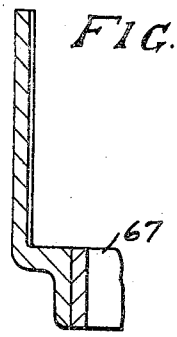


FIG. 23.

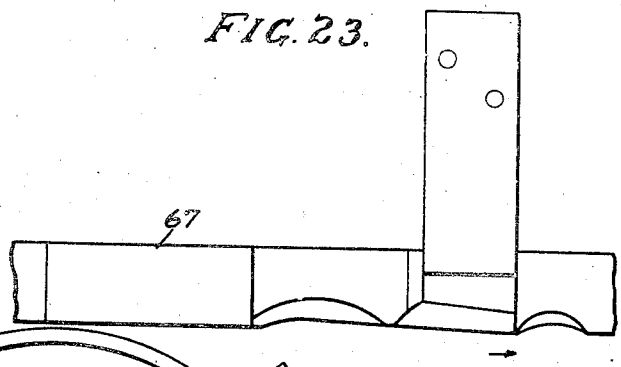


FIG. 20.

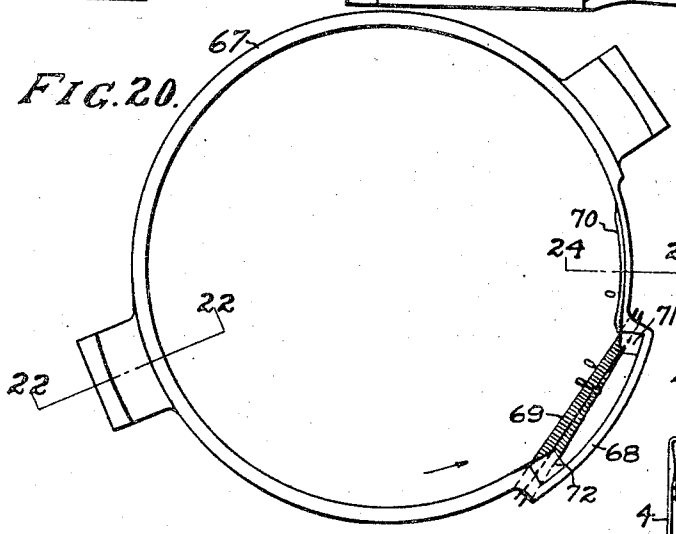


FIG. 24.

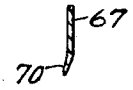


FIG. 25.

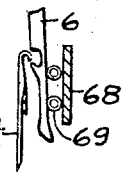


FIG. 21.

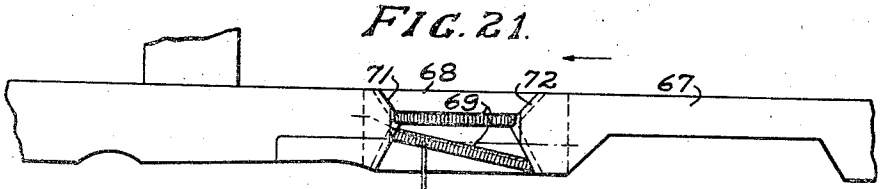


FIG. 26.

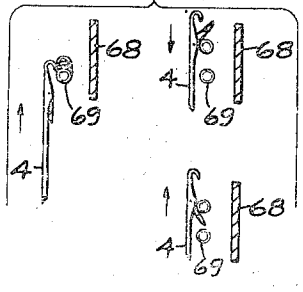
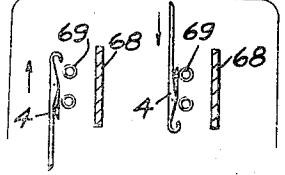
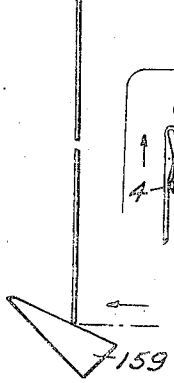


FIG. 27.





INVENTOR:
OSCAR FREGEOLLE,
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FIG. 28.

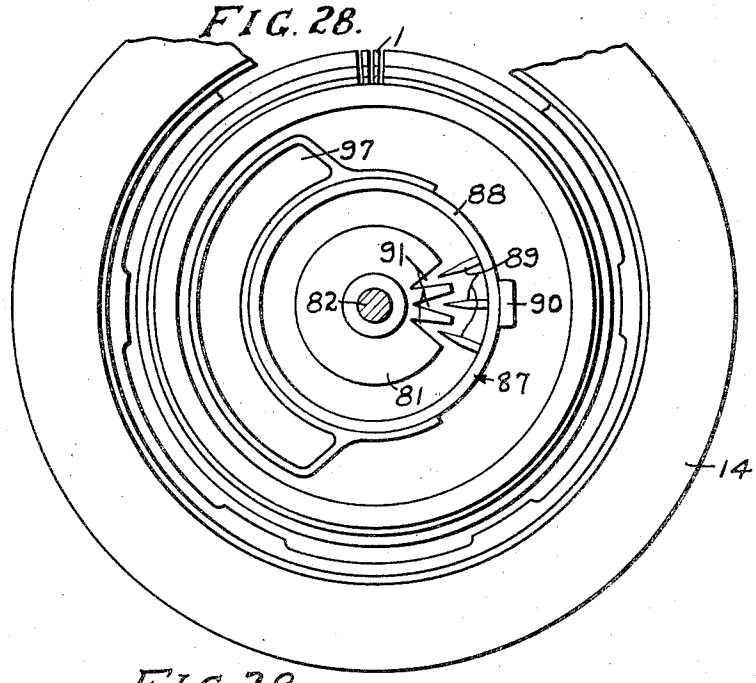
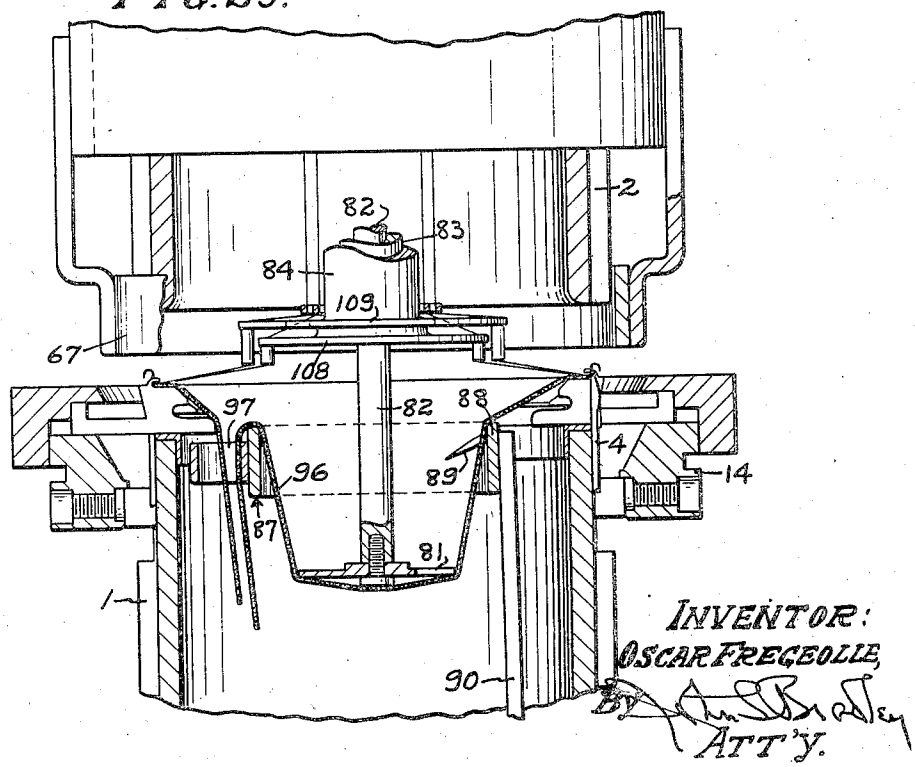


FIG. 29.



INVENTOR:
OSCAR FREGEOLLE,
By
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FIG. 31.

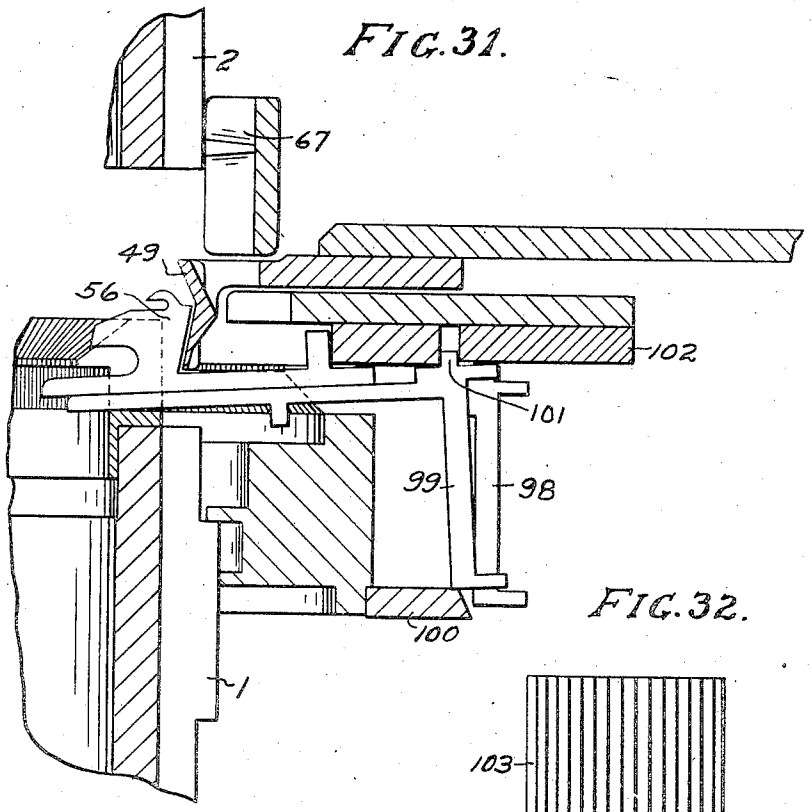


FIG. 32.

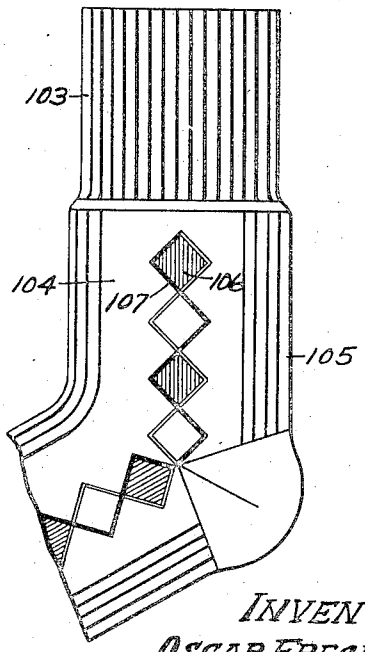
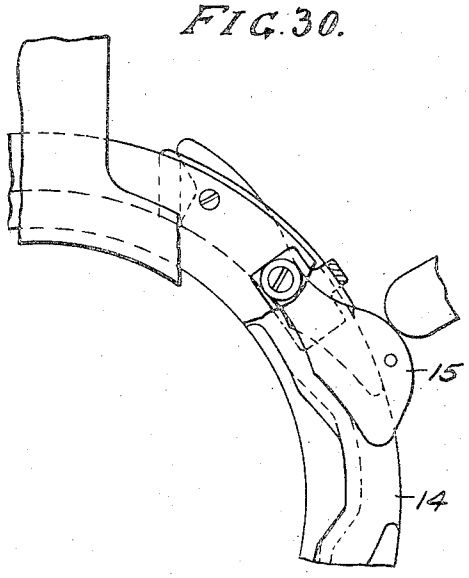


FIG. 30.



INVENTOR:
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BY
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FIG. 33.

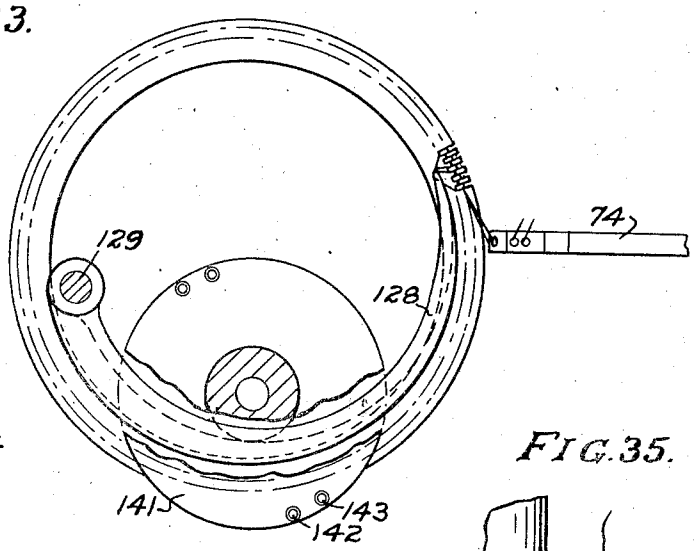


FIG. 34.

