July 28, 1964 A. SCHAUER 3,142,276

DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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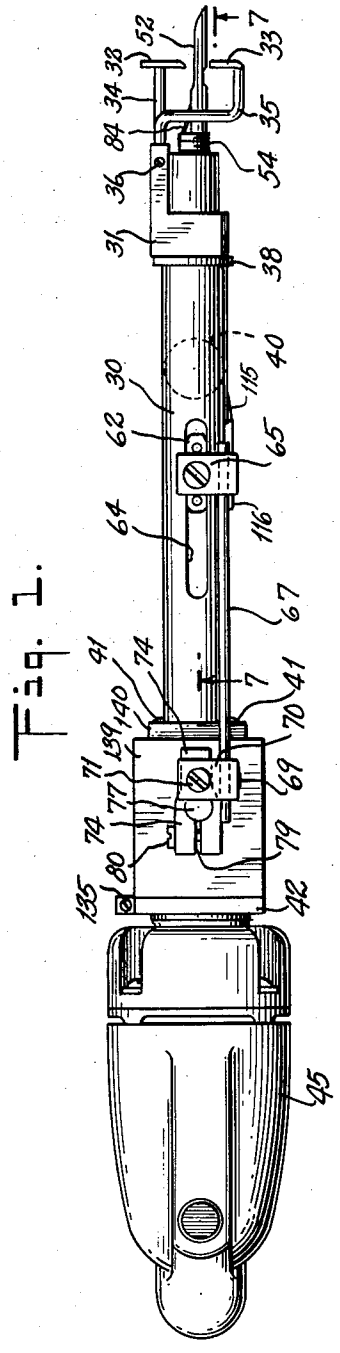


Fig. 1.

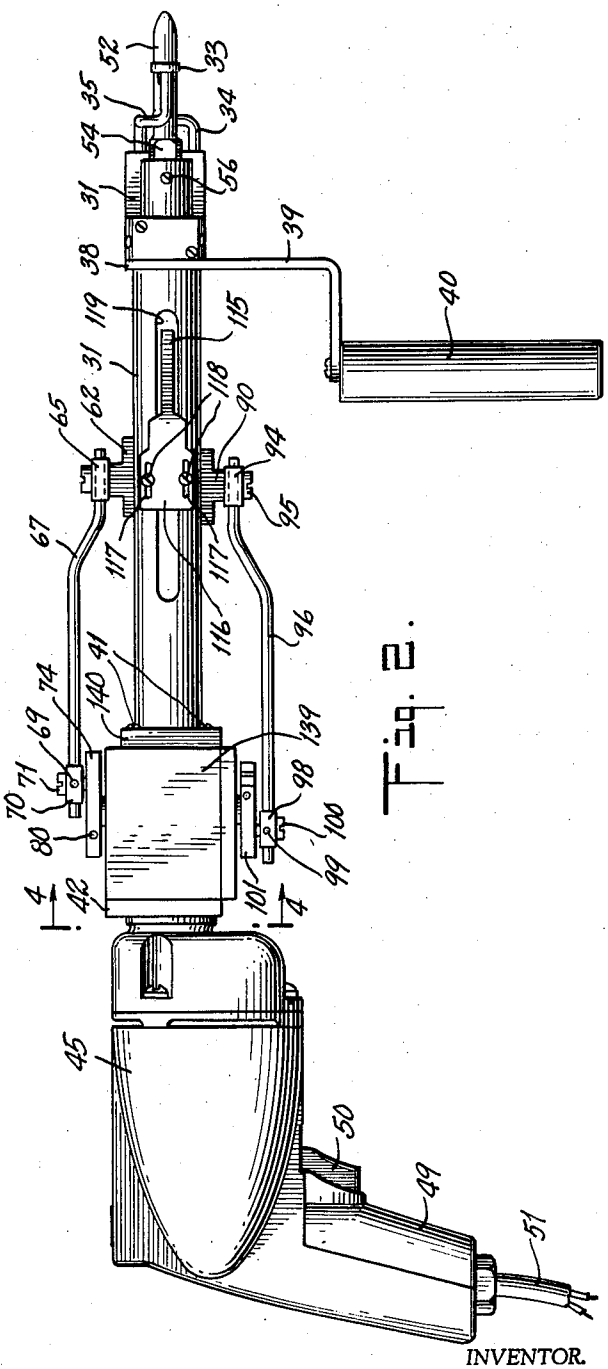


Fig. 2.

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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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Fig. 3.

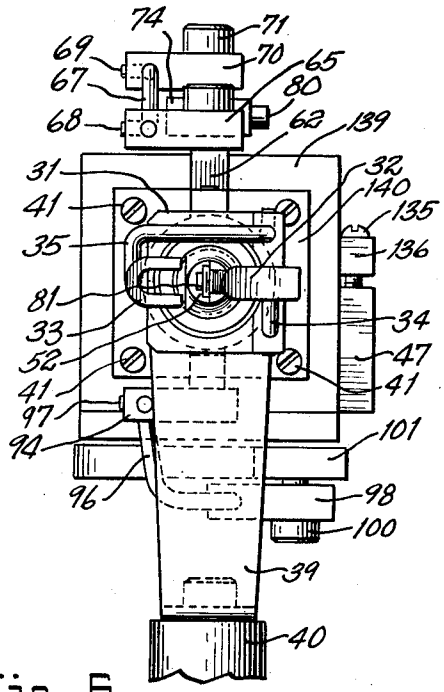


Fig. 4.

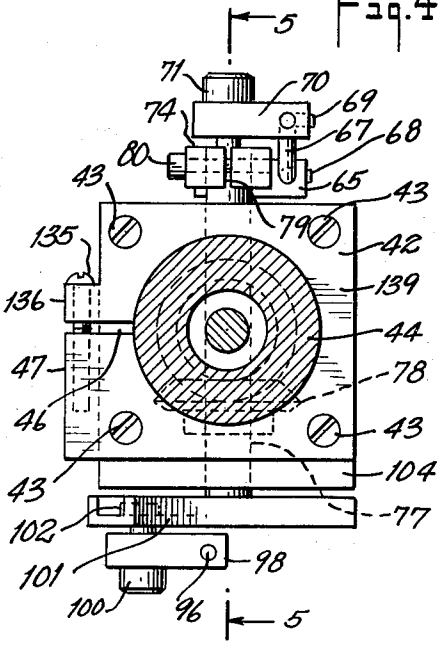


Fig. 6.

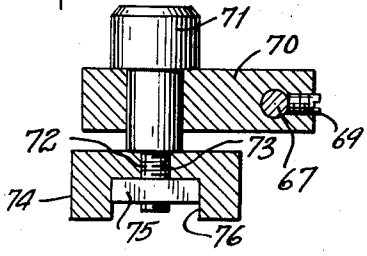
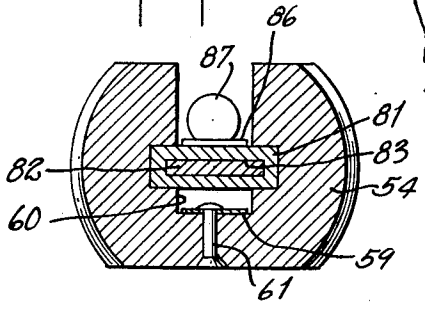


Fig. 14.



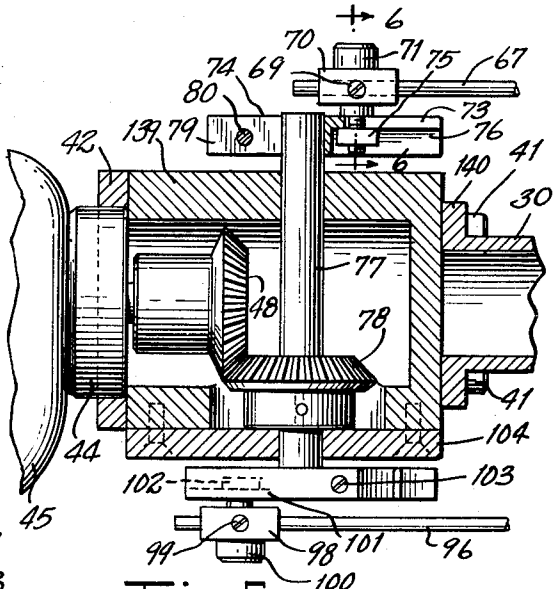


Fig. 5.

