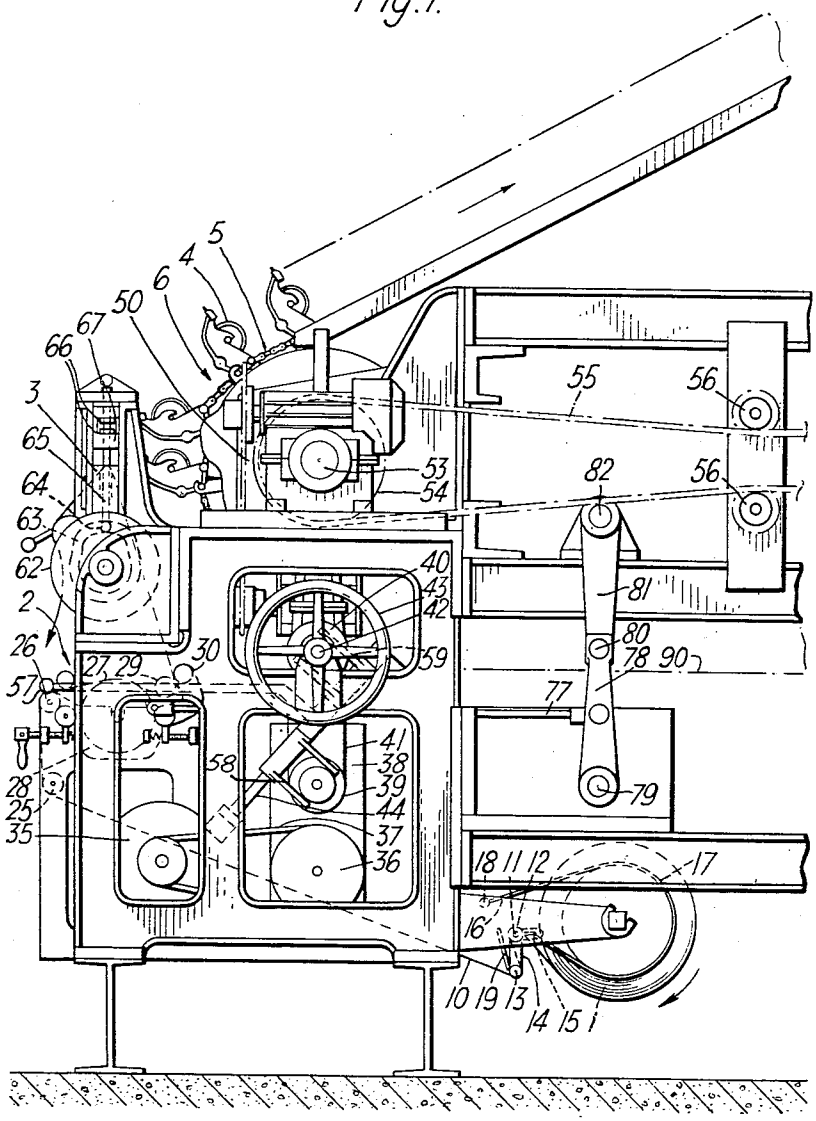
May 29, 1956 E. T. C. BRINTON ET AL 2,747,647

MANUFACTURE OF FABRICS HAVING A TUFTED SURFACE

Filed Jan. 24, 1955 5 Sheets-Sheet 1

Fig. 1.



