

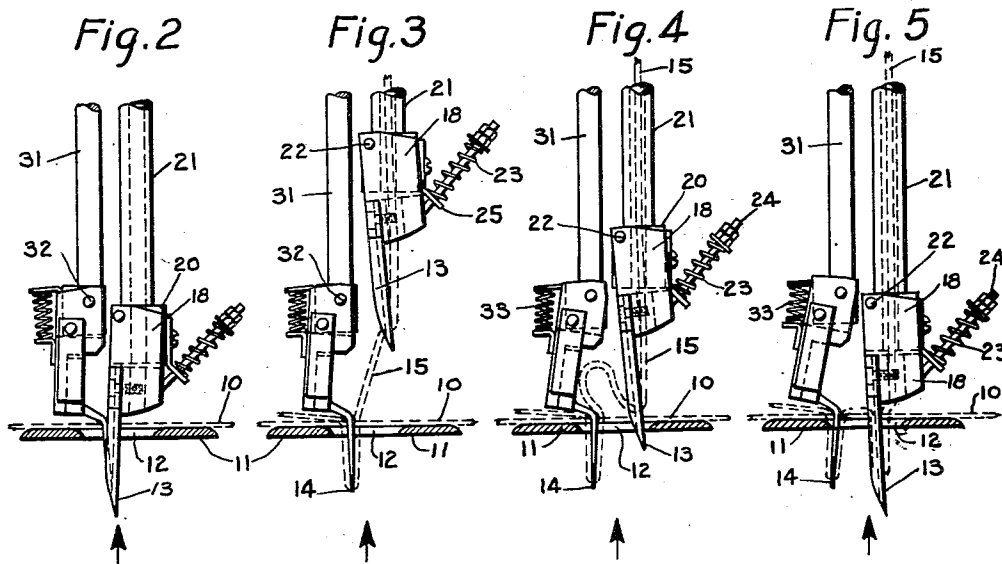
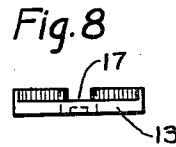
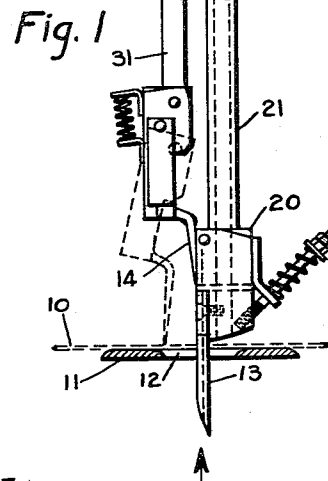
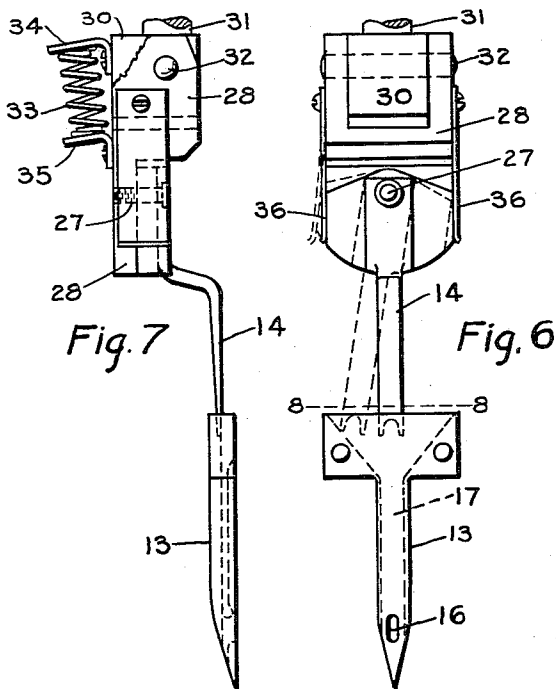
March 19, 1957