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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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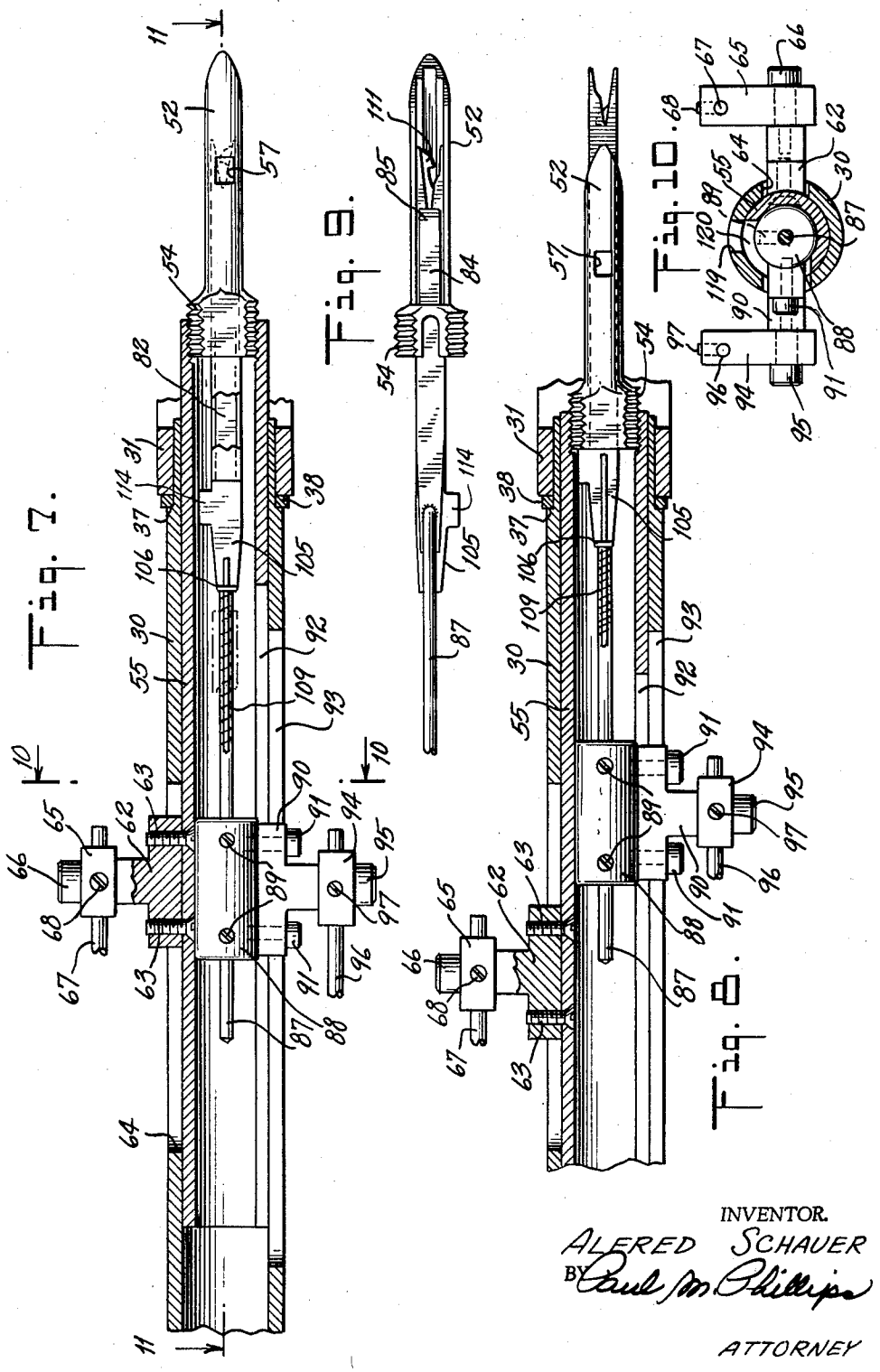


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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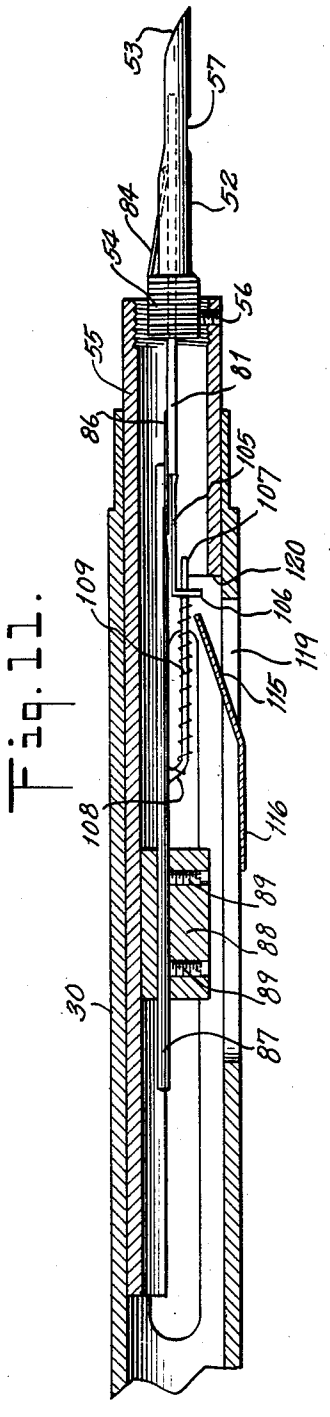


Fig. 11.

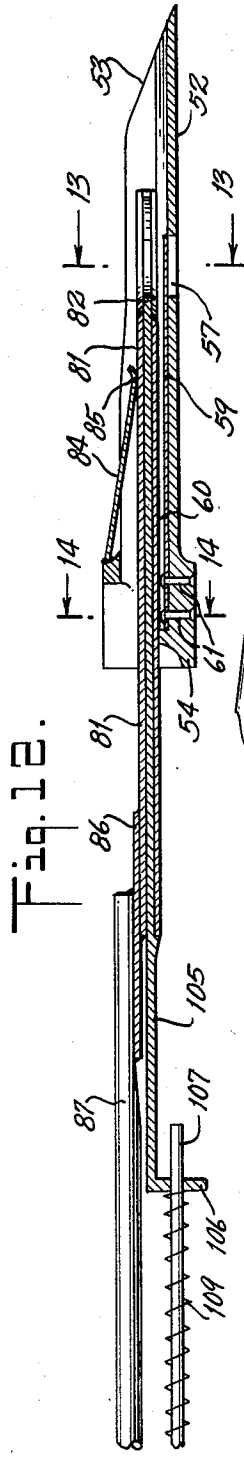


Fig. 12.

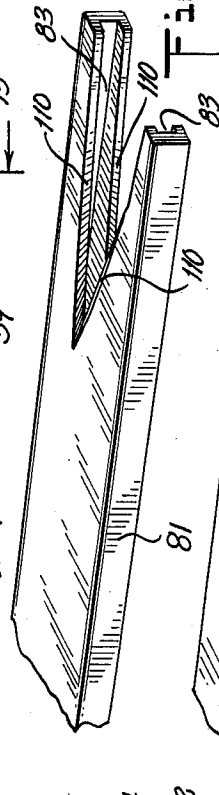


Fig. 15.

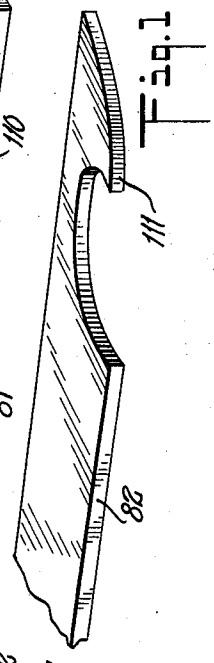


Fig. 16.