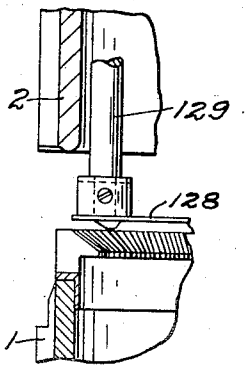


FIG. 36.

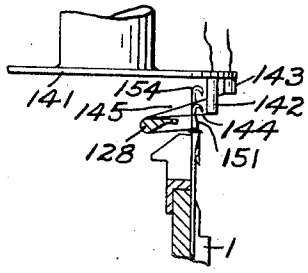


FIG. 35.

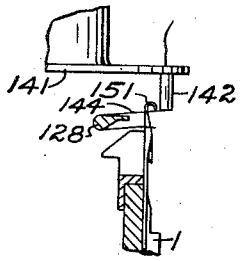


FIG. 37.

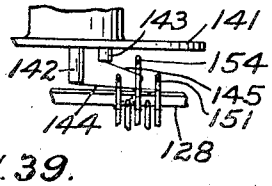


FIG. 38.

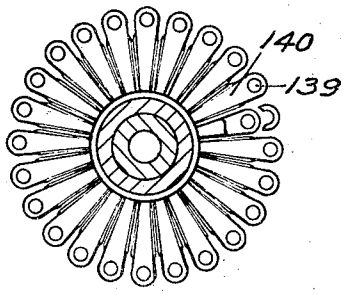
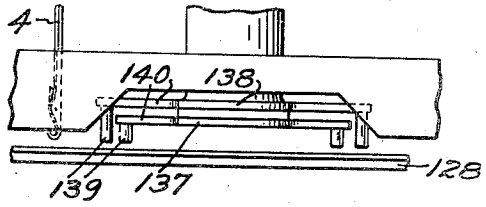


FIG. 39.



INVENTOR:
OSCAR FREGEOLLE,
ATT'Y.

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FIG. 40.

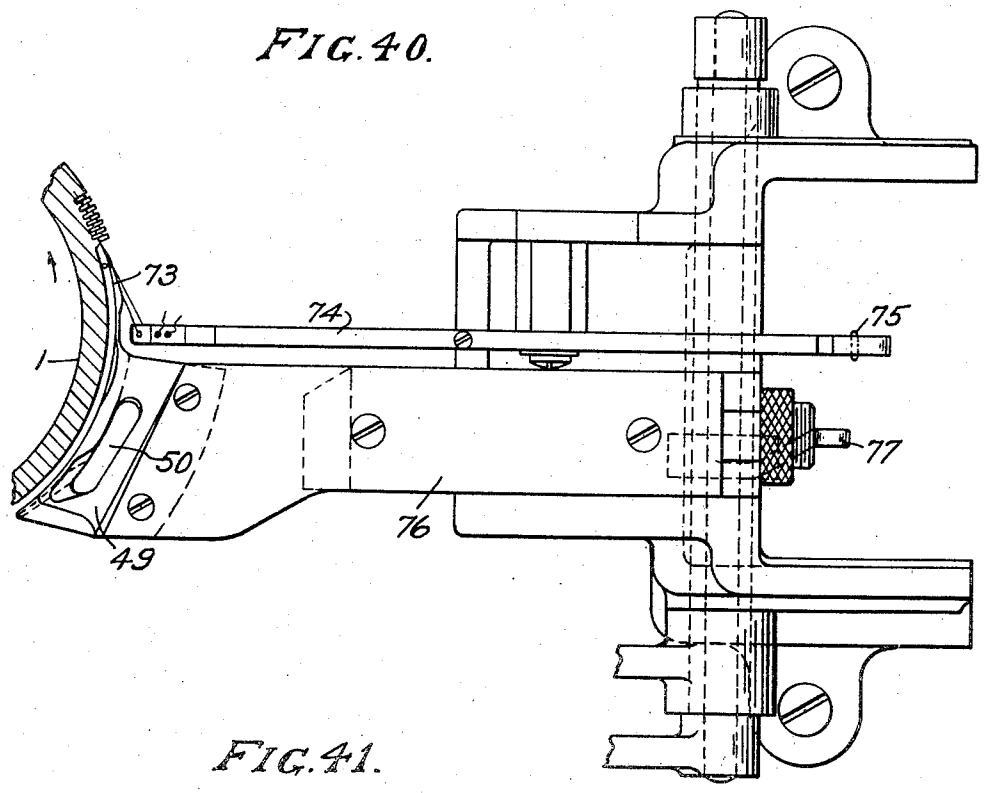


FIG. 41.

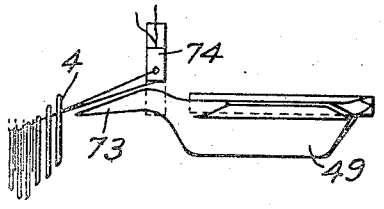


FIG. 42.

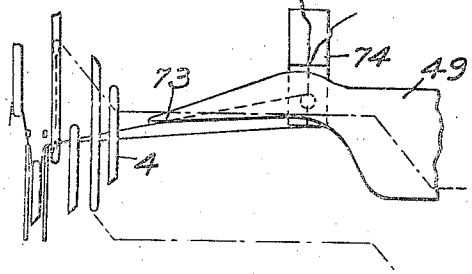
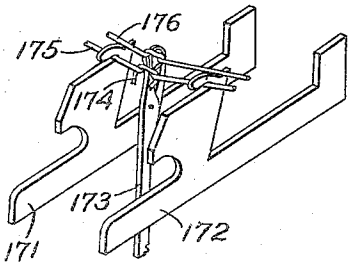


FIG. 65.



INVENTOR:
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By
ATT'Y

April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 43.

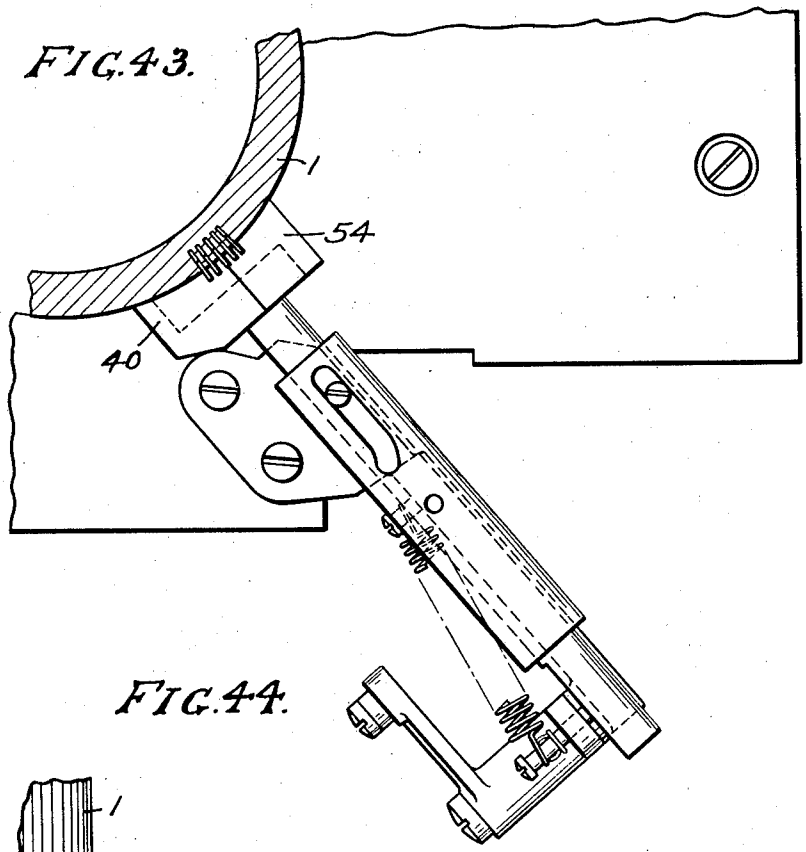
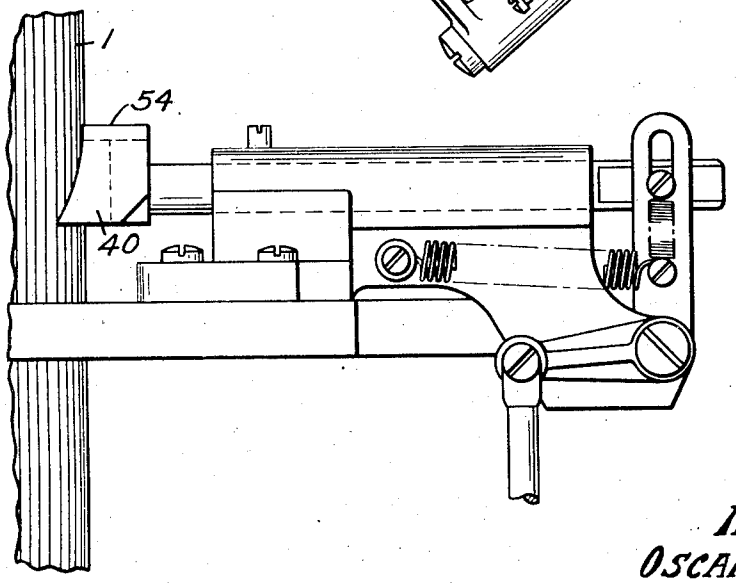


FIG. 44.



INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y

April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 45.

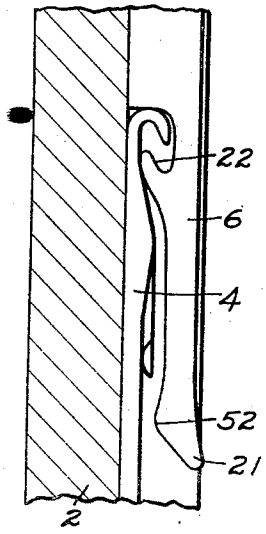


FIG. 47.

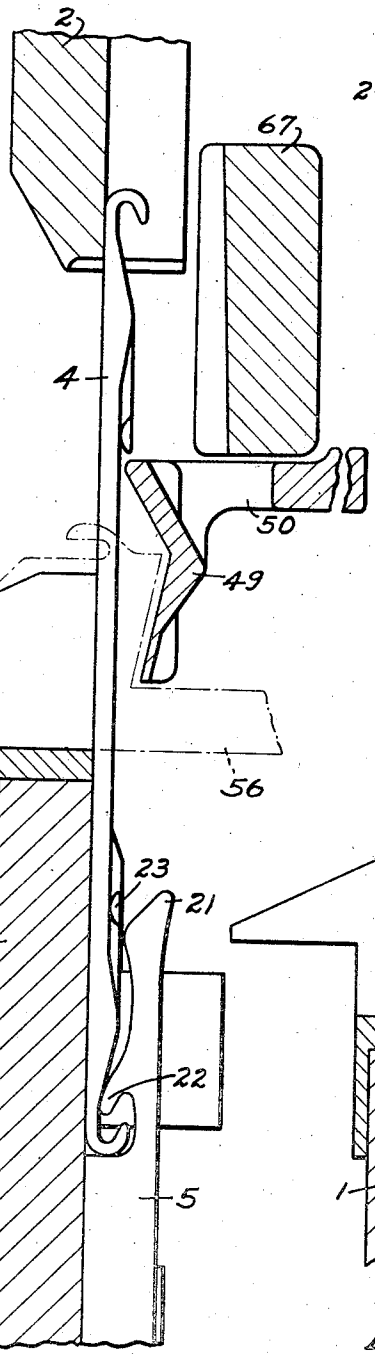


FIG. 48.

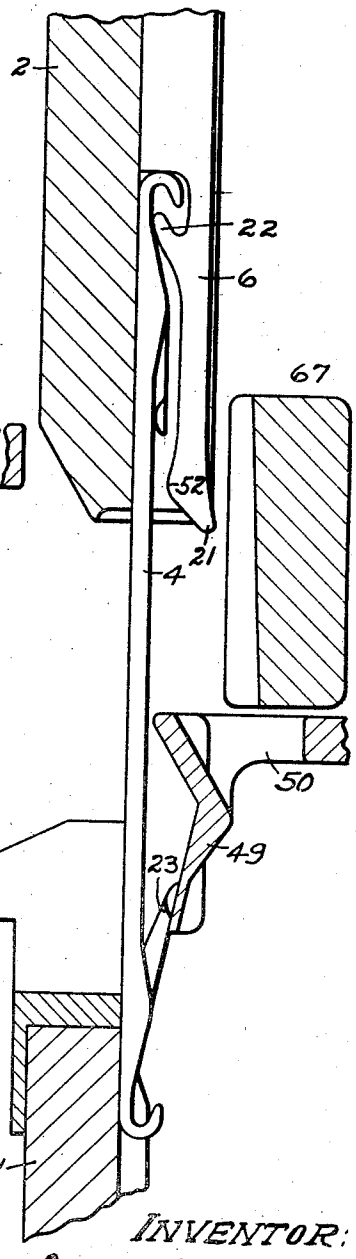
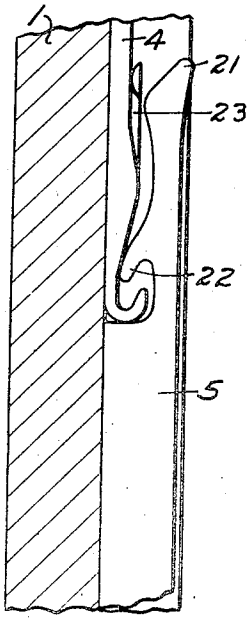


FIG. 46.



INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y.

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FIG. 49.

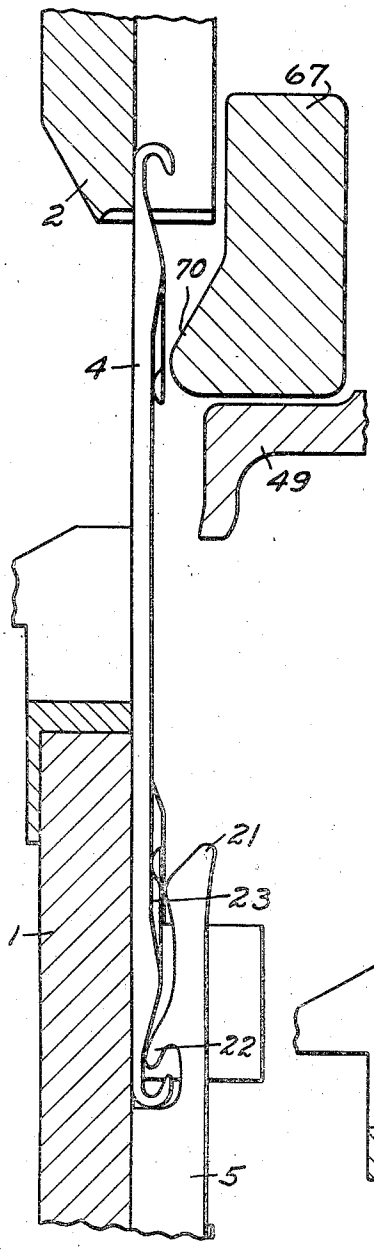


FIG. 50.

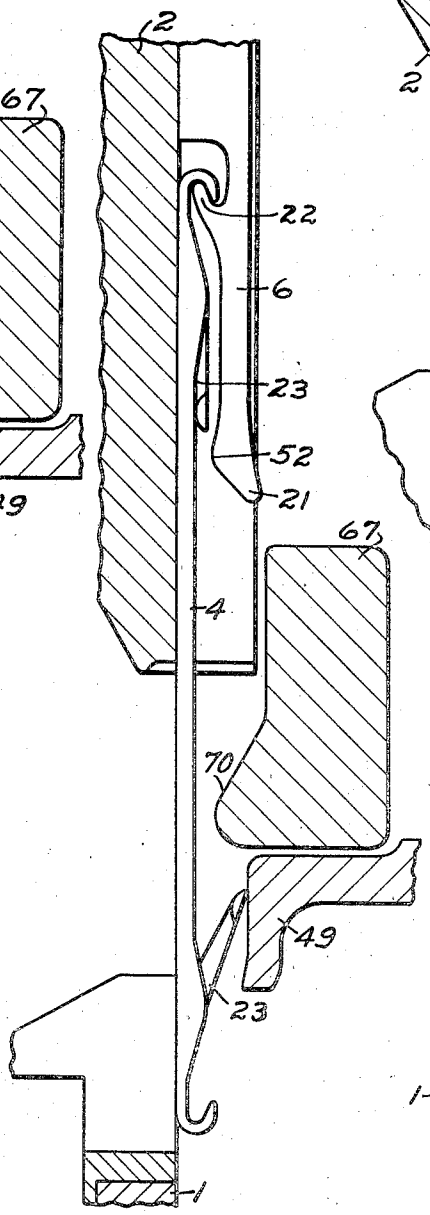
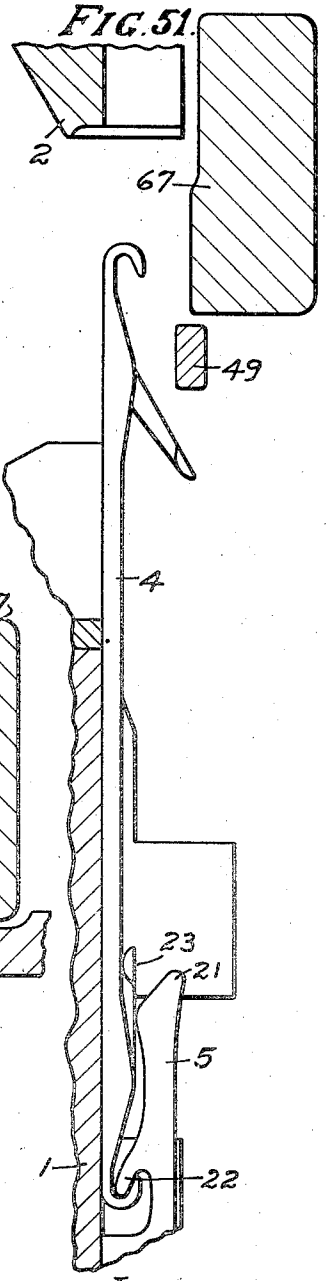


FIG. 51.



INVENTOR:
OSCAR FREGEOLLE,
BY
ATT'Y.

April 27, 1948. O. FREGEOLLE 2,440,333

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FIG. 52

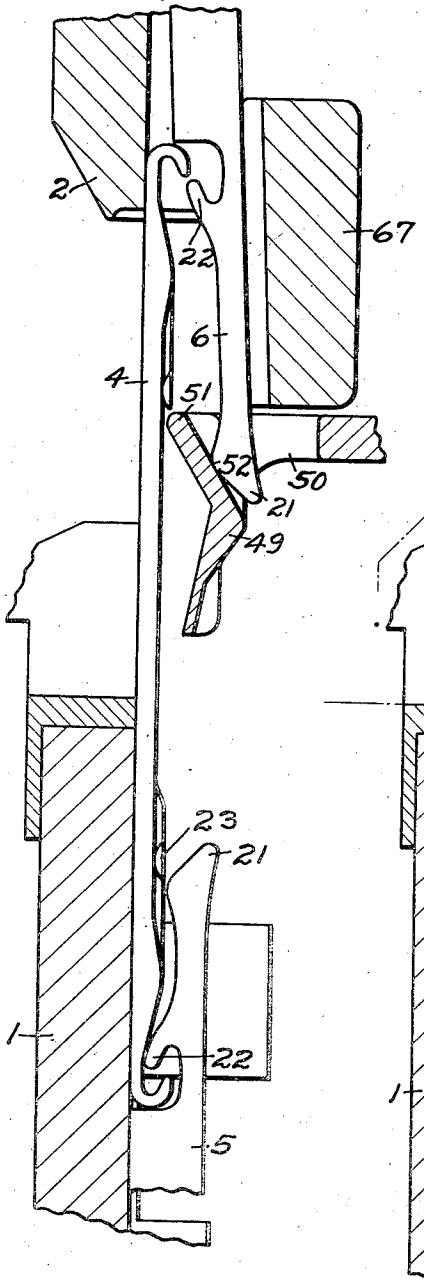
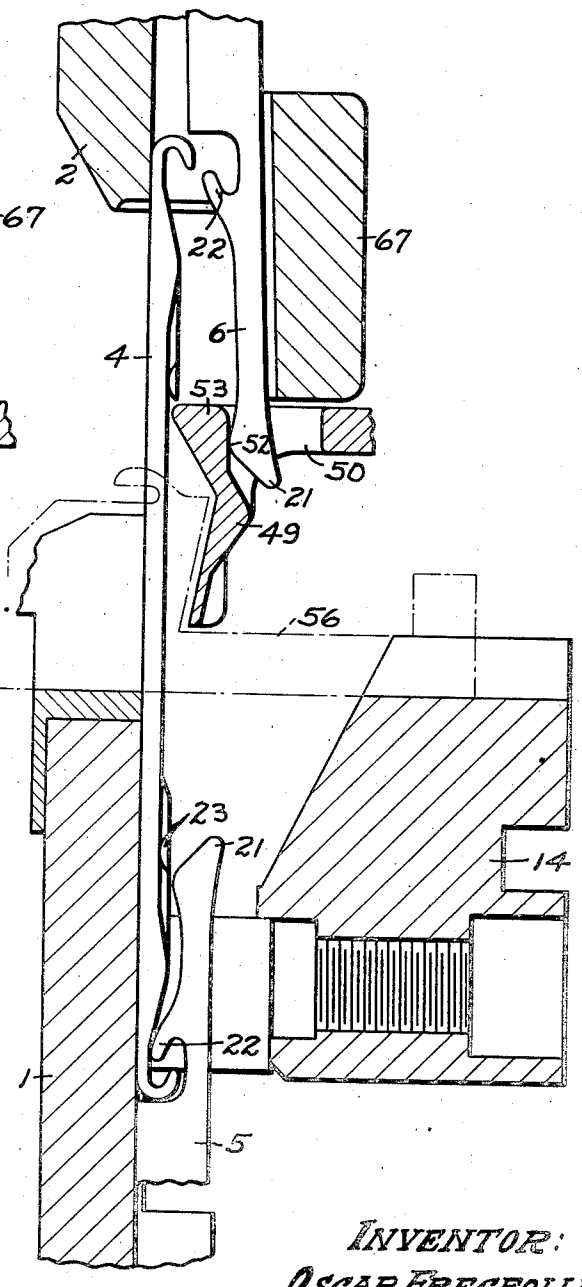


FIG. 53.



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FIG. 54.

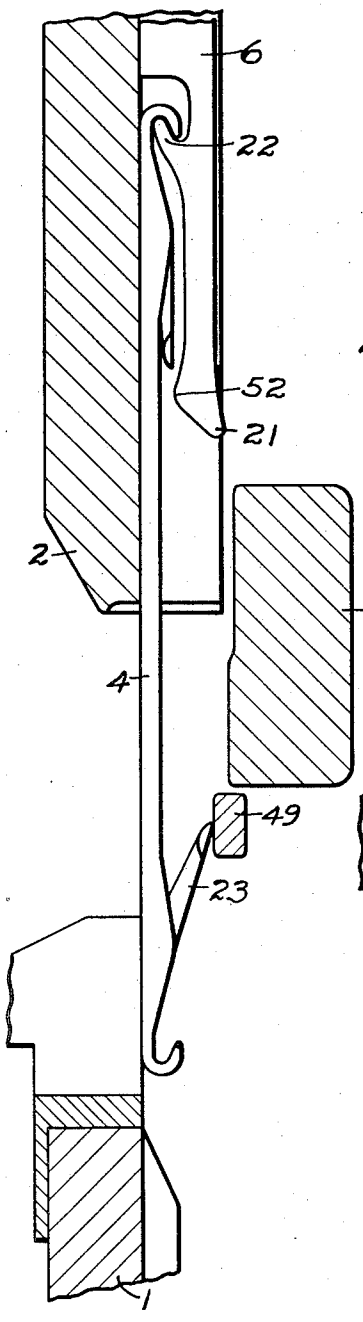


FIG. 55.

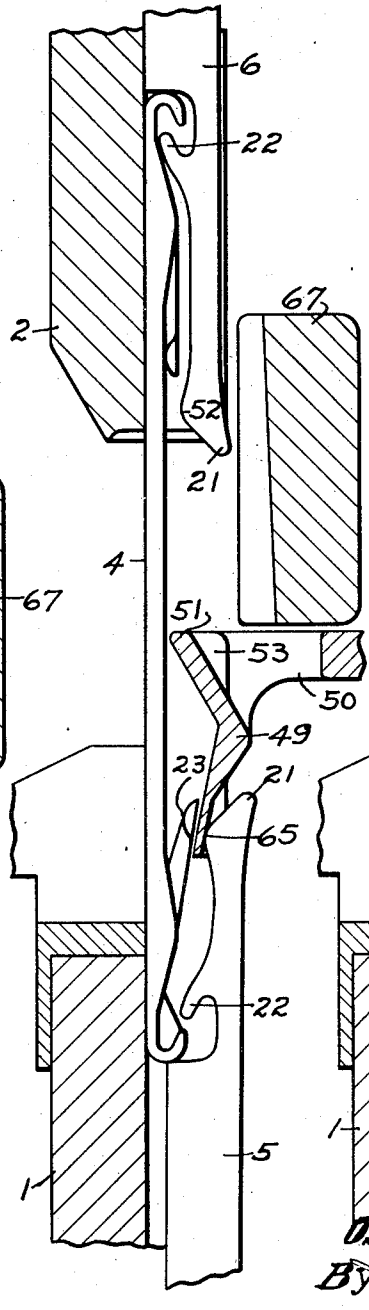
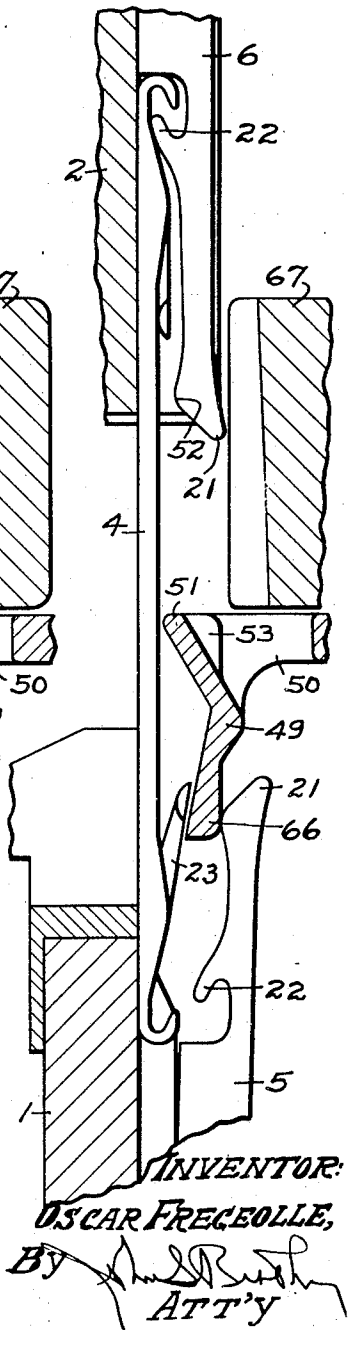


FIG. 56.