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TUFTING MACHINE

2,785,643

Filed Feb. 9, 1954

6 Sheets-Sheet 1



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6 Sheets-Sheet 2

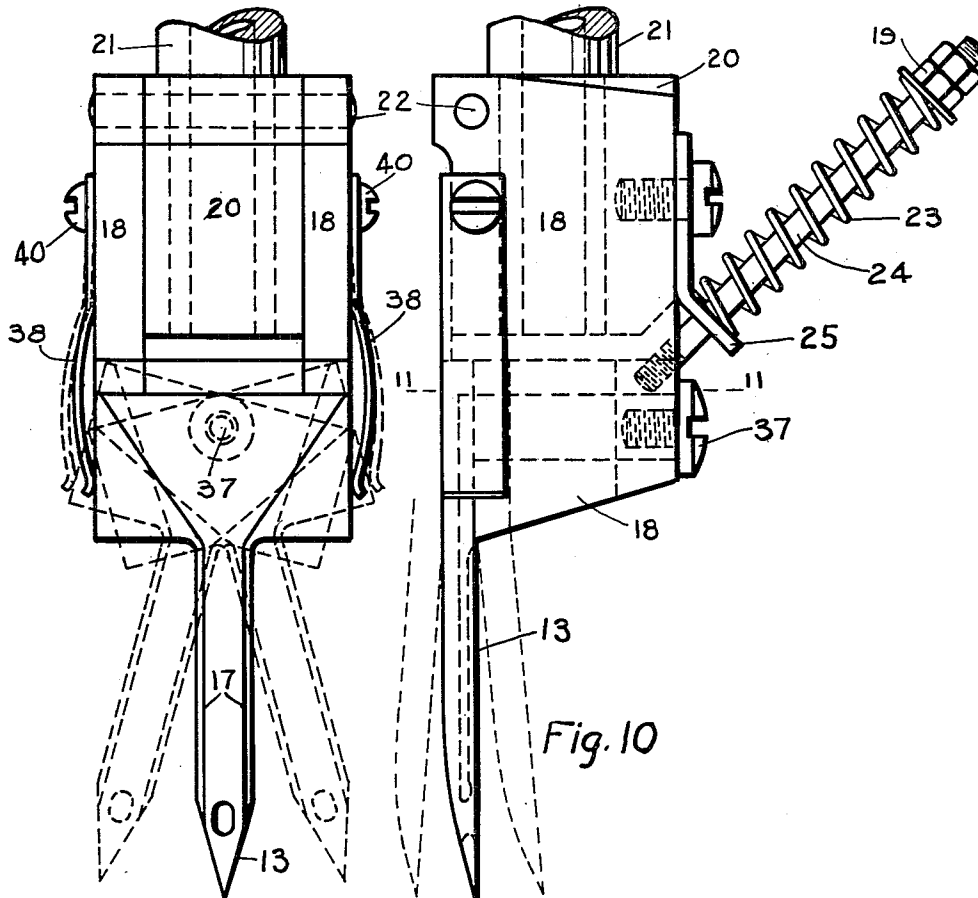


Fig. 9

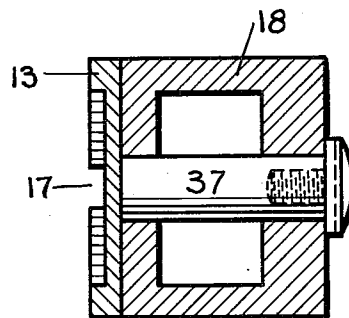


Fig. 11

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TUFTING MACHINE

6 Sheets-Sheet 3

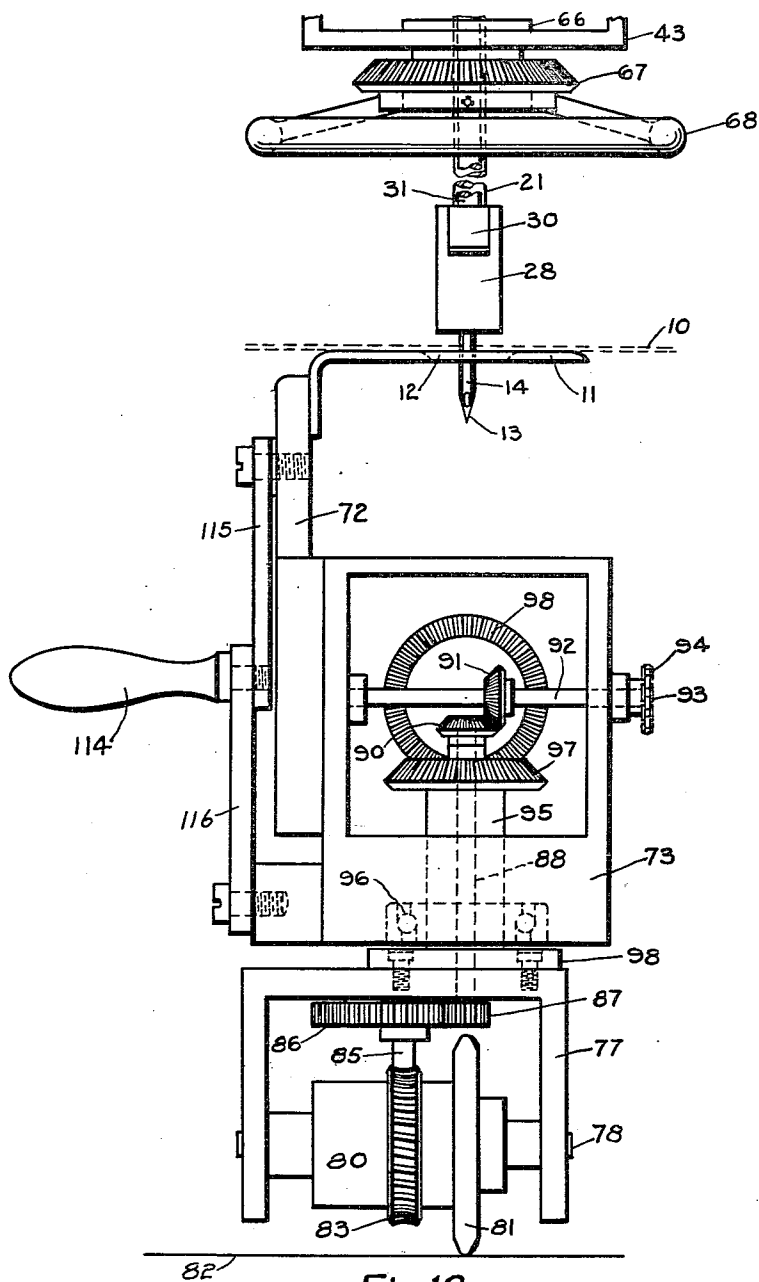


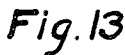
Fig. 12

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6 Sheets-Sheet 4



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6 Sheets-Sheet 5

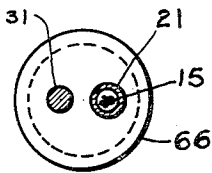


Fig. 15

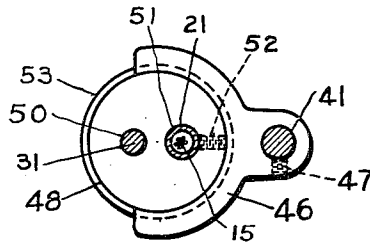


Fig. 16

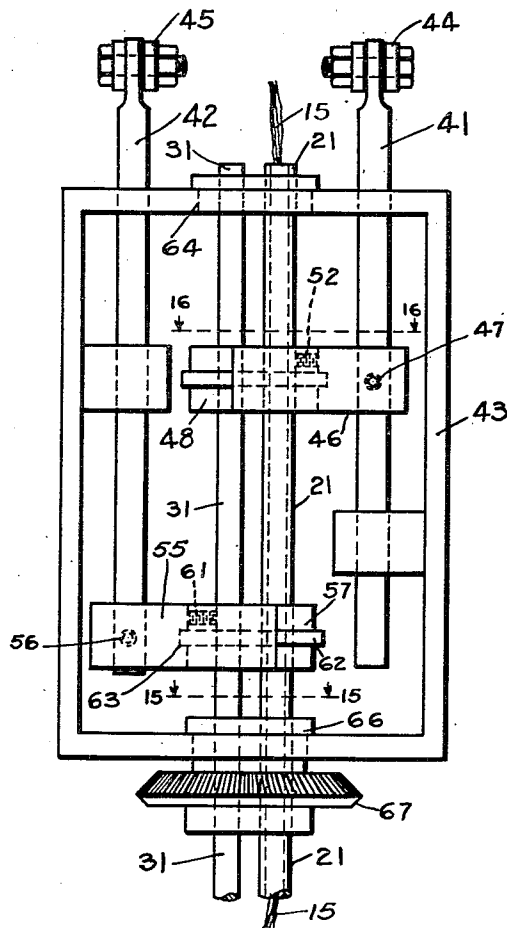


Fig. 14

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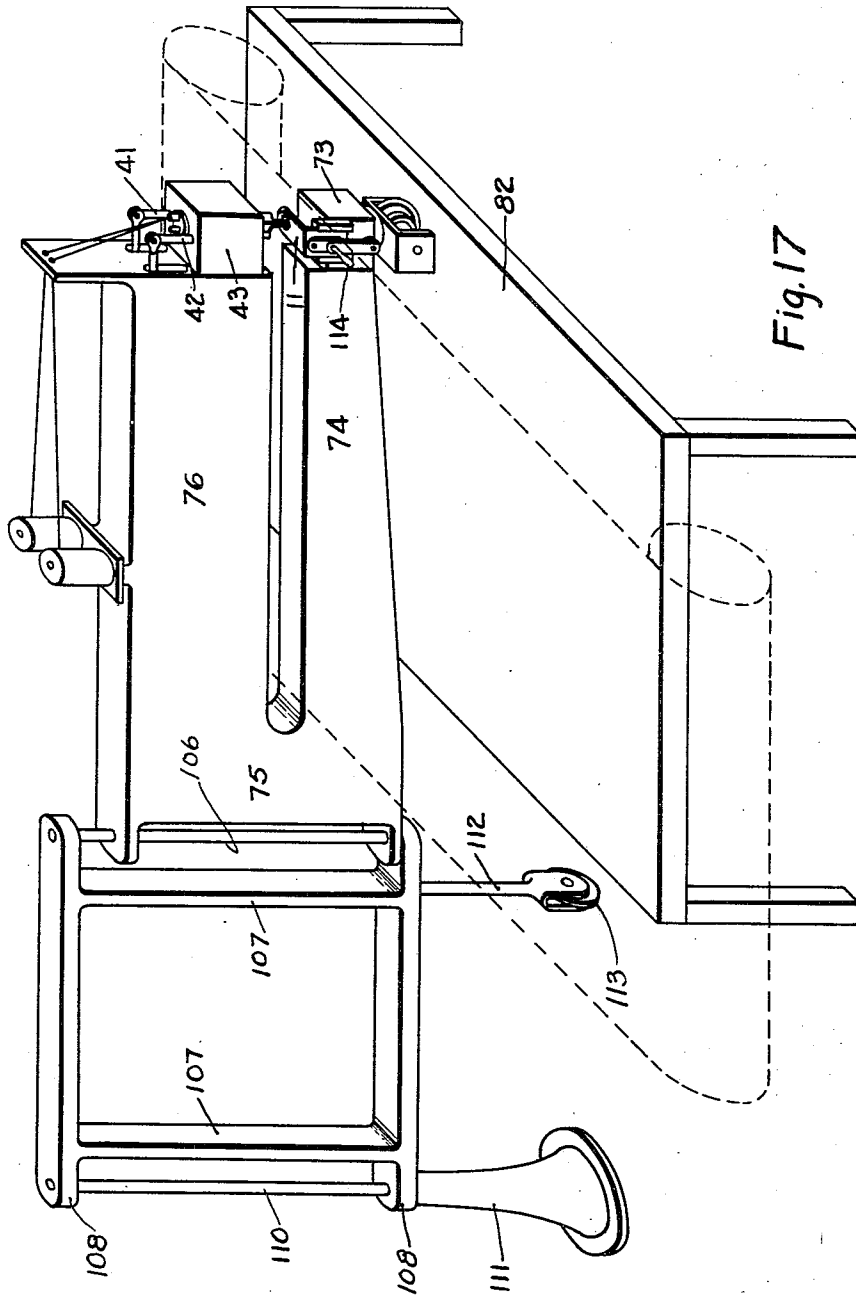
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6 Sheets-Sheet 6



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1