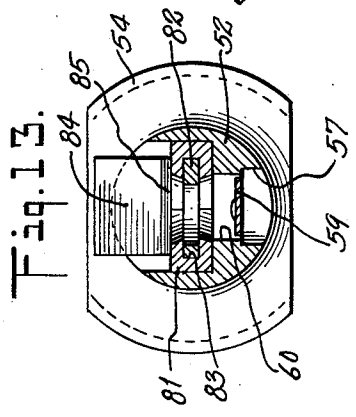


Fig. 13.

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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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Fig. 17.

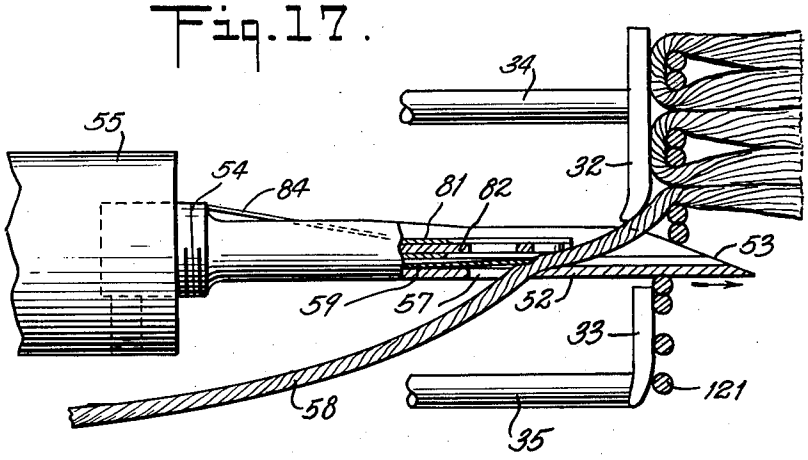


Fig. 18.

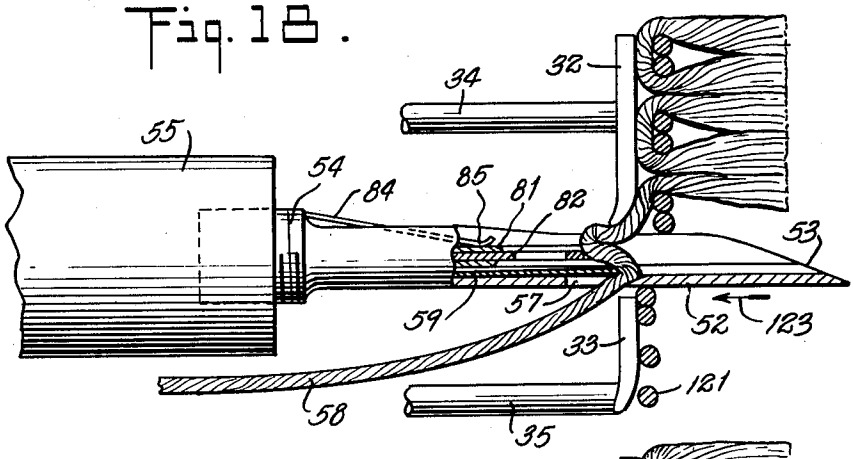
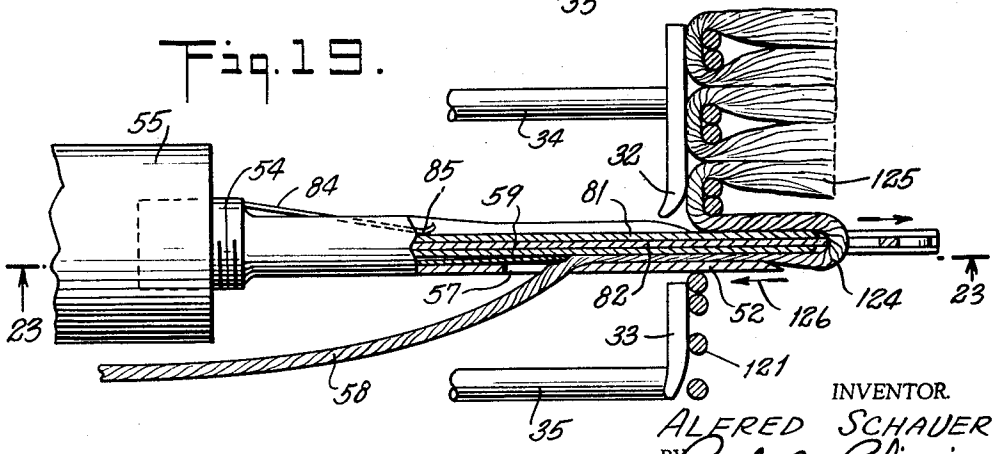


Fig. 19.



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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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Fig. 20.

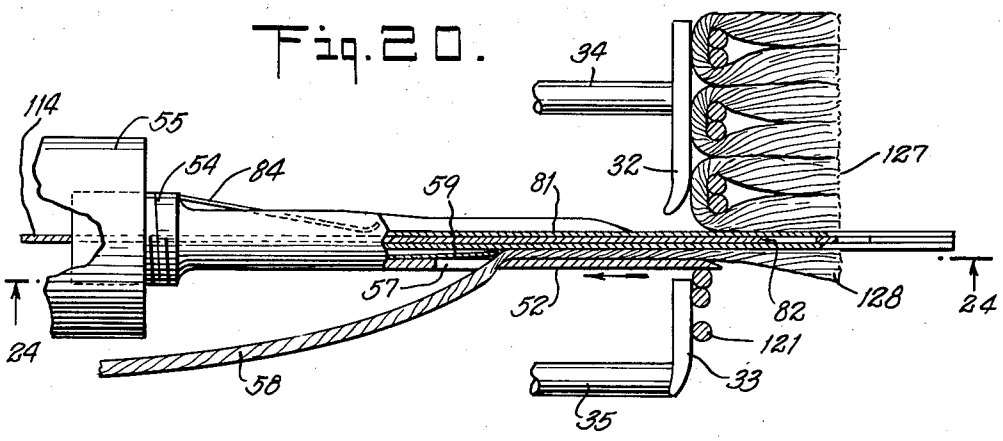


Fig. 21.

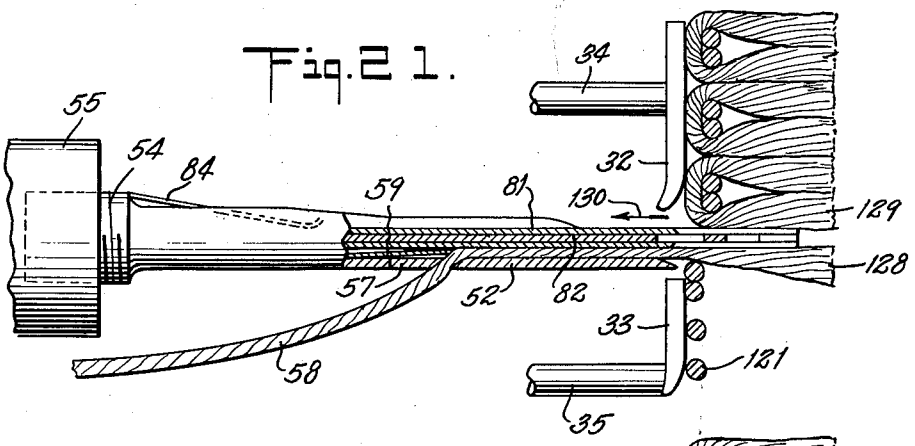
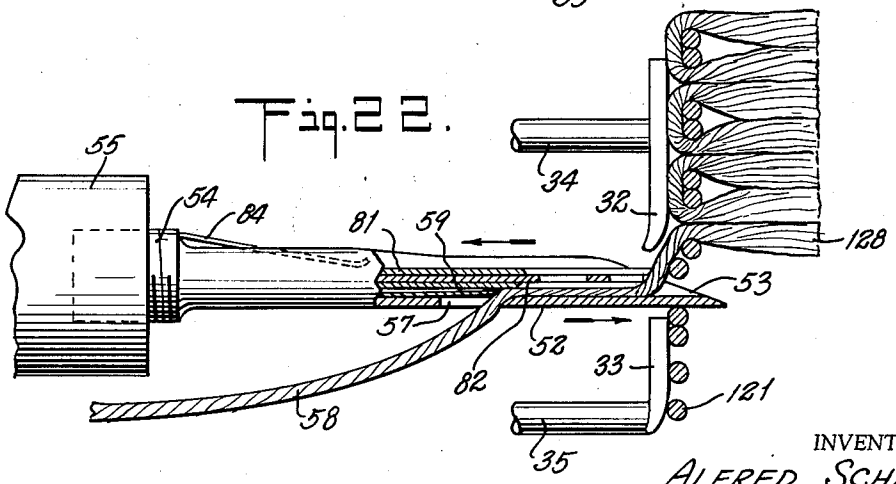


Fig. 22.