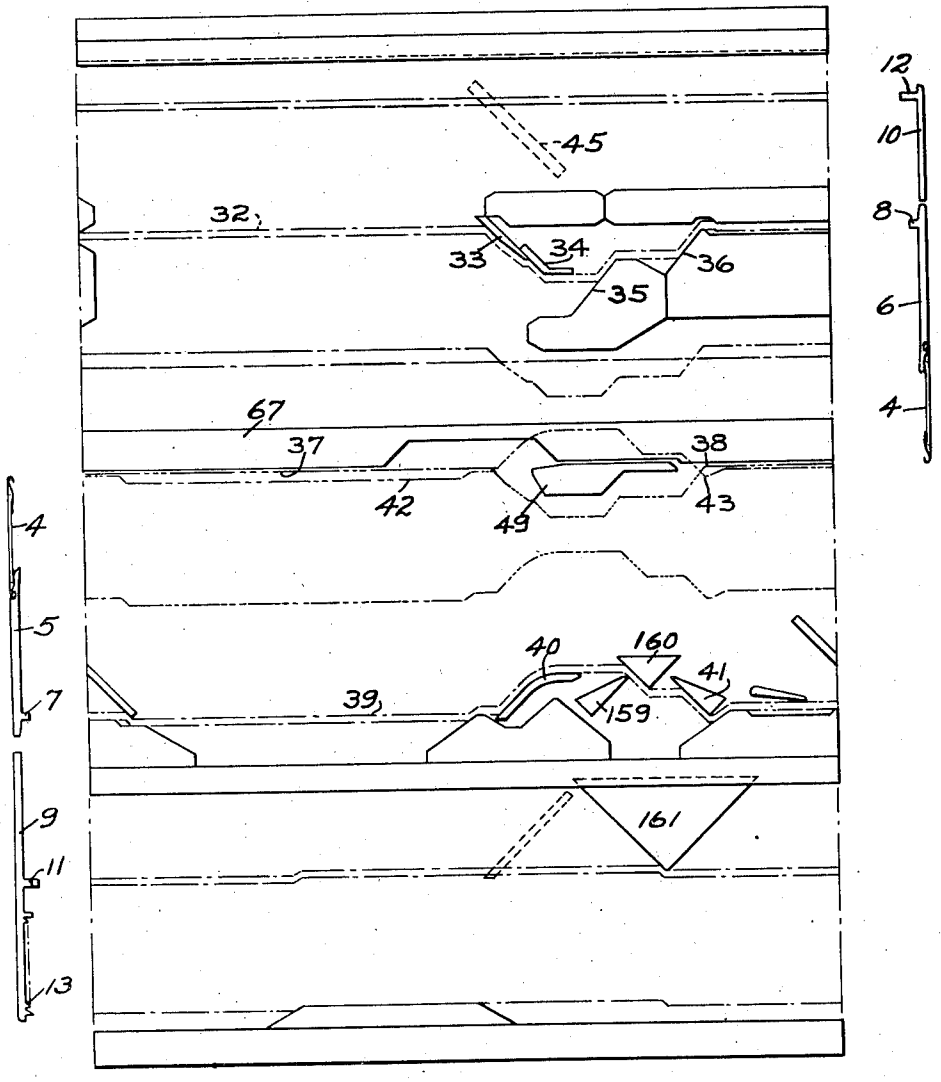
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FIG. 57.



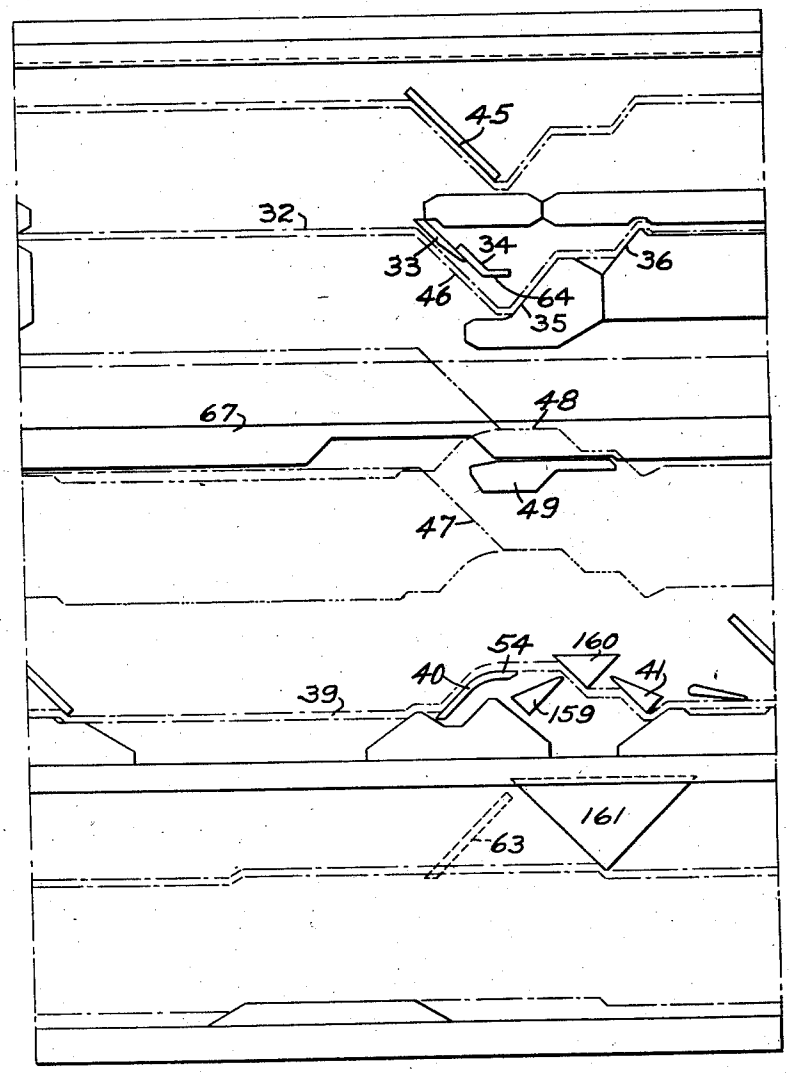
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FIG. 58.



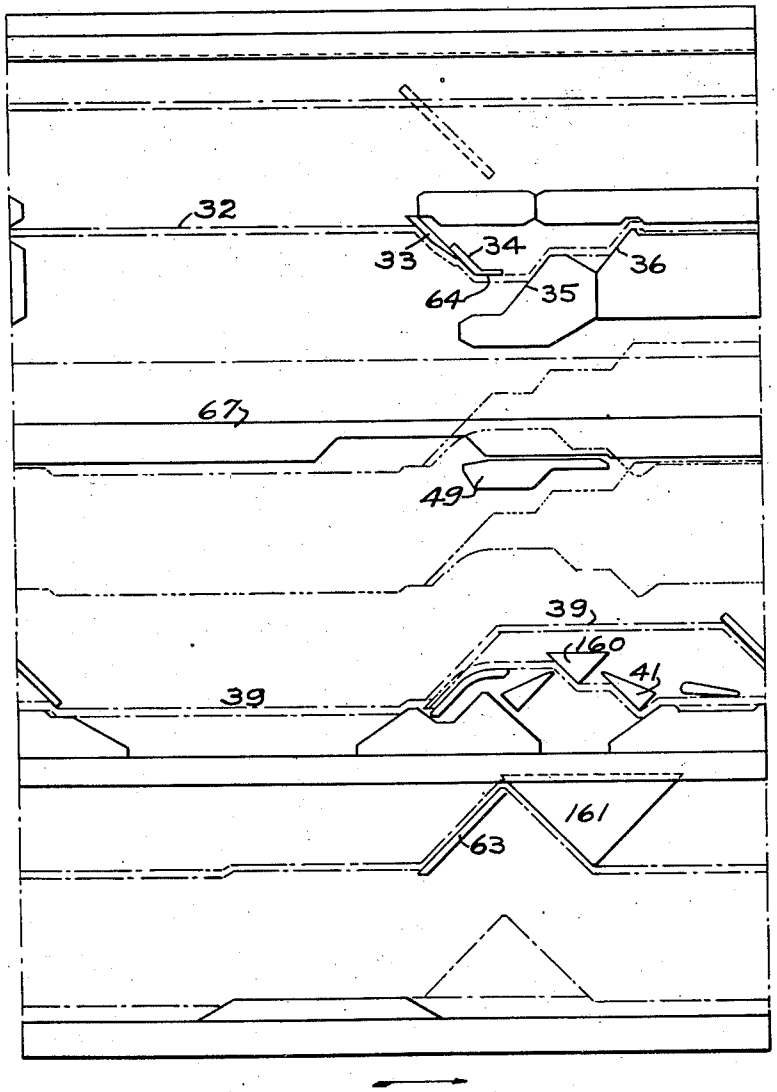
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FIG. 59.



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FIG. 60.

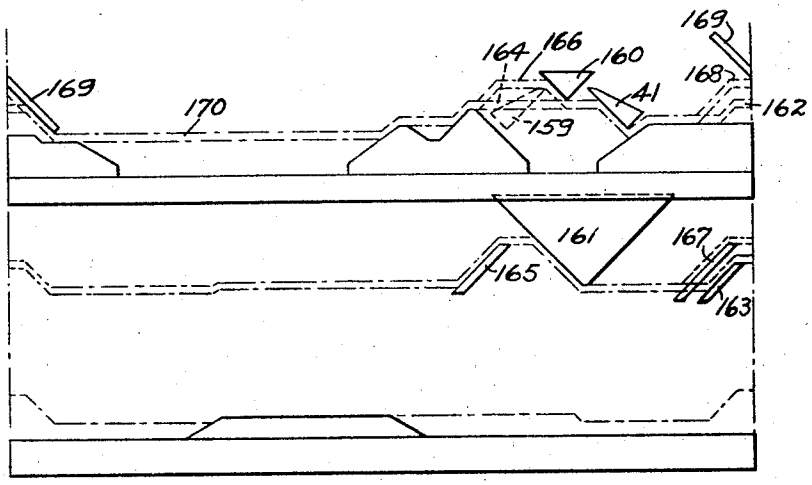
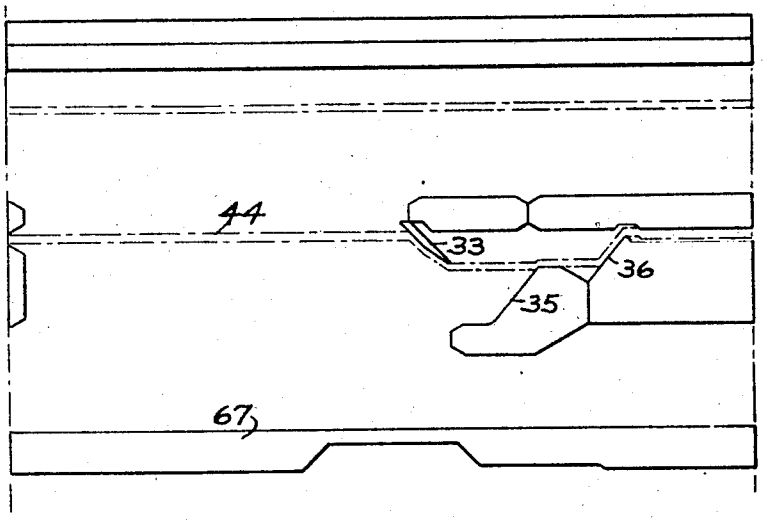


FIG. 61.