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TUFTING MACHINE

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12 Claims. (Cl. 112—79)

The present invention relates to the fabrication of carpet, rug or pile fabrics and more particularly to a tufting mechanism for forming a design or insignia as an embellishment to a completed carpet or rug.

Prior mechanisms functioning for such a purpose include a sewing head operating a yarn needle and associated hook by which the yarn is caused to traverse the carpet fabric to form a tuft design according to a selected pattern. The needle is caused to move step by step across the back of the carpet by hand and as the mechanism is relatively heavy the operators have great difficulty in properly guiding the needle and as a consequence sequential tuft arrangement is interrupted by spaces missed by the needle. Furthermore since both the needle and the hook are rigidly mounted, any angular turning of the needle head is resisted because either the needle or the hook or both may be in the fabric when a turn is to be made to follow the pattern. As a result of this there is damage to the carpet caused by the lateral forcing of the hook or needle and in many instances a severing of the carpet yarn. Also in such prior devices there is no provision to release tension upon the yarn as it is fed by the needle, and even if the pull does not break the fed yarn there is a marked difference in the length of the tufts and a resulting imperfection in the design.

Furthermore in prior mechanisms the single, hollow needle is impractical for heavy carpet as there is no underneath support while the needle pierces the carpet, nor can such a needle carry enough yarn to operate through a stiff backed or presized carpet such as rubber or starch.

Also in conventional tufting machines when the pile yarn goes through the back and is caught by a synchronized looper, the operator has to turn the carpet instead of guiding the needle, so such mechanisms are useless where large rugs or carpets are the kind with which the mechanism is to be used.