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DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

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Fig. 23.

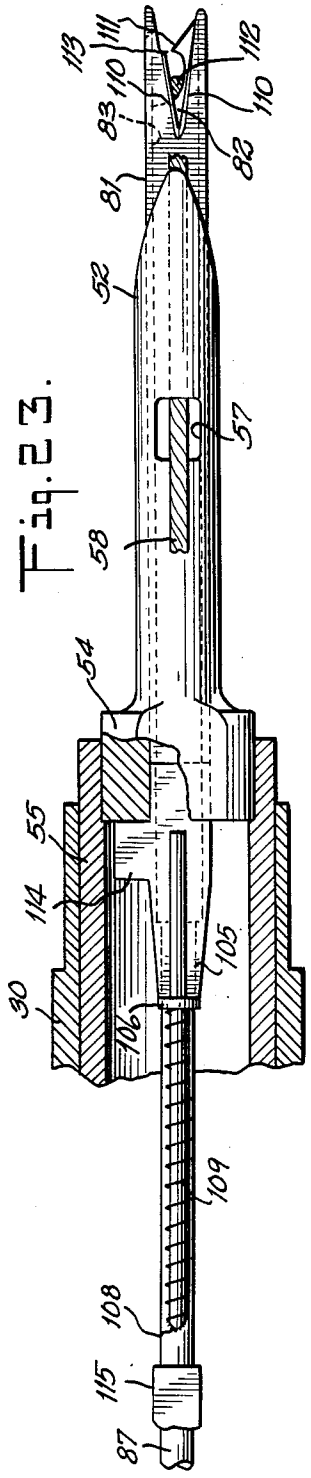


Fig. 24.

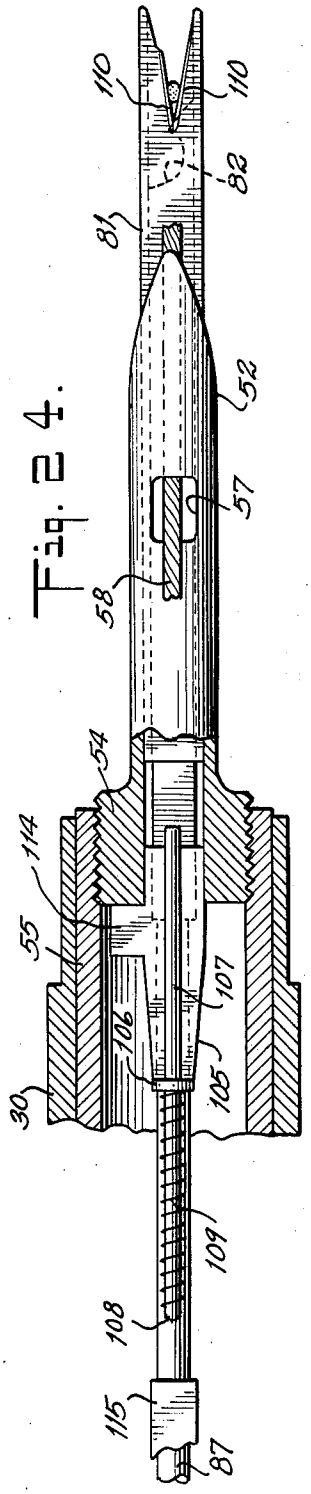
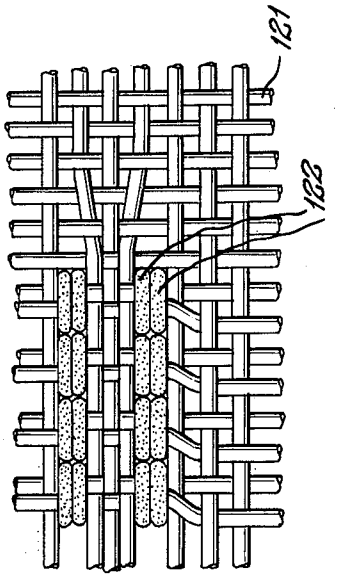


Fig. 25.



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United States Patent Office 3,142,276 Patented July 28, 1964

3,142,276
DEVICE FOR FORMING CUT PILE FABRICS AND THE LIKE

Alfred Schauer, Elmhurst, N.Y., assignor to Roger H. Mullen Inc., New York, N.Y., a corporation of New York

Filed June 25, 1962, Ser. No. 204,677
9 Claims. (Cl. 112—80)

The present invention relates to a device for forming cut pile fabrics and the like and more particularly to a hand gun-type device usable for making cut pile rugs and the like.

Hand guided motor-driven devices of this kind, called hand guns, have been used for some time in making loop pile rugs and the like. Means have also been suggested adaptable to such devices for cutting the pile loops so made, so as to form cut pile fabrics such as rugs, etc. The present invention comprises an improvement on these devices, particularly as to the means for cutting the pile loops, as well as the means for forming the pile loops all of a selected predetermined height, so that the cut pile, when the product is completed, will all be substantially uniform in height rather than ragged, as has been the case in the use of some devices where the cutting operation has been uncertain or irregular for one reason or another.

The present invention provides a means by which the forming of the loops from bights of pile yarn is regular and uniform, as well as selective as to the height of the pile. Furthermore, the pile cutting means is so certain in its operation that the pile is all cut in the same way at the same height, so that the resulting product appears as a velvet carpet with uniform height cut pile.

In order to attain these ends the present invention comprises a means for forming loops by an operation in some ways similar to that heretofore in use in the making of tufted fabrics, in which a needle is projected through a backing fabric, the needle having an eye rearwardly of its forward end. In this instance, however, the needle itself does not project a loop of the pile-forming yarn through the fabric, but merely opens a hole or aperture through which a loop of the yarn may be projected by another member herein termed "an assembly," as it includes a means not only for projecting a bight of the yarn through the fabric, but also for cutting the bight of yarn after it has been projected therethrough to a desired extent.

In the device of the present invention, a number of actuating means are provided for actuating both the needle and assembly aforesaid and other interlocking means are provided by which the bights of the yarn are suitably severed or sheared at the proper point in the cycle of the operation. In the particular device of the present invention, the assembly includes a member having a V-notch forward end across which the yarn loop extends and which is used to project the yarn loop through the backing fabric through the hole or aperture formed by the needle, the cut end of this yarn which forms a part of the previously formed loop and was cut incident to the completion of that operation being held meanwhile against retraction during the formation of a next loop in the next succeeding cycle operation of the device. The bight of the yarn extends across adjacent the apex of the V of the V-notch member aforesaid and is in rear of a hook-shaped member or a hook portion of such a member which extends through a slot in the member having the V-notch forward end as aforesaid. During the projection of the loop of the yarn through the backing fabric this hook member is forward of the bight of the loop of yarn. At about the termination of the forward movement of the assembly, including

the member with the V-notch forward end, the hook-shaped member is moved rearwardly with respect to the V-notch member and the V-notch of the latter is sharpened to a knife edge on at least one surface adjacent thereto, and preferably both such surfaces, so that there will be a positive shearing action between a portion of the hook-shaped member and at least one sharpened knife edge of the V-notch member, which is substantially contiguous therewith, and in any event is preferably in shearing relationship therewith.