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FIG. 62.

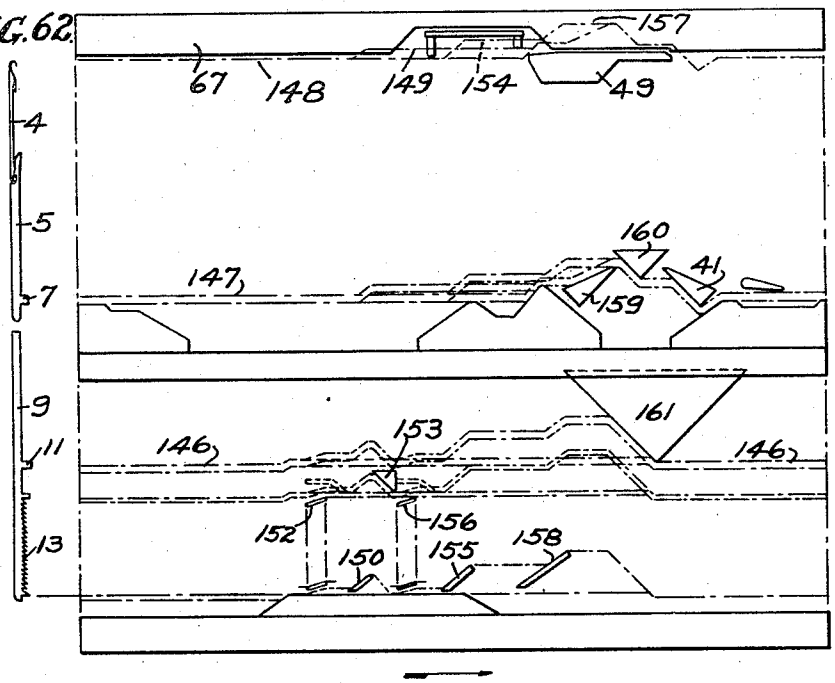


FIG. 63.

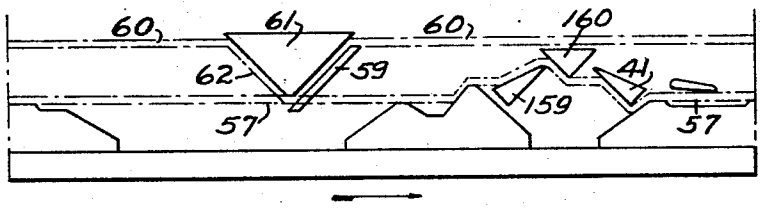
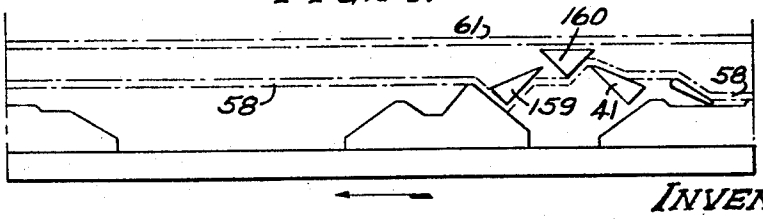


FIG. 64.



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Patented Apr. 27, 1948

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UNITED STATES PATENT OFFICE

2,440,333

KNITTING MACHINE AND METHOD OF KNITTING

Oscar Fregeolle, Central Falls, R. I., assignor to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Original application October 18, 1944, Serial No. 559,136. Divided and this application September 12, 1945, Serial No. 615,810

5 Claims. (Cl. 66—14)

1

This is a division of application for United States Letters Patent #559,136, filed October 18, 1944.

This invention relates to a circular, independent needle, knitting machine having co-axial superimposed needle cylinders with mechanism for transferring needles from one cylinder to the other and utilizing to a large extent the methods and principles of single cylinder machines of the same type.

Generally, in circular knitting machines having co-axial superimposed needle cylinders, the needles are actuated by sliders positioned in the needle slots of both cylinders and provided with butts which co-operate with the knitting cams to cause the needles to draw stitches and with other butts actuated by other cams to effect the transfer of needles from one cylinder to the other.

In the machine of this invention the sliders control the knitting motions of the needles. The transfer of the needles from one cylinder to the other is effected, not by the sliders, but by jacks positioned below and above the sliders in the lower and upper cylinders, respectively, and actuated by jack cams whenever needle transfer is required. The nature and number of the butts on the sliders and jacks depends upon the requirements of the knitting, the method employed and the particular cam arrangements selected.

The machine of this invention is capable of knitting true rib fabric of any desired kind in any desired part or parts of the stocking and to automatically change to plain fabric and back to rib again at any desired point. Also it may be adapted without difficulty as a links-and-links machine.

The invention includes the novel feature of a wrap spindle or device adapted to be positioned eccentrically of the needle cylinders when in operation and concentrically when idle. It also includes a novel needle divider, latch guard and yarn guide for controlling the transfer of the sliders, maintaining the needle latches in proper position and insuring that the yarn is properly fed to the needles. This device also acts as a needle retainer to prevent tilting of the needles when the sliders are being uncoupled.

The machine, as it will be described and as shown in the drawings, is equipped for knitting a 1 x 1 rib top preceded by a weft of a preferred construction which will be described later, for automatically transferring to plain knitting for the leg and the remainder of the stocking. It is also equipped to ornament the leg and instep with true wrap patterns of any desired character and

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is provided with means for plating the entire stocking or any desired part thereof. It is also arranged to knit by the new method by which the yarns are drawn over the backs of the sinkers instead of in the throats and by means of which the quality of plain, plated and wrap fabric has been greatly improved.

As already stated, the mechanisms are to a large extent adapted from single cylinder machine practice. These are in a highly developed state and, as applied to the machine of this invention, are valuable contributions to the capabilities and perfection of machines of the two cylinder type. Contrary to present two cylinder practice the majority of the mechanisms and controls are worked from outside instead of inside the needle cylinders. This adds greatly to the accessibility of many parts, makes adjustments simpler and easier and, consequently, more accurate and provides a far greater space than is available inside the cylinders so that the usual limitations upon the kinds of knitting which can be done, because of lack of space for the necessary equipment, are absent.

In the drawing:

Fig. 1 is a diagrammatic illustration of parts of two stockings produced by what is known as "string work";

Fig. 2 is a large diagrammatic illustration of the welt and true rib top of this stocking;

Fig. 3 is a general view of the mechanism for producing wrap patterns and also of the means for applying tension to the fabric through the heel and toe pocket;

Fig. 4 is a general illustrative view of the machine;

Fig. 5 is a view of a part of the means for operating the wrap mechanism;

Fig. 6 is a view primarily illustrating the means through which these parts and the heel and toe pocket spreader are operated;

Fig. 7 is a view of the two cylindrical driving shafts for the two wrap heads shown in Fig. 3;

Figs. 8 and 9 are plan views of these two wrap heads;

Fig. 10 is a plan view showing the wrap spindle and the means by which the wrap mechanism is supported and moved into and out of operating position;

Fig. 11 is a similar elevation partly in section;

Figs. 12, 13 and 14 are views of fragments of the wrap mechanism support illustrating particularly the means by which its movement may be adjusted;

Figs. 15 to 19 are views of certain cams, the

mounts for these cams and the means whereby they are operated;

Fig. 20 is a diagrammatic plan view of a latch guard;

Fig. 21 is a side elevation of a part of the same latch guard viewed from the inside;

Fig. 22 is a sectional view along the line 22—22 of Fig. 20 of one of the supports of this latch guard;

Fig. 23 is another view of the same support;

Fig. 24 is a section on the line 24—24 of Fig. 20 illustrating the shape of the latch ring at this particular point;

Fig. 25 is a view illustrating the manner in which the latch ring permits the sliders to be uncoupled from the needles;

Figs. 26 and 27 are several views illustrating the manner in which a certain part of the latch ring of Fig. 20 functions to keep the latches open or closed as the case may be;

Fig. 28 is a view illustrating particularly the heel and toe pocket spreader and the device for applying tension to the fabric immediately following these parts independently of the regular fabric tension;

Fig. 29 is an elevation partly in section illustrating this tensioning device and also showing the position of the wrap spindle with respect to it and to the cylinders;

Fig. 30 is a view of a part of a sinker cam cap showing particularly the flopper cam used when the yarn or yarns are drawn over the backs of the sinkers;

Fig. 31 is an elevation partly in section of a mechanism for operating the sinkers for plating and reverse plating;

Fig. 32 illustrates part of a stocking in the leg of which there are alternating panels of rib and plain fabric with reverse plated patterns in the plain fabric panels, these patterns being outlined by wrap patterns produced by reverse spiral wrapping;

Fig. 33 is a plan view illustrating the lower cylinder, the position of the wrap horn and of one type of wrap spindle;

Fig. 34 is an elevation partly in section also illustrating the wrap horn;

Figs. 35, 36 and 37 are views illustrating the manner in which wrap and color-within-color wrap may be produced;

Figs. 38 and 39 are views illustrating another type of wrap head having frangible eyelets useful for producing the wrap patterns in the stocking of Fig. 32;

Fig. 40 is a plan view illustrating primarily the needle divider and associated latch guard, yarn guide and yarn finger and the manner in which they are mounted and operated;

Figs. 41 and 42 are views illustrating the cooperation between the yarn guide and yarn finger in relation to the feeding of the yarn;

Figs. 43 and 44 illustrate a transfer cam, its mounting and operating mechanism;

Figs. 45 to 56 are views showing the manner in which the needles are operated by the sliders, the associated mechanism for controlling these operations and also the means for controlling the needle latches at certain times;

Figs. 57 to 64 are diagrammatic views illustrating the paths followed by the needles, sliders and jacks for producing various types of fabric and the cams associated with these operations; and

Fig. 64 is a view illustrating the manner in which yarn is drawn over the backs of sinkers behind their nibs by needles working in the lower cylinder.

The machine about to be described may be said to correspond, in the two cylinder field to a single cylinder machine of the Banner type. It is capable of doing substantially anything which a single cylinder Banner machine can do with the added capability of making any type or types of true rib fabric because of the presence of the second cylinder. It must be understood, however, that the invention is not limited to two cylinder machines corresponding to single cylinder machines of the Banner type but extends to any type of two cylinder machine to which it is adaptable. Neither is the invention restricted to the relatively simple machine with limited capabilities about to be described.

Generally speaking, the machine follows the conventional two cylinder practice. It has two opposed cylinders 1 and 2 (Fig. 4) in axial alignment adapted to be driven in unison in both rotary and reciprocatory manners by a suitable drive indicated by the gear 3 (Fig. 10). Each cylinder is provided with the usual slots for needles, the slots of one cylinder being in accurate alignment with those of the other. A needle 4 (Fig. 57) for each slot of both cylinders combined is provided having a hook and latch at both ends at usual. Below the space occupied by each needle in the lower cylinder and above the similar space in the upper cylinder is a space for sliders 5 and 6, respectively, (Fig. 57). Each slider is adapted to be engaged with and disengaged from the corresponding hook of the corresponding needle and has an operated butt 7 and 8, respectively.

In the lower cylinder there is a slider for every needle and these are divided into two groups having long and short butts, respectively, corresponding to the usual arrangement of long and short butt needles in single cylinder machines and for the same purposes. The upper cylinder is equipped with sliders only for those needles which are to be transferred to the upper cylinder for knitting the rib top. Since the top is to be 1 x 1 rib every other needle slot of the upper cylinder will carry a slider. The upper sliders are provided with only a single butt in the simple machine being described, but may be provided with additional butts or butts of different lengths and with corresponding cams if more complicated motions are required.

Both cylinders are also equipped with jacks 9 and 10 (Fig. 57) below and above the corresponding sliders. Each of these jacks also has an operating butt 11 and 12, respectively, by means of which the jack and, consequently, the corresponding slider and needle may be controlled. The jacks are utilized to transfer needles from one cylinder to the other and to select needles for other purposes such as wrapping. Consequently, they will be arranged in accordance with the knitting requirements, there being a jack in one cylinder or the other or both for effecting the transfer from one cylinder to the other of the needles which operate in both cylinders at different times and for selecting needles for other purposes. Since the machine illustrated is assumed to be able to knit practically any type of fabric in which needle selection is essential and since all of this knitting with the exception of rib knitting is performed on the lower cylinder, the jacks 9 of the lower cylinder are also equipped with a plurality of selecting butts 13 (Fig. 62) in addition to the operating butt 11 already

referred to by means of which they can be independently controlled in the necessary manner by a suitable selecting mechanism. Frangible saw tooth butts of the type described and claimed in McNaughton Patent #2,058,481 are preferred. By breaking out these butts and associating them with a selecting mechanism in the manner described in this patent practically any desired manipulation of the needles to obtain any sort of pattern by wrapping or any other method can be secured.