It is an object of the present invention to provide a tufting mechanism which overcomes the objections and disadvantages of these prior machines.

Another object of the invention is to provide a yarn feeding needle which is self-adjusting laterally to compensate for angle swing of its head.

Another object is to provide a novel movable support acting against the face of the carpet or rug in opposition to the entering of the needle from the back of the carpet or rug.

Another object is to provide means for preventing either a needle or its associated hook while in the carpet from obstructing angular turning of the yarn head.

Another object is to provide a mounting for a tufting yarn hook which is universal in operation.

Another object is to provide a swingable carriage in association with a power driven unit affording easy manual control for tufting operation.

A further object is to provide a tufting mechanism for multiple operation whereby a single operator can

2

simultaneously apply a plurality of like designs to the same carpet or to a number of rugs.

A still further object is to provide an improved mechanism for piercing a fabric backing to form tufts on the fabric face according to a predetermined pattern and in operation is not limited to the size or weight of the material.

In the accompanying drawings, Figures 1 to 5 show the needle and associated hook in the several steps of forming a tuft through a piece of material; Figure 6 represents a front elevation of the hook mounting showing the hook as entering the needle; Figure 7 represents a side elevation of the mounting shown in Figure 6; Figure 8 represents a plan of the needle on line 8—8 of Figure 6, the hook being omitted; Figure 9 represents a front elevation of a modified form of needle mounting; Figure 10 represents a side elevation of the mounting of Figure 9; Figure 11 represents a section on line 11—11 of Figure 10; Figure 12 represents a detail, in front elevation, of the carriage driving means for synchronizing the under carpet support as associated with the tufting parts shown above the carpet; Figure 13 represents a side elevation of Figure 12 with the added manual control; Figure 14 represents a detail in front elevation of one form of needle and hook reciprocating mechanism, the front of the enclosing box being removed; Figure 15 represents a section on line 15—15 of Figure 14; and Figure 16 represents a section on line 16—16 of Figure 14; and Figure 17 represents a perspective of the machine showing the carriage and its universal guiding control.

Referring to Figures 1 to 5 of the drawings, the several steps in the operation of the tufting unit is shown with the material 10 stretched horizontally with its backing juxtaposed to the unit, and its pile face seated upon a support plate 11, which has an aperture 12 for the passage of the needle 13 and its associated hook 14. As will be described later, the plate 11 has a laterally shiftable mounting to accurately follow the travel of the tufting unit and so hold the material taut while the needle pierces the material. The size of the aperture 12 is sufficiently large to permit proper cooperating action of the needle and hook in feeding and looping the yarn 15 through the material. The yarn 15 is drawn by the needle from a reel or spool of any well known type. The needle 13 is in the form of a thin flat T-shaped strip terminating below the eye 16 in a piercing point formed by a bias cut on the face opposite to the leading face of the needle as the latter travels laterally. The face of the needle opposite the hook is formed with a lengthwise way 17 which diverges in the T-head as a funnel-like guide to lead the hook into its sliding position in the way 17.

In contrast to the rigid mounting of tufting needles which has been the practice heretofore, the present invention provides a rockable mounting which allows the needle to have a restricted swing in the plane of its travel as the mounting moves forward while the needle is still in the material. As shown, the T-head of the needle is bolted or otherwise made fast to a yoke 18, which straddles a block 20 fixed to the lower end of the yarn feeding tube 21, and is pivoted to the block 20 on a pivot 22, to form a horizontal axis transverse to the plane of travel. To restore the needle 13 after a yielding movement and to bias it to down stroke position, a coil spring 23 encircles a bolt 24 and is compressed between the nut 19 on the bolt and an angle bracket 25 fixed to the front of the block 20. The bolt 24 is threaded into the yoke 18 as will be understood. Thus as the needle mounting travels forward fabric contacted by the needle causes the needle and its yoke to yield and prevent damage. As soon as the needle is out of the fabric, the spring 23 snaps it back to normal position.