In connection with all the above, suitable means are provided for automatically actuating the several parts in proper timed relation to each other, all preferably operated from a common actuating means which may be an electric motor carried by the support. Provision is preferably made for independently varying the amplitude and position of the reciprocatory movements of both the needle member and the assembly aforesaid, including the V-notch member and the hook-shaped member aforesaid.

Other and more detailed objects and advantages of the present invention will become apparent from the following particular description of a preferred embodiment thereof, which is illustrated in the accompanying drawings in which:

FIG. 1 is a view in plan of a device for making cut pile rugs embodying the present invention;

FIG. 2 is a side elevation of the device of FIG. 1;

FIG. 3 is a view of the device of FIGS. 1 and 2 as seen from the right in FIG. 2;

FIG. 4 is a view substantially in transverse section on the line **4—4** of FIG. 2;

FIG. 5 is a fragmentary view principally in central longitudinal section on the line **5—5** of FIG. 4, but with some parts shown in elevation;

FIG. 6 is a fragmentary detailed view in section on the line **6—6** of FIG. 5;

FIG. 7 is a view in principally longitudinal central vertical section on the line **7—7** of FIG. 1, but with some parts shown in elevation, this view showing the parts in position with the needle fully extended and the assembly therein not quite to its rearmost position;

FIG. 8 is a view similar to a portion of the view of FIG. 7, but showing the parts in a position with the needle at its rearmost position, and the assembly almost to its fully forward position and with the hook-shaped member retracted with respect to the V-notch member of the assembly;

FIG. 9 is a fragmentary view of a portion of the needle member and the assembly hereinafter described as seen from the side opposite that shown in FIG. 8;

FIG. 10 is a view partly in transverse section on the line **10—10** of FIG. 7 and with some parts in elevation;

FIG. 11 is a view of the parts shown in FIGS. 7 and 8 substantially in longitudinal section on the line **11—11** of FIG. 7;

FIG. 12 is a fragmentary view of some of the parts shown in FIG. 11 on a somewhat larger scale and with the needle, the V-notch member and the hook member therein also shown in central longitudinal section;

FIG. 13 is a view substantially in transverse section on the line **13—13** of FIG. 12;

FIG. 14 is a view similar to that of FIG. 13, the section being taken substantially on the line **14—14** of FIG. 12;

FIG. 15 is an enlarged fragmentary view in perspective showing the forward end portion of the V-notch member and illustrating the construction thereof;

FIG. 16 is a fragmentary view similar to that of FIG. 15 showing the forward end of the hook member;

FIGS. 17–22 inclusive are a series of views illustrating the functional operation of the device and showing par-

ticularly the relationship between the needle, the backing fabric, the assembly for projecting a bight of pile yarn through the fabric and the means including the hook-like member and the V-notch member for shearing the yarn to form cut pile;

FIG. 23 is a fragmentary view with parts in section and other parts in elevation, the view being taken substantially on the line **23**—**23** of FIG. 19;

FIG. 24 is a view of the parts shown in FIG. 23 and similar thereto, the view being taken substantially on the line **24**—**24** of FIG. 20; and

FIG. 25 is a fragmentary view showing a portion of a backing fabric on a substantially enlarged scale and showing the rear of some pile yarns formed therein in accordance with the teachings of the present invention.

While many of the principles of the apparatus of the present invention are applicable to fully automatic machinery and are applicable also to the making of pile fabric other than rugs, there is chosen for illustration in the accompanying drawings and for the following particular description a form of the invention which may be termed a tufting gun for making cut pile tufted fabric. As the description proceeds there will be pointed out equivalents and how certain of the principles of the invention are of more general application.

In the accompanying drawings, FIGS. 1 and 2, the entire device is shown, which includes an outer support **30** here shown as a substantially cylindrical housing. The outer support **30** is part of the stationary frame of the machine. A further part thereof comprises a shoe head **31** which may be threaded or otherwise suitably secured to the forward end (at the right as seen in FIGS. 1 and 2) of the outer support **30**. These parts may be suitably secured together by threading in a manner not specifically illustrated and/or may be secured by the use of one or more set screws in a conventional manner. The shoe head **31** carries shoes **32** and **33** through intermediate rigid stems **34** and **35** as best seen in FIGS. 1, 2 and 3. The shoes **32** and **33** are arranged to bear against the backing fabric or against some of the loops of the cut pile yarn in rear of the fabric as best shown in FIGS. 17–22 and hereinafter more particularly described. Furthermore, these shoes **32** and **33** may be independently adjusted to desired points forwardly of the shoe head **31** by an appropriate adjustment as shown by providing the stems or supports **34** and **35** with portions extending longitudinally into holes or recesses in the shoe head **31** and securing these stems in desired adjusted positions by set screws, one of which is shown at **36**, FIG. 1. It will be understood that any other suitable type adjustment, if desired, may be used in lieu of that shown, and further, that the shape and character of the shoes is not critical except insofar as the shoe **32** enters into the operation as hereinafter described.

It will be understood, however, that for many purposes a fixed adjustment or a fixed relationship between the shoes **32** and **33** on the one hand and the shoe head **31** on the other may be satisfactory; and further, that another shoe head having shoes fixed thereon in different relationships could be substituted for use in lieu of the one presently shown, without providing adjustments as aforesaid.

Preferably arranged between a shoulder **37**, FIGS. 7 and 8, formed near the forward end of the outer support **30** and the shoe head **31** is an annular band **38**, formed as one end portion of a bracket **39** carrying a handle **40**, which may conveniently be made swingable about the longitudinal axis of the outer support **30** either freely or otherwise, and which provides a convenient way by which one end of the entire device may be supported or steadied by one hand of a user.

At the rear of the outer support **30** (to the left as seen in FIGS. 1 and 2) is mounted a gear box **139** which is suitably secured by screws **41** to a flange **140** formed rigid with the outer support **30**. It will be understood that any suitable method of providing a gear box rigid with the rear end of the outer support **30** should be considered equivalent of that specifically shown in the accompanying drawings.

At the rear of the gear box **139** is a split plate **42**, FIGS. 1, 2, 4 and 5. This plate is suitably secured to the gear box as by screws **43** and has a large hole at its center for receiving a substantially cylindrical projection **44** extending forwardly from a prime mover such as an electric motor **45**. The plate **42** is provided with a split portion shown at **46**, FIG. 4, and is sufficiently resilient so that when the cylindrical portion **44** is inserted in the substantially cylindrical hole centrally of the plate **42**, it will permit such introduction. The plate **42** may be tightened around the cylindrical portion **44** of the motor **45** by a screw **135** extending freely through an ear **136** on one portion of the plate **42** and threaded into another portion **47** thereof, FIG. 4, so that the head of the screw **135** will tend to close the split portion **46** and clamp the plate **42** around the portion **44** of the motor, thus holding the motor securely on the rest of the device.

As shown, the motor assembly **45** is illustrated substantially as a pistol grip-type small motor, substantially equivalent to those used commonly at the present time in driving ¼-inch drills. It may also include reduction gearing as is common in such devices. In the present instance the motor **45** is arranged to drive a shaft carrying a beveled pinion **48**, FIG. 5. A pistol grip portion **49** of the motor **45** will permit the user to hold the implement with a finger of his hand in contact with the usual trigger **50** for operating a switch to control the operation of the motor. A suitable electrical cord illustrated at **51** may extend from the grip **49** to any convenient electrical outlet. It will be understood that the motor **45** is here illustrative of any prime mover effective to transmit rotary power to the device, in this case by driving the beveled pinion **48**.

The present invention, as in cases of most tufting apparatus, uses a reciprocating needle which serves to provide a hole between the threads of a backing fabric through which a loop of pile yarn may be introduced. Such a needle is shown in the accompanying drawings at **52**. This needle is formed substantially as a semi-cylindrical shell as is evident from many of the drawings in which it is shown and is provided with a pointed forward end with the point formed by beveling off the shell of the needle as indicated at **53** in FIGS. 11, 12 and 17 through 22. At its rear end the needle **52** has an enlarged portion **54**. If the needle **52** is viewed from the substantially cylindrical side it will appear as shown best in FIGS. 23 and 24.