Associated with the lower cylinder 1 is a sinker head and cap 14 (Figs. 4 and 29) of the general type employed on Banner single cylinder machines. The specific nature of this sinker head and cap depends upon the kind of work to be done on the lower cylinder. Substantially any sinker head and cap used on a single cylinder Banner machine may be applied to the two cylinder machine described herein without material alteration of the head and cap itself or of the operating mechanism. Since it surrounds the lower cylinder, instead of being inside as is usually the case in two cylinder machines, much more space is available so that many knitting operations can be done which are impossible upon the standard two cylinder machine because of lack of space within the cylinder for the necessary mechanism. Also the entire assembly is much more accessible for adjustment and repair. The sinker head assembly is mounted in exactly the same relation to the lower cylinder as it is in a single cylinder machine and operates in exactly the same way and for the same purposes.

Since the machine of this invention, as shown and described, is equipped for knitting a 1 x 1 rib top, a plain leg, and a plain foot, all, with the exception of the heel and toe, in a rotary manner and, since the knitting of the plain fabric of the leg and foot except the heel and toe is to be knit by the method in which the yarn is drawn over the backs of the sinkers instead of in their throats, a sinker head assembly having sinker cam cap similar to that shown and described in U. S. Patents No. 2,374,857; 2,376,044 and 2,360,668 and also illustrated in Fig. 30 hereof may be employed. As shown in Fig. 30 a flopper cam 15 is provided for moving the sinkers in earlier and further than usual for this purpose. If a more complicated type of knitting, such as 1 or 2 feed split work, is to be done the sinker cam cap such as that shown and described in co-pending application #512,469, filed December 1, 1943, now Patent No. 2,360,668, is suitable. As already stated, this two cylinder machine can utilize substantially any sinker head and cap assembly suitable for a single cylinder machine of the same type.

The machine can best be described in connection with the knitting of the stocking shown in Fig. 1. In the knitting of the top, both cylinders are utilized, otherwise the stocking is knit on the lower cylinder.

As is usual with two cylinder machines, the stockings are knit as string-work since the tensioning effect of a fabric take-up is required during rib knitting. Assuming that the machine has been knitting stockings, such as that illustrated in part in Fig. 1, each completed stocking is followed by several courses of loopers rounds 16 (Figs. 1 and 2). These may be followed by one or more tuck courses 17 which provide a ravel resistant section at the end of the knitting. During the knitting of the last course loops

18 on the needles in the lower cylinder are cast off so that they will not be interlinked with the corresponding loops of the following course. The loops 19 will be interlinked and provide the connection between the finished and the next stocking and also a clearly seen severing course by means of which the stockings can be easily and accurately cut apart.

The tuck courses also provide sufficient resistance against raveling that the necessary tension for the next stocking can be maintained by the fabric take-up through the loops 19.

To start the construction of the stocking shown in the Figs. 1 and 2 the first course of which is indicated at 20 in Fig. 2, the needles are equally divided—alternate needles working in the top cylinder and the remainder in the lower cylinder through sliders 6 and 5 which are connected to the respective needles as shown in Figs. 45 and 46.

As will be seen, the end of each of these sliders 5 and 6 adjacent the needles has a terminal section pointed at its free end 21 and provided with a hook 22 at its inner end adapted to engage the corresponding hook of the needle. In consequence, any needle in either cylinder can be given the required knitting motions through the slider to which it is coupled. This is also in accord with ordinary two cylinder practice. However, note that the end 21 of lower slider 5 is shorter than the end of the corresponding upper slider 6, so that the tip of the lower latch 23 of needle 4 in the lower cylinder is exposed. This is novel and for a purpose which will be explained later.

The first course 20 of the stocking shown in Figs. 1 and 2 is knit on all needles alternating in the cylinders and consequently results in true rib fabric. However, the yarn taken by the upper cylinder needles is not cleared of the latches with the result that the loops are not cast off but are retained in the hooks of the needles when the next course 24 is made resulting in a tuck. The following courses 25 are then knit on the needles of the lower cylinder only. The next course 26 is knit on all needles of both cylinders, again resulting in 1 x 1 rib fabric by knitting alternately through courses 24 and 25. Thereafter, the cycle of courses 20 through 26 is repeated as indicated, Fig. 2. In this manner the welt 27, Fig. 1, is made, the ridged and low portions resulting from this construction being indicated at 28 and 29. It is decorative and also has the elasticity and other characteristics suitable for use with 1 x 1 true rib fabric. It is understood, of course, that this type of welt may be eliminated entirely or altered in respect to the type of stitches employed and the number of courses of each.

After the welt is completed the remainder 30 of the top of the stocking illustrated is completed by the desired number of simple 1 x 1 true rib courses 31 knit by the needles in both cylinders. Thereafter the leg is knit of plain fabric, all of the needles operating in the lower cylinder.

The paths followed by the needles of both cylinders when making plain true rib fabric of which most of the top, as described, is composed, are shown in Fig. 57. As already stated, the needles are operated by the sliders. The needles in the upper cylinder are operated by sliders 6 through butts 8 which follow the path indicated by broken lines 32 in Fig. 57 down cams 33 and 34 and up cams 35 and 36. The

needle hooks follow a corresponding path 37 and knit at 38.

At the same time the butts 7 of sliders 5 in the lower cylinder are moving along the path 39 to pass over raise cam 40 (Figs. 43, 44 and 57) and under stitch cam 41. The hooks of the needles in the lower cylinder operated by these sliders follow the path 42 and knit at 43, a point which corresponds to the lowest point of stitch cam 41.

To make the tuck courses, such as 17 and 24 (Fig. 2), the knitting operation is similar with the exception that cam 34 is pulled out by suitable mechanism (Figs. 4, 15–19), the path of the butts 8 of sliders 6 then being that shown at 44 in Fig. 61. Because of the removal of cam 34, the needles in the upper cylinder do not move down far enough to clear the latches so that after a new yarn is taken both yarns are retained in the hooks and are not knit. Before the next course is knit cam 34 is moved in again so that the upper cylinder needles knit, as shown in Fig. 57 to complete the tuck.

Courses, such as 25, are knit by the lower cylinder needles only. For this purpose both cam 33 and cam 34 are pulled out so that the needles of the upper cylinder are not lowered and, consequently, do not take the yarn. Mechanism for this purpose is shown in Figs. 4, 15–19.

Following the completion of the true rib top, the leg of plain, non-rib fabric is made by knitting the full complement of needles in the lower cylinder. Therefore, the needles in the upper cylinder must be transferred to the lower cylinder before the first course of the leg is knit. This transfer is accomplished by upper cylinder jacks 10, the butts 12 of which engage cam 45 (Figs. 4, 15–19 and 58) which has been moved into operating position. Consequently, the sliders 6 and the needles to which they are coupled move downward along paths 46 and 47, respectively. At the same time lower cylinder sliders 5, moving along the regular knitting path 39, pass over cam 40 raising the lower cylinder needles a corresponding amount as indicated at 48. The transferred needles are now in the position shown in Fig. 52 which corresponds exactly to the position of the needles which have been working in the lower cylinder and which required no transfer as shown in Fig. 47.

During the transfer, the needles transferred are coupled to the lower sliders 5 and uncoupled from upper sliders 6 by which they have been operated up to this time. This is accomplished by needle divider 49 (Fig. 52). Needle divider 49 is provided with an opening 50 through which the ends 21 of slider 6 can pass and a relatively thin lip 51 adjacent and substantially concentric with the lower cylinder. This lip is so shaped that, as a slider 6 moves down under the influence of a jack 10, its end 21 will pass over lip 51 and through opening 50. The enlargement 52 just back of point 21 of slider 6 engages with lip 51, which becomes progressively thicker as shown at 53 in Fig. 53, acts as a cam to swing slider 6 away from the cylinder and disengage hook 22 from the corresponding needle hook. At the same time the lower hook of the needle has engaged the lower slider 5, swung it outward and let it snap back into the hook as shown in Figs. 52 and 53. During these operations the lower sliders are riding upon the horizontal surface 54 of cam 40 (Fig. 58) and the downward travel of the upper cylinder jacks 10 and sliders 6 caused by jack cam 45, is such that, at its completion, the distance between the hooks of the corresponding upper and lower cylinder sliders is equal to the length of the needle 4.

The upper cylinder jacks and sliders are immediately raised again by slider cams 35 and 36 to a high position where they will not interfere with the operation of the needles by lower sliders 5. The slider 6 is prevented from becoming coupled to the upper hook of needle 4 again by needle divider 49 which has the shape shown in Fig. 53 in this area.

There is now a needle in each slot of lower cylinder 1 each coupled to its slider 5. The plain fabric leg 55 is now knit on all of the needles which function with the sinkers in a manner identical with that of a single cylinder machine. As heretofore stated, the yarn is drawn over the backs of sinkers instead of in the throats to take advantage of the great improvement in uniformity of loops and of fabric structure, wrap and plating made possible by this method of knitting. The method is fully described in U. S. Patents No. 2,374,857; 2,376,044; 2,360,668 and application #549,157, filed August 19, 1944, now Patent No. 2,402,744. It will be sufficient to say here that the yarn is drawn over the backs of the sinkers instead of in the throats by moving the sinkers in further and sooner than usual, and that the previous loops drawn in the same way and transferred to the throats of the sinkers over the tops of the nibs are cast off by the sinkers while the newly drawn yarn is still over their backs. Consequently, the newly drawn comparatively unstable loops are not involved in or affected by the casting off operation. Because of the manipulations undergone, alternately, by the needle and sinker loops, a very perfect plain fabric and greatly improved wrapped patterns and plating are obtained.

This method of knitting is illustrated by Fig. 65 which shows diagrammatically the relative positions of two sinkers 171 and 172, the intermediate lower cylinder needle 173 and three courses of knitting 174, 175 and 176, respectively, at approximately the completion of the draw for the third of these courses. This represents plain fabric or the outstanding wales of rib fabric. As will be seen, the needle loops of course 174 have been completed and cast off. The needle loops of course 175 have been interknit therewith and the sinker loops of this course are in the throats of the sinkers. Consequently, when the sinkers are moved forward to cast off the needle loop of course 175, these sinker loops will be carried forward also and will move the intervening needle loop inwardly beyond the vertical travel of the needle 173. Meanwhile, the sinker loops of course 176, the needle loops of which have been drawn through the needle loops of course 175, remain on the backs of the sinkers and are not affected by the casting off operation. The newly drawn sinker loops can and generally do remain on the backs of the sinkers until the knitting cams are again approached for the next course at which time the sinkers are drawn back sufficiently to transfer these sinker loops from the backs to the throats of the sinkers.

To draw the yarn over the backs of the sinkers in this way it is necessary to move the sinkers in further and sooner than usual. For this reason, a flopper sinker cam 15 (Fig. 30) is provided. When this cam is swung in to the position shown in Fig. 30, it supplants the usual cam during the drawing of the yarn. When this flopper cam is

out of action, the usual sinker cam operates in the usual way.

These things are made possible by the use of a sinker head assembly external of the needle cylinder. As previously stated, practically any sinker head and cap assembly used on a single cylinder machine of the same type can be applied to this machine without difficulty and advantage taken of the high state of perfection which these devices have reached. The patents and application referred to above disclosed sinker head and cap arrangements suitable for this machine. These operate in the same way and may be operated by the same or similar mechanisms. The sinkers themselves 56 may be the same with the exception that it may be necessary to cut away the extreme backs as shown in Figs. 31, 47 and 53 to accommodate the needle divider 49. However, this part of the back of the sinker has nothing to do with the drawing of the yarn.

The needles are, of course, guided by lower sliders 5 the butts 7 of which follow the path 57 (Fig. 63) through the knitting cams. The foot, with the exception of the heel and toe, is knit in the usual rotary manner by all of the needles operating in the lower cylinder. The heel and toe are, of course, knit in the reciprocatory manner, also as usual. The path followed by the butts 7 of the short butt lower sliders 5 which guide the needles during the knitting of the heel and toe are shown at 57, 58 and in Fig. 63 and 64. At the beginning of the heel or toe cam 59 is moved in to raise the long butt sliders so that they will follow path 60 above the knitting cams. At the completion of the heel or toe cam 61 is moved in and cam 59 retracted to bring the long and short butt needles down again into the normal knitting path 57 as indicated at 62 in Fig. 63.

After the completion of the toe the usual loopers rounds 16 may be knit by all the needles operating in the lower cylinder after which alternate needles are transferred to the top cylinder for the knitting of tuck stitches such as those shown at 17 in Fig. 2.

The process of transferring alternate needles to the upper cylinder from the lower cylinder is substantially the reverse of that already described. The needles coupled to lower sliders 5 are raised by jacks 9, butts 11 of which move up on cam 63 (Fig. 59). At the same time upper cylinder sliders 6 are brought down by cams 33 and 34 onto the flat portion 64 of cam 34. The continued upward movement of the lower cylinder needles and sliders under the control of jacks 9 and cam 63 cause the hooks of the upper sliders to engage with the hooks of the needles. The lower cylinder sliders 5 have now been uncoupled from the needle because the narrow edge 65 of needle divider 49 has entered between the needle latch and the slider and has disengaged it from the needle as the sliders move along the constantly thickening contour of needle divider 49 as shown at 66 in Fig. 56. It is because the tips 21 of the lower latches 23 of the needles 4 are exposed by the shortness of the ends 21 that the narrow edge of the divider 49 can operate as just described and the latches can be held open by the needle divider 49. The lower cylinder jacks 9 immediately move down again leaving the lower cylinder sliders 5 to continue along path 39. Simultaneously, the needles transferred to the upper cylinder are moved upward by cams 35 and 36 acting upon upper sliders 6 so that they cannot again be engaged by the lower cylinder sliders 5. Therefore, these needles

are now coupled only to the upper cylinder sliders 6 and, consequently, are arranged to knit in the upper cylinder only.