3

Referring now to the hook and its mounting, the hook 14 proper, is a relatively thin flat offset body dimensioned to ride freely in the guide way 17 of the needle and having a base or butt pivoted, on a horizontal pivot 27, to a yoke 28, which straddles a head 30 on the lower end of a vertically arranged operating rod 31, and is in turn pivoted on a pivot 32 passing through the head 30. This latter pivot 32 permits the hook to yield rearwardly as its mounting moves forward while the hook is in the fabric but is restored to its normal position by a biasing coil spring 33, immediately after the hook clears the fabric. This coil spring 33 is compressed between a bracket 34 fixed to the head 30, and a bracket 35 fixed to the yoke 28. Thus the hook 14 is free for a limited swing in the plane of travel of the mounting. The pivot 27 is provided to permit yielding of the hook cross-wise of the path of travel but is biased to vertical position by flat springs 36 bearing respectively against opposite sides of the hook butt, which latter has flat faces abutting the respective springs 36. From the foregoing it will be observed that the hook has a yield swing both in the plane of travel and transverse to that travel which in association with a rotary movement about a vertical axis (to be described) provides a complete universal movement.

While the needle 13 is pivoted at 22 to yield in the plane of its travel, it is contemplated also to provide for a cross-wise yielding as shown in Figures 9 and 10, wherein the butt of the needle is arranged to swing about a pivot 37 through the yoke 18 at right angles to the pivot 22 but is maintained biased to its normal vertical position by flat springs 38, fixed respectively to opposite sides of the yoke 18 by studs 40, while the free ends of the springs 38 bear respectively against opposite sides of the needle butt.

As a preferred means for vertically reciprocating the needle 13 and hook 14, in alternately timed relation, two vertically reciprocal rods 41 and 42 are journaled in a housing 43, the former being actuated by a rock lever 44 and the latter by a rock lever 45. The two levers 44 and 45 are alternately actuated respectively by cams or the other well known movement transmitting means. The motion of the rod 41 is transmitted to the needle tube 21 by a laterally disposed yoke 46 fastened to the rod 41 by a set screw 47 at one end and at the other end straddling a collar 48, which is provided with two holes 50 and 51 for the respective passage of the hook rod 31 and the needle tube 21. The yoke 46 is thus adjustable on the tube 21 to vary the stroke of the needle as desired. A set screw 52 fastens the collar 48 to the tube while an integral circumferential flange 53 on the collar 48 seats in a groove 54 in the yoke 46. By this arrangement reciprocation of the yoke 46 is transmitted to the collar 48 and to the tube 21, while permitting the collar 48 to turn with any turning of the needle and hook about a vertical axis. Since the collar 48 is not connected to the rod 31 the latter has free sliding movement through the hole 51 for independent reciprocation as required. Preferably the hole 51 provides a clearance about the rod 31.

In a like manner the motion of the rod 42 is transmitted to the hook rod 31 by a laterally disposed yoke 55 fastened to the rod 42 by a set screw 56 at one end and at the other end straddles a collar 57, which is provided with two holes for the respective passage of the needle tube 21 and the hook rod 31. The yoke 55 is thus adjustable on the rod 42 to vary the stroke of the hook as desired. A set screw 61 fastens the collar 57 to the rod 31 while an integral flange 62 on the collar 57 seats in a groove 63 in the yoke 55 similarly to that described for the yoke 46. Thus reciprocating movement is transmitted by the yoke 55 to the collar 57 and the rod 31, while permitting the collar 57 to follow any turning of the needle tube 21 and the hook rod 31 about

4

a vertical axis. Since the collar 57 is not connected to the tube 21, the latter has free sliding movement through its collar hole for independent reciprocation as required. Preferably this collar hole provides a clearance about the tube 21.

For permitting the tufting unit to follow the contour of a selected pattern it is journaled in the housing 43 so that the tube 21 and rod 31 can rotate together about a vertical axis. Thus the upper ends of these members traverse holes in a bearing 64 journaled in the housing 43 and the lower ends thereof traverse holes in a hub 66 journaled in the bottom of the housing 43. Rotation of the unit takes place through the medium of a driven bevel gear 67 keyed to the hub 66 and arranged to be manually turned by a hand wheel 68 for accurate swing of both the needle and the hook. Also the gear 67 is in mesh with a bevel gear 70 keyed to a laterally extending suitably journaled shaft 71 for a purpose to be described. By this construction the needle and the hook have a compound motion of rotation and reciprocation, the former causing the tufting members to turn together about a vertical axis to follow a pattern, and the latter to simultaneously alternately reciprocate the needle and the hook.