At its rear end the needle has an enlarged portion **54** which is flattened as shown on two sides, FIG. 13, and which is outwardly threaded as best seen in FIGS. 7, 8 and 9. The enlarged portion **54** is shown threaded into the forward end of a needle barrel **55**, which is shown as a substantially cylindrical member (see FIGS. 7, 8 and 10). In order that the needle may be positively secured within the forward end of the needle barrel **55**, a set screw **56**, FIGS. 2 and 11, may be threaded through the forward end portion of the needle barrel into engagement with one of the flattened surfaces of the enlarged portion **54** of the needle.

At a point spaced somewhat in rear of its forward pointed end previously described, the needle **52** is provided with an eye or aperture **57** here shown as substantially rectangular in outline. Pile yarn for forming the pile of the fabric which the device is adapted to make is supplied from any suitable source (not shown) through appropriate guide means (also not illustrated) to the path shown for the yarn at **58**, FIGS. 17–24 inclusive. This yarn then passes through the eye **57** of the needle to the hollowed-out inner portion thereof in a manner which is now conventional in this art. Means are pro-

vided for preventing over-supply of the yarn through the needle eye from the yarn source, such means comprising a flat spring **59** which is disposed in a substantially rectangular slot **60** in the needle (see particularly FIGS. 13 and 14), and is secured at its rear end to the needle by one or more rivets **61** or any other desired manner. The forward end of this spring as seen best in FIGS. 17–22 serves to engage a portion of the yarn as it passes inwardly through the eye **57** of the needle and to act substantially as a check valve, allowing the yarn to move inwardly of the needle as is required in the operation, but substantially preventing retraction of the yarn outwardly through the needle eye.

Means are provided for reciprocating the needle carrying member and thereby the needle in a desired manner. For this purpose the needle barrel **55** has secured thereto a member **62**, FIGS. 1, 2, 7, 8 and 10, this member **62** being secured as shown by a pair of machine screws **63** or the like and extending freely through a slot **64** formed in the outer support **30**. The member **62** has pivoted thereto a block **65**, the block **65** being secured to the member **62** by a screw **66** having a smooth cylindrical portion extending through a part of the block **65** and being threadedly secured into the member **62**. Connected rigidly to the block **65** is a connecting rod **67**, which is preferably secured thereto by a set screw **68**, so that the block **65** may be adjusted lengthwise of the connecting rod by loosening the set screw **68**, adjusting the parts to a desired position, and retightening the set screw **68**.

The other or rearward end of the connecting rod **67** is shown as adjustably connected by a set screw **69** to a block **70**, which is essentially similar to the block **65** and is similarly mounted for pivotal movement by a screw **71** as best shown in FIG. 6. The screw **71** has a cylindrical portion extending through a cylindrical hole in the block **70** as shown, FIG. 6, and a threaded portion **72** extending through an elongated slot **73** extending radially of a crank arm **74**, and the portion **72** being threaded tightly into a nut **75**, having flattened sides received in a non-rotatable manner in a groove **76** which extends radially of said crank arm below and parallel to the slot **73**. The crank arm **74** is mounted on a shaft **77** as best seen in FIG. 5. This shaft **77** is the main drive shaft for the device as a whole and is preferably suitably mounted in bearings (not shown) on the gear box **139**. Within the gear box the shaft **77** carries a beveled gear **78** in mesh with the beveled gear **48** when the motor assembly is in its normal operative position with respect to the device as shown in FIGS. 1, 2 and 5.

Means are provided for rotatably adjusting the crank arm **74** about the axis of the shaft **77**. For this purpose the crank arm has a split or bifurcated portion **79**, FIG. 1, the two portions thus split apart being urged together by a suitable bolt **80** extending freely through the upper of the two portions as seen in FIG. 1 and threaded into the lower thereof in a conventional manner.

From the foregoing it will be seen that various adjustments of the needle operation are provided for by the apparatus just discussed. In the first place, the amplitude of the needle movement may be varied without varying any other characteristics of this movement by varying the effective length of the crank arm of the crank **74**. This may be accomplished in the device shown by loosening the screw **71**, adjusting the connection between this screw and the crank arm **74** to a desired point and again retightening the screw.

A second adjustment which may be made is to vary the position of the entire stroke of the needle movement without varying the amplitude of it. This may be accomplished in the device shown by adjustably varying the connection at either end of the connecting rod **67** with its associated blocks **65** or **70**, these connections being secured by the set screws **68** at one end and **69** at the other.

As a third adjustment of the needle movement, its timing in the cycle of operations, i.e. with respect to the other means operated by the common actuating means, may be adjusted by varying the angular position of the crank arm **74** about the axis of the drive shaft **77**, this adjustment being secured by the bolt **80**. It will be understood, however, that this is a relative adjustment, as either this or the other means hereinafter described, which is driven by the common drive shaft **77**, may be adjusted with respect thereto and either adjustment will effect a phase variation of one with respect to the other.

Mounted in sliding relation in the needle **52** and for longitudinal movement in a path substantially concentric with the curvature of the outer part of the needle and preferably substantially parallel therewith, i.e. with a longitudinal axis thereof, is an assembly including a member **81** having a portion of rectangular cross-section slidable in the needle as shown in FIGS. 13 and 14 and an inner hook member **82**, which is slidable in a substantially rectangular slot **83** within the member **81**. In order to provide for guiding the forward ends of these members, the needle **52** is formed with rectangular grooves for receiving and guiding the member **81** as best shown in FIG. 14. Furthermore, as to that portion of the member **81** which may project forwardly beyond the needle and beyond that portion where it is positively guided in place by the sides of the groove shown in FIG. 14, a leaf spring **84** (see FIGS. 11, 12 and 17–22 inclusive) is provided which is suitably secured at its rear end to a part of the enlarged portion **54** of the needle and bears as shown at **85**, FIG. 18, onto a part of the member **81**. This becomes quite important when the member **81** is projected a substantial distance beyond the end of the needle as in the position of the parts shown in FIG. 20.

At its rear end the member **81** has fixedly secured thereto either directly or through the intermediation of a plate as shown at **86**, FIGS. 12 and 14, a rearwardly extending actuating stem **87**. While an intermediate plate **86** is shown in the present drawings, it will be understood that this is not essential to the device and the stem **87** could be formed in any way rigid or integral with the member **81**.

Means are provided for reciprocating the member **81** and parts carried thereby. For this purpose the actuating stem **87** has secured thereto a substantially cylindrical member **88**, FIGS. 7, 8, 10 and 11, this securing being effected by one or more set screws **89**. The member **88** is preferably cylindrical as shown and is mounted for longitudinal sliding movement within a cylindrical bore concentric with the needle barrel **55**. Thus the rear end of the assembly **81–82** is guided accurately for solely longitudinal movement. Secured to the cylindrical member **88** and projecting laterally therefrom is a member **90**, FIGS. 7, 8 and 10, this member being secured to the member **88** by a pair of cap screws **91** as shown and having a portion extending through an elongate longitudinal slot **92** in the needle barrel **55** and through a registering slot **93** in the outer support **30**. Outside the outer support **30** the member **90** has pivoted thereto a block **94** by the use of a pivot pin **95** which has a cylindrical portion received in a bearing part of the block **94**. The pivot pin **95** has a threaded portion which is suitably threaded into a part of the block **90** in an appropriate firm manner. The block **94** has adjustably secured therein a connecting rod **96**, this securing being effected, for assembly, by a set screw **97**.

At its rear end, the connecting rod **96** is connected to be driven by a crank carried by the shaft **77** in a manner similar to that described hereinabove as to the manner of connecting the connecting rod **67** to the crank arm **74** carried by the same drive shaft **77**. As shown particularly in FIGS. 4 and 5, the connecting rod **96** extends through a hole in a pivot block **98** and is secured thereto in an adjusted position by a set screw **99**. The block **98** is pivot-

ed about a cylindrical portion of a screw **100** which passes through a suitable slot in a crank arm **101** and is threaded into a suitable nut **102** having flat sides bearing against the sides of a further grooved-out portion of the crank arm **101** in a manner similar to that shown in FIG. 6 as to the corresponding connection in the mechanism for reciprocating the needle **52**. The crank arm **101** is fixed in an angularly adjusted position onto the shaft **77** and this adjustment is secured, for example, by a set screw **103**.