Knitting then proceeds on both cylinders to form courses 17 (Fig. 2) as previously described with respect to similar courses 20. Separating course is then formed by knitting in a similar manner on both cylinders with the exception that the yarn taken by the lower cylinder needles is run off. In consequence, the finished fabric is attached to the succeeding stocking only by the loops 19. This construction, as already explained, provides a severing course which can be accurately located with ease and also a sufficient degree of run-resistance to prevent material from unravelling even though the loops 19 are under the usual tension from the fabric take-up. The knitting of the stocking is then complete. It will be understood, of course, that the construction of the stocking may be varied in any desired way. The method of knitting will vary to correspond but, essentially, it will follow that described above.

Immediately above the needle divider and extending entirely around the cylinder is another latch guard 67 (Figs. 20–23). This is a ring having a continuous inner surface with the exception of the part immediately above and adjacent the needle divider. Here the ring is broken by an offset portion 68. The normal circle of the ring is complete, however, by two or more springs 69 extending across the broken part and immediately above the needle divider 49. These springs serve the same purpose as the rest of the ring for controlling the latches but are resilient and give outwardly to permit the sliders to be disengaged from the needles as shown in Fig. 25.

Latch guard 67 keeps closed the latches of the needles working in the upper cylinder at all times except when they are passing by the needle divider 49 and for a short distance on either side thereof. In these two spaces the latches are freed, first to permit them to be opened by the loops as they pass from the hooks to the shanks and then to permit them to be closed by these same loops when they are cast off and the new loops drawn. While the needles are passing by the needle divider the latches which have been opened as just described are kept open by it. With respect to needles working in the lower cylinder no particular latch problem is presented since it is immaterial whether they are open or closed until the point is reached where the yarns are transferred from the hooks to the shanks of the needles. At this point the yarns will open the latches after which they are kept open by latch guard 67 until just before the knitting point is reached.

There is also danger that, when the needles are moving down, the latches may strike the top of needle divider 49 and be damaged. To prevent this the corresponding part of latch guard 67 projects inwardly as at 70 so that the needle latches are kept completely open and cannot strike the top of needle divider 49 (see Figs. 20, 24 and 49). In short, latch guard 67 and needle divider 49 function to keep the needle latches open or closed as the case may be whenever such control is required. The manner in which springs 69 operate for this purpose under five different conditions is diagrammatically illustrated by Figs. 26 and 27.

As a further precaution against damage to the needle latches the ends 71 and 72 of latch guard 67 at offset portion 68 are bevelled in both directions so that if any latch of any needle assumes

a more or less horizontal position while passing across springs 69 it will be closed as the case may be depending upon whether it is above or below springs 69.

Needle divider 49 is positioned close enough to the cylinder to serve as a needle guide and support when a needle is being uncoupled from a slider. At that time, the needle is retained in its slot by the other slider in the other cylinder only so that it is very possible that, when the slider to be uncoupled is swung out for that purpose, it will tend to carry the needle with it to some extent. This is effectively prevented by needle divider 49 because of its close proximity to the cylinder (see Figs. 52, 53, 55 and 56).

At the right end of needle divider 49 is an extension 73 (Figs. 40, 41 and 42) in the form of a horn substantially concentric with the cylinders and tapering to a point. By this the needle latches are kept open after they have passed beyond the needle divider proper. Also this extension cooperates with yarn finger 74 to insure that the yarn is properly fed to the upper cylinder needles. With the exception of when rib knitting is being done yarn finger 74 is in the relatively high position shown in Fig. 41 and needle divider 49 is drawn out of operating position away from the needle cylinder. Before rib knitting is begun needle divider 49 is moved in and yarn finger 74 is moved down to the lower position shown in Fig. 42 which will insure that the yarn is fed low enough to be within the latches of the upper cylinder needles.

When yarn finger 74 is in this low position the yarn is deflected slightly downward and outward by horn 73 to obviate any possibility that it will engage a needle above the tip of its latch and be cast off instead of being taken in the hook. Similarly, when rib knitting is completed yarn finger 74 is raised again to its high position (Fig. 42) and needle divider 49 retracted. During these movements the yarn may engage with the underside of horn 73 but will slip from its end and feed above the horn directly to the needle as shown in Fig. 41.

Needle divider 49 and yarn finger 74 may be operated by any suitable mechanism indicated by 77 and 75 in Fig. 40 properly timed for the requirements. The mechanism for moving needle divider 49 into and out of operating position is indicated in Figs. 4 and 40 at 76—80.

As is well-known, tension must be maintained upon the fabric while rib knitting is in progress in order that the loops may be properly cast off from the needles. Generally speaking, any suitable type of fabric take-up may be employed for this purpose. However, the knitting of the heel and toe pockets introduces unsymmetrical portions of fabric which completely eliminate the possibility of uniform tension being applied to the fabric immediately succeeding them by the usual fabric take-up means. Consequently, a supplementary take-up device should be used to apply tension to the heel and toe pockets so that the immediately succeeding fabric may be properly tensioned at all points.

A form of supplementary take-up of this character is shown in Figs. 3, 28 and 29. It consists of a disc-like pocket spreader 81 mounted on the end of a rod 82 extending from the uppermost part of the machine through tubular shafts 83 and 84 within housing 85. Normally rod 82 is maintained in its uppermost position, that shown in Fig. 3, by a spring 86. In this position, spreader 81 is inoperative.

Associated therewith is the supplementary fabric take-up proper 87 (Figs. 28 and 29). This consists of a ring 88 longitudinally movable within the lower cylinder 1, provided with inwardly projecting needle-like points 89 adapted to engage with the fabric of the heel or toe pocket. Ring 88 is mounted on a rod 90 by which it is moved up and down by suitable mechanism. In spreader 81 are V-shaped recesses 91 adapted to register with points 89 as shown in Fig. 28.

Registry is maintained through a pin 92 (Figs. 4, 5 and 6) mounted in a ring 93 (Figs. 4, 5, 6, 10 and 11) vertically slidable on housing 85 and projecting through a slot in this housing so as to engage a recess 94 in rod 82. This recess is of sufficient length to permit rod 82 to move up and down the required distance but will prevent it from turning independently of housing 85. Spreader 81 and supplementary take-up 87 rotake with the cylinders, consequently, their relative positions in this respect are constant.

When the heel pocket is completed rod 82 is caused to move downward against spring 86 by suitably timed operating means, indicated in Fig. 3 by the lever 95, to engage spreader 81 with it. This spreads the pocket 96 substantially as shown in Fig. 29. Thereupon supplementary fabric take-up 87 moves up from a low position, passes along the outside of toe pocket 96 to substantially the position shown in Fig. 29, the points 89 penetrating the fabric of the toe pocket. Then spreader 81 is permitted to move upward again to its inoperative position and take-up 87 is released to descend of its own weight, supplemented by a spring, if desired, as the subsequent knitting progresses and maintaining tension upon the fabric above the toe pocket.

When the supplementary take-up has reached a low position it is released, the tension then being maintained by the regular fabric take-up. After the toe pocket is completed the same procedure is repeated to maintain tension on this side of the fabric subsequently knitted.

During both of these operations the rest of the fabric such as that of the leg passes through the arcuate slit 97 forming an extension of take-up 87 on the side opposite points 89. This fabric is tensioned throughout by the regular fabric take-up. Through the cooperation of the regular and auxiliary take-ups an adequately uniform tension is maintained on the fabric at all points to insure perfect knitting.

The pocket spreader 81 also serves to keep the heel pocket out of the way of the wrap heads and wrap yarns when they are in operation.

The auxiliary take-up just described is a modification of that shown in U. S. Patent #2,068,605 to which reference may be had for a more detailed description of its general characteristics and mode of operation. Except for the heel spreader 81 and its operating mechanism the take-up may be considered as substantially identical in construction and in operation to that of this patent. Attention is called to claims 3, 4 and 8 of the patent referred to which are believed to cover broadly the supplementary take-up of this invention.

Plated fabric can be produced on this machine by following the procedure outlined above. The two yarns may be fed by the single yarn lever 74 as is shown in Fig. 40 or by separate yarn levers, the angle between the two yarns in either case being correct to insure proper relative placement of the two yarns. Preferably, the method followed for producing plated fabric is that already

mentioned in which the yarns are drawn over the backs of the sinkers instead of in the throats as heretofore briefly described and as fully described in U. S. Patents Nos. 2,374,857; 2,376,044; 2,360,668 and, particularly, in co-pending application #549,157. Briefly, this permits the yarns to be fed directly to the needles in their correct relative order so that accurate placement is positively insured and the loops are cast off by engagement of the sinker throats with them only and not with the comparatively unstable, newly drawn loops. These are still on the backs of the sinkers and are undisturbed by the casting off operation.

Also the yarns may be fed higher above the latches than heretofore so that all danger of cutting or fraying when the latch is closed is eliminated.

As fully explained in the U. S. patents and co-pending application referred to this method of knitting produces a fabric having a greatly improved and more uniform structure both with respect to individual loops and to the fabric in general so that the plated fabric is also much more perfect than heretofore.

If reverse plating is desired, other means is required. For the purpose of this description the machine is provided with Banner 12 step reverse plating equipment. This is fully illustrated and described in Patent #2,052,777 and is also illustrated in Fig. 31 hereof. With this device the sinkers are operated in the usual way by the usual cams to produce plated fabric, the yarns being drawn in the throats of the sinkers. Each sinker 56 is supported by a jack, two of which are shown at 98 and 99 in Fig. 31, by means of which it is operated for reverse plating. Jack 98 is in inoperative position during which the sinkers are controlled directly by the usual cams. For reverse plating, the jacks are moved in by suitable selectors and ride up on cam 100, so that butts 101 engage with cam 102 as indicated by jack 99. These cams impart to the jacks and, through them, to the sinkers, the necessary movement for reverse plating. By providing each sinker with a jack and selecting the jacks by a suitable mechanism the position, extent and character of the reverse plated areas are controlled at will.

The terms plating and reverse plating should not be misunderstood. Heretofore, plating in which the yarns are drawn either in the throats of the sinkers or over the front slope of the nibs has usually been referred to as normal plating whereas for reverse plating the yarns have been drawn over the back slopes of the nibs. However, since the terms plating and reverse plating are merely relative indicating the reversal of the yarns either kind of plating may be termed normal or reverse. Thus in the present case, if the stocking as a whole is knit by the suggested method in which the yarn is drawn over the backs of the sinkers, normal plating would also be carried out in the same way, reverse plating being obtained by any suitable method such, for example, as that disclosed for normal plating in Patent #2,299,797. This difference in phraseology should be remembered with respect to this patent and other prior patents on the same subject.

One type of plated and reverse plated stocking is shown in Fig. 32. In this the normally plated area may include the true rib top 103 and plain and rib panels 104 and 105 in the leg and foot. If the suggestions given above are followed, normally plated areas 104 in the leg and foot will be knit over the backs of the sinkers. Reverse plated areas are indicated by the diamonds 106. These may be of the same or different colors.

Fig. 32 also illustrates the possibility of combining true rib and plain or plated fabric in the leg and foot. To knit this combination of rib and plain fabric needle selection is required, those needles knitting the rib portions being equally divided in alternation between the upper and lower cylinders and the rest being in the lower cylinder. The manner in which such needle selection is secured and the way in which they are transferred from one cylinder to the other through the agency of jacks, such as that shown in Fig. 62, has already been described. Fig. 32 illustrates the possibility of outlining the reverse plated areas with wrap patterns 107. In fact, any desired wrap pattern may be included with or without plating and reverse plating if suitable methods are followed.

The mechanism illustrated for producing wrap patterns has wide possibilities including the making of the so-called reverse spiral wrap such as that shown in Fig. 32 outlining the reverse plated diamonds. As shown in Fig. 3 the machine is provided with two tubular shafts 83 and 84 rotatable within housing 85 terminating at their lower ends in disc-like heads 108 and 109, respectively. Shafts 83 and 84 are provided with spiral slots 110 and 111, respectively, one being the reverse of the other as shown in Fig. 7. Pin 92 on vertically slidable ring 93 passes through spiral slots 110 and 111. Therefore, by moving pin 92 up or down by means of ring 93 heads 108 and 109 can be made to rotate in both directions but always in opposite directions.