Since the tufting unit is arranged to travel over all of the backing area of a carpet in following the pattern it is necessary to provide means for causing the support plate 11 to accurately follow the same pattern and maintain its vertically aligned relation with the needle and the hook. For this purpose the plate 11 is fixed to a post 72 to extend horizontally in contact relation with the pile face of the carpet or other material and with its hole 12 coaxial with the axis about which the tufting unit turns. The post 72 forms an extension of a gear box 73, which is carried on the outer end of one branch 74 of a vertically bifurcated arm 75, the upper second branch 76 thereof, carrying the housing 43 in superposed relation to the gear box 73. The bifurcated arm 75 thus provides an elongated horizontal slot or throat to receive the carpet being tufted. As a travelling support, a swingable inverted U-shaped frame 77 has a transverse shaft 78 supporting a rotatable drum 80 having a wheel 81 keyed thereto and adapted to travel over the top of a table 82. The drum 80 carries an attached worm gear 83 driven by a pinion 84 through a gear train including shaft 85, gear 86, pinion 87, spindle 88, bevel gears 90 and 91, shaft 92, sprocket 93 and chain 94. This chain 94 is driven from a suitable power source as will be understood.

As a means for swinging the frame 77 about a vertical axis, a sleeve 95 extends upwardly through the bottom of the gear box 73 to turn relative thereto in a bearing 96 to terminate in a bevel gear 97 keyed thereon. The lower end of the sleeve 95 carries a flange 98 bolted or otherwise made fast to the top of the wheel frame 77. As shown, the sleeve 95 provides a through hole for the spindle 88. The gear 97 is driven by a meshing gear 98 keyed to a shaft 100 extending horizontally below and parallel to the shaft 71, and driven by bevel gears 101 and 102 from a shaft 103 in turn rotated by bevel gears 104 and 105 from the shaft 71. Thus by operating the hand wheel 68, the tufting unit and the wheel frame travel in synchronism while following the pattern. As an aid to accurate and sensitive angular turning the traction face of the wheel 81 is bevelled to form an approximate line contact with the table top.

In order that the two units carried by the arm 75 can be swung to all parts of the stretched carpet, this arm 75 is pivoted on a vertical pivot 106 fixed to a skeleton frame 107 having upper and lower extensions 108 journaled upon a post 110 rising from a pedestal 111 fixed to the floor. Adjacent the free end of the frame 107 a depending leg 112 carries a journaled wheel 113 to support and follow the movement of the arm 75. As will be seen from Figure 12, a horizontal universal swing of the tufting

5

head and the underneath supporting plate 11 is provided, and which in conjunction with the swivelled wheel support ensures precision following of a pattern. This swing movement is controlled by the user grasping the handle 68 attached to the gear 67. While the swivelled wheel rides upon a fixed base as a support for the plate assembly and can accurately trace the pattern, it has also an important function as a control for tuft spacing. As will be seen from Fig. 12, the wheel 81 rotates about a horizontal axis but it is also turnable about its vertical swivel axis which is directly alined with the axis about which the needle turns. Thus since the tufting unit and the wheel 81 swing together about the common pivot 106 with the same radius the pattern is always followed precisely and without distortion. This novel axis alinement assembly is what brings about its universal movement, ensures accurate coordination for uniform spacing of the tufts, and prevents a distorted pattern such as necessarily follows where the supporting wheel and unit do not swing about a common pivot. It should be borne in mind that present novel assembly solves the problem of effectively tufting heavy, backed carpet and hence requires massive construction weighing hundreds of pounds. By this pattern following assembly the entire area of a stretched carpet can be operated upon by manually propelling the jointed frame wherever the pattern dictates tufting is to take place. There is no turning or other manipulation of the material as has been necessary in applying a pattern to a carpet heretofore.

With the pattern following motion in mind the operation of the tufting unit can be followed from Figures 1 to 5, inclusive, wherein the axis of rotation of this unit is indicated by the arrows. In Figure 1 the needle 13 has pierced the material and drawn a length of yarn with it and the hook 14 has snapped into alinement with the hook guide and then follows down as shown in Figure 2 to hold the placed yarn while the needle rises to leave the loop held by the hook as in Figure 3. As the needle tube 21 is moving to the right as shown in Figure 2, the needle mounting swings about its pivot 22 to relieve strain upon the fabric and as it rises to clear the fabric the coil spring 23 restores it to the position shown in Figure 3. Here a length of yarn 15 follows the needle upwardly while the hook holds the loop, and it is this length which serves to relieve any strain on the yarn as the needle again starts down on a working stroke. This small excess strain relieving length is shown in dotted lines in Figure 4 where it enters the space provided by the offset of the hook. It should also be noted in Figure 4 that the hook 14 due to lateral contact with the fabric (while its mounting moves to the right as shown in Figure 4) has yielded by swinging about its pivot 32 but holds the loop as shown in Figure 5 while the needle has continued its down movement drawing the yarn for the next loop. As soon as the hook rises about the fabric as shown in dotted lines Figure 1, it is restored to its initial position by the coil spring 33. Where sharp angular turning is required in following the pattern both the needle and the hook are provided with yield-means to relieve the lateral strain on the fabric. In the case of the needle, the pivot 37 functions as shown in Figures 9 and 10, while in the case of the hook the pivot 27 functions. In both constructions flat springs operate to restore the members as soon as each rises above the fabric.