The lower end of the shaft **77** as seen in FIG. 5 has a bearing in a plate **104** which is suitably secured to the gear box **139** by screws or the like as illustrated in dotted lines in FIG. 5. This is solely for convenience of assembly and disassembly of the parts and other constructions generally equivalent thereto could be substituted if desired.

From the foregoing it will be seen that provision is made for varying the amplitude of the reciprocatory movement of the assembly including the member **81** and parts carried thereby. This may be done in accordance with the specific teaching herein given of the present device by varying the effective length of the crank arm **101**, which in turn may be done by loosening the screw **100**, and adjusting this screw and its nut **102** lengthwise of the radial slot in the crank arm to bring the parts to a desired adjusted position and then retightening the screw **100**.

A further adjustment may be made by shifting the entire position of the movement of the assembly **81–82** longitudinally of the device, i.e. forwardly or rearwardly, without varying the amplitude thereof. This may be done by adjustably varying the connection between the connecting rod **96** and the block **94** on one hand or on the other hand the block **98**, the adjustment in either instance being secured by the set screws **97** or **99** respectively.

A third adjustment which may be made is a phase adjustment between the phase of operation of the needle on the one hand and that of the operation of the assembly **81–82** aforesaid on the other. This can be accomplished by a relative rotation of either of the crank arms **74** or **101** with respect to the other or with respect to the drive shaft **77** as by holding one of these arms stationary and adjusting the other. The crank arm **101** as aforesaid is adjustably secured to the drive shaft **77** by the set screw **103**.

The next portion of the device to be considered is the member **82** having a hook-shaped forward end hereinafter referred to as the hook member, the forward portion of which is shown in perspective in FIG. 16 and which is mounted for solely sliding movement in a direction longitudinally of the device in the slot **83** of the member **81**, FIG. 15, all as aforesaid. The rear end of the member **82** may be suitably connected to or form a part of a member portion **105**, FIGS. 7, 8, 9, 11 and 12. In FIG. 12 these parts are shown as integral although this is not essential. In any event, the portion **105** has its rear end turned up as shown at **106** and bored or pierced to serve as a guide for a stem **107** which is suitably secured by welding or brazing or the like at **108** to the stem **87** and extends forwardly from adjacent to the point **108** generally parallel to the stem **87**. Between the connection at **108** and the turned up portion **106** of the member **105** is a compression spring **109**. The effect of this spring is always to move the portion **105** and hence the hook member **82** forwardly, i.e. to the right as seen in FIGS. 7, 8, 10 and 11 with respect to the V-notch member **81** and thus to hold these parts in relative position shown in FIGS. 9 and 23.

When it is desired to effect a pile cutting operation as generally hereinabove referred to, the hook member **82** which is located at its normal forward position at the outside as shown in FIG. 23 is drawn rearwardly with respect to the V-notch member **81** to the position of these parts shown in FIG. 24, forcing the bight of the yarn into engagement with inclined beveled and sharpened surfaces **110** of the V-notch member which are respectively formed by beveling the outer edges of the V-notch member to form knife edges adjacent to the hook member. The hook member has a hook portion **111** which extends far enough laterally so that when the hook member is retracted, it will positively engage the bight of yarn shown at **112** in FIG. 23 to sever it against one or another or several of these surfaces **110** or the knife edges formed by these bevels. At the same time, the hook portion **111** of the member **82** is of such dimensions that at the forward position of the member **82** there will be a free passage as shown at **113**, FIG. 23, through which the bight of yarn may freely pass to the position thereof shown in full lines in that figure.

Means are provided for moving the hook member **82** as aforesaid and for assuring that it will be brought to and held at a selected position so as to execute the desired cyclic operation of the device. As previously described, the compression spring **109** tends at all times to move the hook member **82** forwardly with respect to the V-notch member **81**. When, however, it is desired to move the hook member from the FIG. 23 position to that shown in FIG. 24, this is accomplished by a differential movement between the member **81** on the one hand and the needle **52** on the other. For this purpose the portion **105** of the member **82** has one or more laterally extending projections **114** (only one being shown in the accompanying drawings) which are arranged to engage against a rear portion of the enlarged head **54** of the needle **52**. When then the needle **52** is retracted by the means aforesaid with respect to the V-notch member **81**; or when the latter is projected forwardly sufficiently beyond the needle **52**, as the case may be, then the rear end of the enlarged head **4** of the needle will engage the lateral projection **114** of the portion **105** and will move the hook member **82** rearwardly against the compression spring **109**. In this movement it is guided by the turned up rear end **106** of the member **105**, which has an aperture through which the stem **107** extends. This differential motion of the members **81** and **82** is effective to cut the pile of the yarn.

When thereafter it is desired that the hook member **82** shall reassume its normal forward position with respect to the member **81**, this is accomplished generally to a large extent at least by a reverse differential movement of the needle **52** and the V-notch member **81**, permitting the compression spring **109** to expand, and thereby moving the turned up end **106** and the parts **105** and **82** rigid therewith toward their forward position with respect to the V-notch member **81**.

In order, however, to assure that this hook member **82** shall always be moved positively to its utmost forward position with respect to the V-notch member **81**, auxiliary means are provided comprising a stop blade **115**, FIG. 11, which engages the turned up rear end **106** of the member **105** at the rearmost end of the movement of the latter.

The blade **115** as seen in FIG. 2 is formed as a forwardly extending tongue constituting a part of a member **116** which is curved to the extent necessary and provided with slots **117** (FIG. 2) through which screws **118** extend, these screws being threaded into the main outer support **30**. Thus the stop blade **115** may be adjusted longitudinally of the device and this adjustment secured by tightening the screws **118**. This adjustment is provided so as to position the stop blade **115** accurately, so that it will cause the hook member **82** to move to its most forward position with respect to the V-notch member **81** at the rearmost position of the latter.

In order that the member **116** may be attached to the outside of the device as shown in FIG. 2 and the stop blade **115** thereof extend through to engage the turned up rear end **106** of the member **105**, the outer support **30** is provided with a slot **119** and the needle barrel **55** is provided with a registering slot **120**. The stop blade **115** extends through both slots as shown in FIG. 11.

It will be seen from the foregoing that the mechanism generally used for actuating the reciprocating means in the present case comprises cranks and connecting rods.

This mechanism may be adequate for many purposes. However, other equivalent reciprocating mechanism, including, for example, cams and cam followers by which any desired type of movement may be obtained is believed to be equivalent to the crank means herein shown, with adjustments of the amplitude of movement and also the position of movement being accommodated by the use of substitute cams to replace other cams. Such cams could, of course, be carried and rotated by the shaft **77** in lieu of the cranks shown thereon.

A machine cycle is shown in the several views FIGS. 17–27. In FIG. 17 the device of the present invention has been brought against a backing fabric here shown generally at **121** which may be of any suitable type and of any suitable material. It may, for example, be of jute or the like, woven in the general style and pattern of monk's cloth. Such a fabric is shown in FIG. 25 and some threads thereof also generally diagrammatically in FIGS. 17–22. As shown in FIG. 17, the device is brought against the fabric until the shoes **32** and **33** are seated thereon and the point of the needle **52** penetrates the fabric as shown. As illustrated in the drawings, there are two cross threads of the backing fabric between each penetration of the needle. This may be one way of operating the device, although the number of threads between each penetration of the needle is not critical or a necessary vital part of the present invention. Also as shown in FIG. 25, there are two plies of pile yarn shown at **122** which are inserted simultaneously; whereas in the previous figures only a single pile yarn **58** is shown. Here again optional uses of the device are illustrated in that one, two, three, or possibly more plies of yarn may be trained through the needle in the manner shown for the pile yarn **58** in FIGS. 17–22 and all of the plies thus trained through the eye **57** of the needle may be used simultaneously and in a parallel fashion as shown in FIG. 25.