A wrap spindle of this type is suitable for producing the double spiral wrap outlines of the diamonds shown in Fig. 32. Its scope is, in fact, much greater than this. It can produce double spiral wrap patterns entirely around the stocking. The manner in which such a spindle operates is fully described in Patent #2,230,213 to which reference may be had.

The vertical movement of ring 93 just described is obtained by means of a pivoted yoke 112 (Figs. 4, 5, 6, 10 and 11) operated at the required times by suitable mechanism indicated by the rod 113 (Figs. 10 and 11). Housing 85 and, consequently, the wrap spindle are driven in a 1 x 1 relation to the cylinders through gears 114, 115, 116 and 117. When the wrap spindle which passes down through the upper cylinder as will be seen from Figs. 4, 10 and 11 is idle, it is substantially concentric with that cylinder.

When it is to operate to produce wrap patterns, it is swung into the eccentric position shown in Fig. 10 in which heads 108 and 109 are in the usual position overlapping the needle circle occupied by eccentric wrap spindles in single cylinder machines. This horizontal swinging of the wrap spindle is effected without disengaging it from gears 114—117. It simply swings in a concentric arc around gear 116. When swung into concentric position, obviously, its timing will be altered but it is then inoperative so that this is immaterial. When it is swung again into the eccentric operating position its timing is restored.

The means for swinging the wrap spindle in this way includes yoke 112 which besides being pivotally mounted for vertical movement, is also mounted on hub 118 swingably mounted on post 119 concentric with gear 116. Hub 118 is provided with arm 120 by means of which it is swung

through suitable operating mechanism indicated by the lever 121 in Figs. 4, 10 and 11.

Gear 117 is rotatably and swingably supported by a plate 122 integral with or attached to hub 118 and resting in a fixed arcuate guide 123 (Figs. 3, 4, 10, 11, 12, 13 and 14). Guide 123 is provided at each end with adjusting screws 124 and 125, respectively, by means of which the concentric and eccentric positions of the wrap spindle can be adjusted.

In fact, plate 122 supports the entire wrap mechanism shown in Fig. 3 including the wrap spindle proper, the bobbin support 126, wrap yarn take-up mechanism 127 and, in addition, the heel and toe pocket spreader already described. All of these elements swing as a unit with plate 122.

A wrap horn such as that shown at 128 in Fig. 33 is provided for the usual purpose. This is supported upon a rod 129, Figs. 4, 10, 11, 33 and 34, extending through upper cylinder 2 and terminating in an offset bracket 130 (Figs. 4 and 11) connected to a short downwardly projecting shaft 131 which passes through a fixed sleeve 132. Shaft 131 is slidable in sleeve 132 but is prevented from turning by screw 133 passing through a slot 134 in the sleeve. Shaft 131 is urged downwardly by spring 135. When in its downward position horn 128 is in position to cooperate with the wrap spindle to produce wrap patterns. Shaft 131 and, consequently, rod 129 and wrap horn 128 can be moved upward by suitable mechanism operating against the end of shaft 131 indicated in Fig. 11 by the numeral 136 to move the wrap horn up out of the way at any time when wrapping is not being done.

Another wrap spindle of several which may be used for introducing wrap patterns in plain or plated panels such as that shown at 104 in Fig. 32 in an otherwise true rib stocking is illustrated by Figs. 38 and 39. Here, as before, there are two wrap heads 137 and 138 one smaller than the other mounted in the same positions on tubular shafts 83 and 84, respectively. In this instance, however, the several eyelets or yarn guides 139 are at the extremities of frangible tongues 140 any number of which can be broken out, the construction suggesting that of the frangible butts on several well-known types of jacks. By breaking out all of these tongues with the exception of a few at opposite sides of each head the wrap spindle can be kept in wrapping position for making wrap patterns in the non-rib side panels of a stocking such as that shown in Fig. 32 without interfering with the needles when they operate in both cylinders to knit the true rib parts 105 alongside. If desired, double spiral wrap can be produced by this spindle, the two heads being shogged in opposite directions in the same way and by the same mechanism described above. For other types of wrapping one of the heads 137 or 138 can be used alone.

Color within color wrapping can also be performed in the usual way. For example, a head such as that shown at 141 in Figs. 33, 35–37 may be employed. This consists of a single disc provided with long and short yarn tubes 142 and 143, respectively, the regular wrap yarn 144 being fed through long tubes 142 and the "color-within-color" yarn 145 through short tubes 143 so that the requisite difference in feeding angle to insure that each yarn will be fed only to its own selected needles is obtained. As is well known, the needles which make the normal wrap are raised at normal height so that the wrap yarn 144 can be fed to them alone and the needles which are to produce the color-within-color effect are raised still higher so that this yarn 145 can be fed too high to be taken by the regular wrap needles. The color-within-color needles also receive the normal wrap yarn 144 but they have been raised so high that this yarn lies below their latches so that it is not knit but is cast off. Three steps in the feeding of the wrap and color-within-color yarns in the making of color-within-color wrap are shown in Figs. 35, 36 and 37.

If the method of knitting employed is that suggested in which the yarns are drawn over the backs of the sinkers the wrap yarn or yarns may be fed to the needles higher than the other yarn or yarns. This results in decided improvement in the control of the wrap yarns and in the perfection of the resulting wrap pattern. The making of a perfect wrap is also greatly assisted by the fact that the underlying fabric is of a much more perfect loop structure. All of this is fully illustrated and described in co-pending application #508,693.

The paths followed by the lower cylinder jacks, sliders and needles before selection are indicated in Fig. 62 at 146, 147 and 148, respectively. Before wrap yarn 144 is fed, the needles which are to be wrapped by this yarn are raised to the high level 149 by cam 150. This corresponds to the level of needle 151 in Fig. 36. This is done by lower cylinder jacks 9 operating upon sliders 5 coupled to these particular needles. Only the particular jacks referred to are affected because only these jacks are selectively raised by selector 152 to a height at which they will be further raised by cam 150. This selector 152 may be of any suitable design. Several forms are known to those skilled in the art. See, for example, Patent #2,248,875. The selected jacks are immediately brought down again by cam 153 but the needles remain at the height 149 until they are wrapped. Immediately thereafter the needles which are to be wrapped with the color-within-color yarn 145 are raised to the still higher level 154 by cam 155, after the corresponding jacks have been selected by a second similar selector 156. These needles are wrapped at that height. Thereafter these needles are raised to the still higher level 157 by the same jacks through cam 158 at which level they are joined by needles 151 and all of the other needles their sliders moving up stitch cam 159. Thereafter all of the sliders pass down center cam 160 and under rear stitch cam 41 to cause the needles to knit in the usual way. At the same time the jacks 9 which have been selected to make the needle selections just described are moved down again to normal level 146 by cam 161.

If, instead of a true rib top, an elastic top is desired, a preferred form is that shown in U. S. Patent #2,247,343. In this top a plurality of strands of elastic pass directly through the first course of inelastic yarn. This is followed by a plurality of tucked courses in each of which elastic yarn is laid-in. These courses are in turn followed by any desired number of plain knit courses in each of which elastic is laid-in.

This top can be produced on a machine of this invention utilizing the lower cylinder only and following the procedure of the patent referred to, it being remembered, of course, that the needles instead of being operated directly by the cams are operated through sliders which are operated by the cams. Because of this difference the paths

followed by the sliders and jacks are shown in Fig. 60.

For this top, elastic is fed to alternate needles in every course in such a way that it is laid-in instead of being knitted-in. For this purpose the alternate needles referred to are raised to the level 162 (Fig. 60) by jacks which pass up cam 163. At level 162 the elastic yarn is fed to these needles as shown in the patent referred to. The several strands of inlaid elastic in the initial course are obtained in the same way, stitch cam 159 being drawn out and the inelastic yarn lever moved out of action so that the needles do not pass over the front stitch cams as indicated at 164. After the required number of strands of elastic have been laid-in in this way, front stitch cam 159 and the inelastic yarn lever are moved into operating position with the result that all of the sliders and needles pass through the regular knitting cycle. This encloses the plurality of strands of elastic within the first course of knitted inelastic loops. All other courses with the exception of the tuck courses are knitted in the same way, an elastic yarn being fed to alternate needles at level 162 and all of the needles passing through the knitting cams in the usual way to knit the inelastic yarn. Such elastic fabric may be ornamented with a wrap pattern, if desired, using preferably the knitting method in which the yarns are drawn over the backs of the sinkers.

For the tuck stitches shown in the patent, stitch cam 159 is withdrawn and jack cam 165 is moved into operating position. Jack cam 165 operates upon jacks beneath alternate sliders to raise corresponding needles to knitting height as indicated at 166 whereupon the sliders pass under guard cam 160 and rear stitch cam 41 to cause the needles to knit in the usual way. These are the needles to which the elastic has been previously fed.

The remaining unselected sliders are not affected by jack cam 165. Consequently, they are raised only to level 164 at which the needles receive yarn but which is not high enough to cast off the latches. Consequently, when these sliders pass under rear stitch cam 41 the yarn is retained in the hooks of the needles and is not cast off so that there are two yarns in the hooks of these needles.

For the following course, if the tuck is to be a single course tuck, stitch cam 159 is moved in again so that all of the needles knit. This sequence is repeated as many times as necessary for the number of tuck courses desired.

With respect to the loose course made by casting off loops 18 (Fig. 2) without knitting, this is done by raising the needles, by which loops 18 are carried, so high that they are first cast off the latches and then off the needles. This is done by causing jacks underlying the sliders which operate these needles to pass up cam 167 so as to raise the sliders to the level 168. From this level they are immediately brought down again by cam 169 to the usual holding level 170 with the result that loops 18 are cast off the needles.

I claim:

1. In a knitting machine, the combination of superposed, axially aligned, rotatable needle cylinders, sinkers movable radially and substantially horizontally, needles capable of knitting in either cylinder, means in each cylinder which cooperate to cause needles to knit true rib fabric in the leg of a stocking, sinkers operably associated with needles knitting in the lower cylinder, means for moving said sinkers inwardly soon enough and far enough to cause yarn to be drawn over their backs behind their nibs and through the corresponding needle loops of the previous course, means for casting off the lower cylinder needle loops of the previous course by sinkers acting upon the intervening sinker loops only and causing the newly drawn sinker loops to pass from the backs to the throats of the sinkers upwardly over the tops of the nibs.

2. In a knitting machine, the combination of superposed, axially aligned rotatable needle cylinders, sinkers movable radially and substantially horizontally, needles capable of knitting in either cylinder, means in each cylinder which cooperate to cause needles to knit true rib fabric in the leg of a stocking, sinkers operably associated with needles knitting in the lower cylinder, means for moving said sinkers inwardly soon enough and far enough to cause yarn to be drawn over their backs behind their nibs and through the corresponding needle loops of the previous course, means for casting off the needle loops of the previous course by sinkers acting upon the intervening sinker loops only and causing the newly drawn sinker loops to pass from the backs to the throats of the sinkers upwardly over the tops of the nibs, means for feeding a plating yarn to the needles and drawing and knitting it concurrently with and in the same manner as said first mentioned yarn.

3. In a knitting machine having superposed axially aligned rotatable needle cylinders, the combination of needles capable of knitting in either cylinder, sinkers associated with the lower cylinder which are movable radially and substantially horizontally, means in each cylinder which cooperates to cause needles to knit true rib fabric in the leg of a stocking, sinkers operably associated with a plurality of consecutive needles knitting in the lower cylinder, means for moving said sinkers inwardly soon enough and far enough to cause yarn to be drawn over their backs behind their nibs and through the needle loops of the previous course by all but the first and last of said plurality of consecutive needles knitting in the lower cylinder, means for casting off the corresponding lower cylinder loops of the previous course by sinkers acting upon the intervening sinker loops only and causing the newly drawn sinker loops to pass from the backs to the throats of the sinkers upwardly over the tops of the nibs.

4. A method of knitting true rib fabric in the leg of a stocking upon a knitting machine having superposed axially aligned rotatable needle cylinders, needles capable of knitting in either cylinder and sinkers associated with the lower cylinder which are movable radially and substantially horizontally which includes the steps of knitting consecutive courses each of which includes purl stitches and groups of plain stitches in alternation and in which all but the first and last of said plain stitches are drawn over the backs of sinkers behind their nibs and are later transferred to the sinker throats after the corresponding loops of the previous course have been cast off by the sinkers acting upon the intervening sinker loops only.

5. A method of knitting rib fabric in the leg of a stocking upon a knitting machine having superposed, axially aligned, rotatable needle cylinders, needles capable of knitting in either cylinder and sinkers movable radially and substantially horizontally which includes the steps of forming each

course by knitting in alternation by needles in the upper cylinder and by a plurality of needles in the lower cylinder and, when knitting in the lower cylinder, moving sinkers inwardly soon enough and far enough that the yarn will be drawn over a part of their backs behind their nibs having a definite height by all but the first and last of said plurality of lower cylinder needles, casting off the corresponding cylinder loops of the previous course by sinkers acting upon the intervening sinker loops only and causing the newly drawn sinker loops to pass from the backs to the throats of the sinkers upwardly over the tops of the nibs.

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