In order that the needle and the hook can be removed from the carpet, as in change of pattern or otherwise, the support 11, is arranged to be lowered by a handle 114, to control a toggle, including pivoted links 115 and 116, the former being pivoted to the post 72, which carries the support 11. In this way the carpet follows the lowering movement until free from both the needle and the hook. Thus a forward pull of the handle 114, breaks the toggle for the lowering movement and a rearward push restores the toggle to bring the support 11 to its carpet supporting position.

6

Having now described my invention, I claim:

1. In a tufting machine, the combination of a needle for passing yarn through a fabric, a hook coacting with said needle to form a loop in said fabric, common means for causing said needle and hook to travel in a selected path, means mounting said needle to swing in the plane of its travel while in the fabric, means also mounting said needle to swing cross-wise with respect to its path of travel means mounting said hook to swing in the plane of its travel in response to lateral fabric contact, and means to respectively reciprocate said needle and hook in timed relation.
2. A tufting machine in accordance with claim 1, wherein supplemental means mounts the hook to swing cross-wise with respect to said path of travel in response to lateral fabric contact to prevent fabric damage by lateral contact therewith.
3. In a tufting machine in accordance with claim 1 wherein means are provided to rotate said needle and said hook about a common vertical axis.
4. In a tufting machine, the combination of a needle for passing yarn through a fabric, a hook coacting with said needle to form a loop in said fabric, common means for causing said needle and hook to travel in a selected path, means respectively mounting said hook to swing in the plane of its travel and cross-wise of said travel in response to lateral fabric contact, means to restore said hook when out of the fabric, and means to respectively reciprocate said needle and hook in timed relation.
5. In a tufting machine the combination of a tufting unit including a needle, a hook and means respectively to reciprocate said needle and hook in timed relation, means to rotate said needle and hook about a common vertical axis, a plate to support a carpet on the face opposite to that which the needle enters, means including a swivelled wheel for maintaining said plate in alined position with respect to said needle, the swivel axis of said wheel being in alinement with said hook and needle axis means to drive said wheel, a frame for supporting said unit and said maintaining means respectively alined in vertical spaced relation to receive a carpet therebetween, and means mounting said frame for universal movement in a horizontal plane to follow a selected pattern.
6. A tufting machine in accordance with claim 5, wherein means are provided to turn said tufting unit relatively to said frame.
7. A tufting machine in accordance with claim 6, wherein means operate to turn said wheel in synchronism with said tufting unit.
8. A tufting machine in accordance with claim 7, wherein a common means controls both turning means.
9. In a tufting machine, the combination of a needle for passing yarn through a fabric, a hook coacting with said needle to form a loop in said fabric, common means for causing said needle and said hook to travel in a selected path, means mounting said needle to swing cross-wise with respect to said path of travel, means mounting said hook to swing cross-wise with respect to its path of travel, said two swinging means being respectively actuated by lateral contact of the needle and the hook with the fabric, and means to reciprocate said needle and hook in timed relation.
10. In a tufting machine, the combination of a needle for passing a yarn through a fabric, a hook coacting with said needle to form a loop in said fabric, common means for causing said needle and hook to travel in a selected path, means respectively mounting said needle to swing in the plane of its travel and cross-wise of said travel, both in response to lateral fabric contact, means respectively mounting said hook to swing in the path of its travel and cross-wise of said travel, both in response to lateral fabric contact, and means to respectively reciprocate said needle and hook in timed relation.
11. As an element of a tufting unit, a vertically disposed rod, means supporting said rod for reciprocation, a rockable member pivoted to the lower end of said rod to swing

7

in a selected plane, a yoke pivoted to said member to swing in a plane at right angles to said first plane, and a hook carried by said yoke, whereby said hook support is operated selectively by lateral fabric contact with the hook in its line of travel and by contact cross-wise of said travel. 5

12. As an element of a tufting unit, a vertically disposed yarn feed tube, means supporting said tube for reciprocation, a rockable member pivoted to said member to swing in a selected plane, a yoke pivoted to said member to swing in a plane at right angles to said first plane, and a needle carried by said yoke, whereby said needle support 10

8

is operated selectively by lateral fabric contact with the needle in its line of travel and by contact cross-wise of said travel.

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