Considering the comparison of FIGS. 17 and 18, it will be noted that the needle **52** has been moved to its most forward position, which position is that shown for the needle in FIG. 7; and in FIG. 18, the initial portion of the retracting movement of the needle has started as indicated by arrow **123**. Up to this time the loop or bight of the pile yarn has not actually been extended through the fabric, as the eye **57** of the needle is not normally extended through the fabric, although this is largely immaterial from the point of view of the essential operation of the device. In any event the position of the eye of the needle at the point of greatest penetration of the needle will bring a bight of the yarn closely adjacent to or through the fabric and in position so that a bight of the yarn may be picked up by the reciprocating assembly **81–82** as shown FIGS. 18 and 19.

During the portion of the cycle shown from that position of the parts in FIG. 18 to that in FIG. 19, the needle continues to move toward the rear, while the assembly **81–82** moves forwardly. This results in a bight of the pile yarn being picked up by the V-shaped forward end of the member **81** by slipping past the portion **111** of the hook member through the space **113**, FIG. 23, which shows the bight yarn at **112** in the position to which it is carried through the fabric to form a loop as shown at **124**. During this period the end of the yarn which forms a part of the cut pile at **125**, FIG. 19, is prevented from being retracted through the fabric by the pressure of the lower end, as seen in FIG. 19, of the shoe **32**, which bears on a part of the yarn in rear of the fabric **121** and thus prevents retraction of the cut end portion **125**. FIG. 19 shows the parts in a position in which the assembly **81–82** is almost at its furthest extended position forwardly. At about this time the needle is still retracting as shown in FIG. 19 by the arrow **126** in that figure. This is almost to the position of the parts shown in FIG. 24 which shows these parts after the needle has retracted sufficiently with respect to the assembly **81–82** so that the hook member is drawn rearwardly as aforesaid to cause a cutting of the yarn to form cut pile. This occurs with the pile loop or bight of the yarn at about the position shown in FIG. 19 and is incident either to the continued rearward movement of the needle **52**, while the assembly and particularly the V-shaped member **81** is substantially stationary or to the continued forward movement of the assembly with the needle either stationary or moving rearwardly, or both in accordance with the adjustment of the apparatus.

Still further movement of the parts with a continued retraction of the needle and a start of the retraction of the assembly following the shearing of the yarn is shown in FIG. 20, the pile being cut at a point slightly to the right (as seen in the drawings) of the level of the remainder of the cut pile at **127**, so that the yarn end at **128** which may be slightly further retracted during the final retractive portion of the needle movement, as it is caught between the spring **59** and the side of the eye **57** of the needle **52**, will be retracted only to the level **127** of the other cut pile.

As shown in FIG. 21, the needle **52** has retracted sufficiently, so as to be clear of the fabric and is substantially stationary and the assembly **81–82** is now retracting so as also to be clear of the fabric, i.e. to a position substantially as shown in FIG. **22**. Meanwhile, the end **129** of the previously cut loop is held substantially stationary by the shoe **32** bearing against the rear surface thereof; and the apparatus of this invention may then be moved from the position of FIG. 21 to the position of FIG. 22 for the making of a next loop as soon as the assembly **81–82** has cleared the fabric by a retractive movement as shown by the arrow **130**, FIG. 21. FIG. 22 shows the start of the next cycle in forming a new loop and corresponds substantially to the showing of the parts in FIG. 17.

Rows of cut pile may be formed at any desired interval from one another and as shown in FIG. 23, there are three threads of backing fibers between rows of cut pile. Here again this is not absolutely essential, but any desired spacing of the rows of cut pile may be made in accordance with the desires of the users of the device and in accordance with the type of carpet or other pile fabric which is being made.

While there has been shown and described herein but one principal form of the device; and some variations have been referred to as the description has proceeded, it will be understood that other variations and modifications will occur to those skilled in the art from the foregoing particular disclosure. I do not wish to be limited, therefore, except by the scope of the appended claims, which are to be construed validly as broadly as the state of the art permits.

What is claimed is:

1. A device for forming cut pile fabrics and the like by projecting a loop of pile yarn through a backing fabric and cutting the loop, comprising

an outer support forming a part of a frame for the device,

a needle carrying member carried by and mounted for reciprocatory movement with respect to said support and provided with a needle having a pointed forward end for piercing a backing fabric, and an eye in said needle rearwardly of said forward end,

an assembly also carried by and arranged for longitudinal sliding movement with respect to said support in a direction substantially parallel to the direction of reciprocatory movement of said needle and including a longitudinally extending member having a forward end portion disposed so as to be projectable through an aperture in the backing fabric formed by the needle once the needle is projected and extends therethrough, said longitudinally extending member having a substantially V-notch forward end and hav-

ing longitudinally extending guide means, at least one edge portion of said V-notch adjacent to said guide means being sharpened to form a knife edge;

an inner hook member portion which forms a part of said assembly and extends through said guide means and is longitudinally movable with respect thereto, said hook member portion being mounted for solely longitudinal sliding movement with respect to the V-notch forward end of said longitudinally extending member,

said hook member portion having (*a*) a forward position in respect to said V-notch forward end, such that a bight of a pile yarn may be moved past said hook member portion to a position between it and the apex of the V of said V-notch forward end and (*b*) a rear position in which it has moved to the rear of said apex of the V,

a common actuating means, means driven by said actuating means for reciprocating said needle carrying member with respect to said support and thereby for reciprocating said needle to cause it repeatedly to penetrate said backing fabric, means driven by said actuating means in timed relation with the reciprocation of said needle for reciprocating said assembly to cause said V-notch forward end thereof to move through an aperture in said backing fabric through which said needle extends to project through said backing fabric a bight of pile yarn passing across said V-notch and behind said hook member portion,

and means actuated in a predetermined timed relation to the reciprocations of said needle and said assembly to cause said hook member portion to move from its forward to its rear position, so as to shear said bight of pile yarn at said knife edge.

2. A device for forming cut pile fabrics in accordance with claim 1, in which said outer support is formed as a housing having a substantially cylindrical guideway therein for a portion of said needle-carrying member, which is formed as a portion of a piston for reciprocation in said guideway; and in which said assembly is mounted for reciprocation in a path parallel to that of said needle-carrying member, said needle-carrying member having guide means therein in which a portion of said assembly is slidable.

3. A device for forming out pile fabrics in accordance with claim 1, in which said actuating means comprises a continuously rotatable shaft, and in which said means driven by said actuating means for reciprocating said needle carrying member comprise crank means on said rotatable shaft, and a connecting rod interconnecting a portion of said crank means remote from the center of rotation thereof with a part secured to said needle-carrying member for reciprocating the latter.

4. A device for forming cut pile fabrics in accordance with claim 1, in which said actuating means comprises a continuously rotatable shaft, and in which said means driven by said actuating means for reciprocating said needle-carrying member and said means driven by said actuating means in timed relation with the reciprocation of said needle comprise two crank means separately secured to said rotatable shaft and connecting rods respectively connecting said crank means with said needle-carrying member and with said assembly.

5. A device for forming cut pile fabrics in accordance with claim 3, further comprising means for adjustably varying the amplitude of movement of said needle, comprising means for adjustably varying the effective length of the arm of said crank means.

6. A device for forming cut pile fabrics in accordance with claim 3, further comprising means for adjustably varying the position of the needle movement longitudinally of such movement independently of the amplitude of such movement, comprising means for adjustably varying the position along said connecting rod of its connection at one end thereof.

7. A device for forming cut pile fabrics in accordance with claim 1, in which said hook member portion is actuated to move from its forward position to its rear position, both as aforesaid, by a predetermined differential movement between said needle-carrying member and said assembly.

8. A device for forming cut pile fabrics in accordance with claim 1, further comprising a shoe carried by said outer support and constructed and arranged to hold a portion of the yarn extending to the cut end of the immediate preceding cut loop of such yarn, so as to prevent the retraction of said cut end incident to the formation of a next succeeding loop during the next cycle of the operation of said device.

9. A device for forming cut pile fabrics in accordance with claim 1, in which said hook member portion is formed as a part of a flat parallel-sided member which is mounted in shearing contact with said knife edge, so that upon movement of said hook member portion from its forward to its rear position, a bight of yarn will be positively sheared by said knife edge.

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