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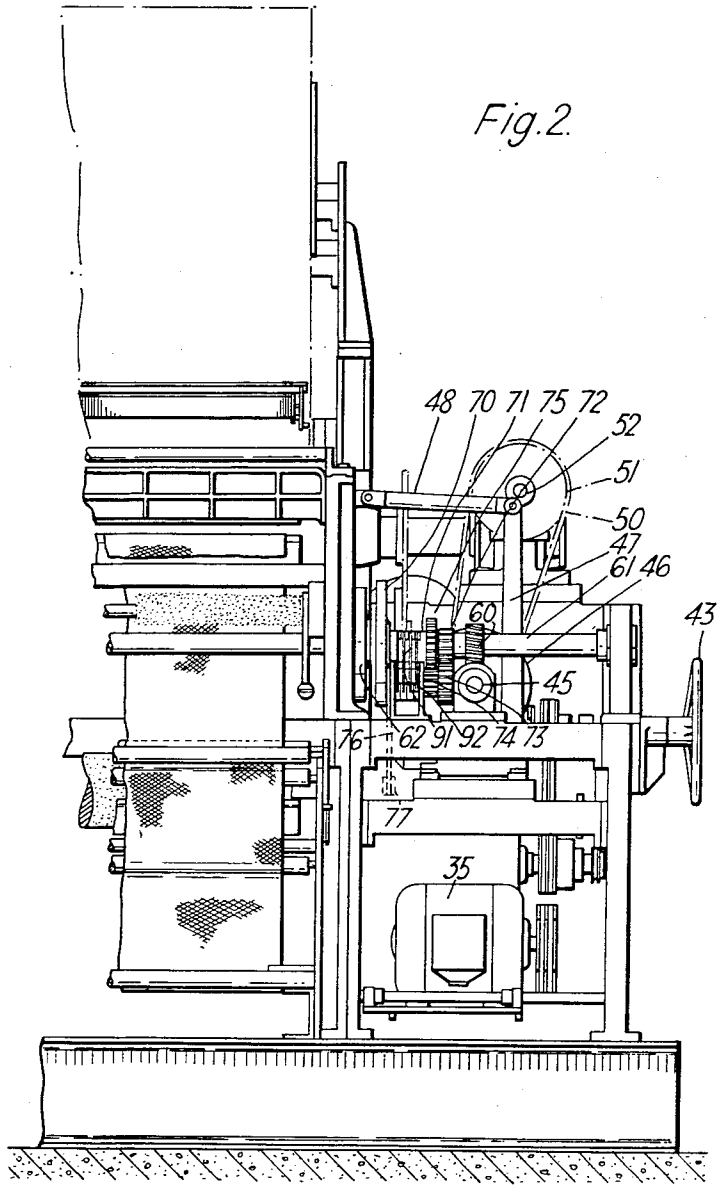
Filed Jan. 24, 1955 5 Sheets-Sheet 2

Fig. 2.



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Filed Jan. 24, 1955 5 Sheets-Sheet 3

Fig. 3.

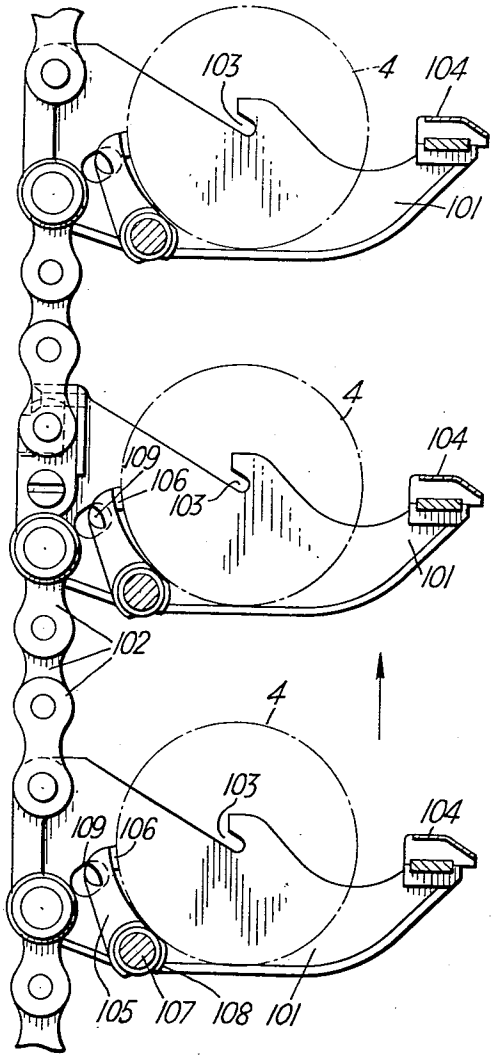
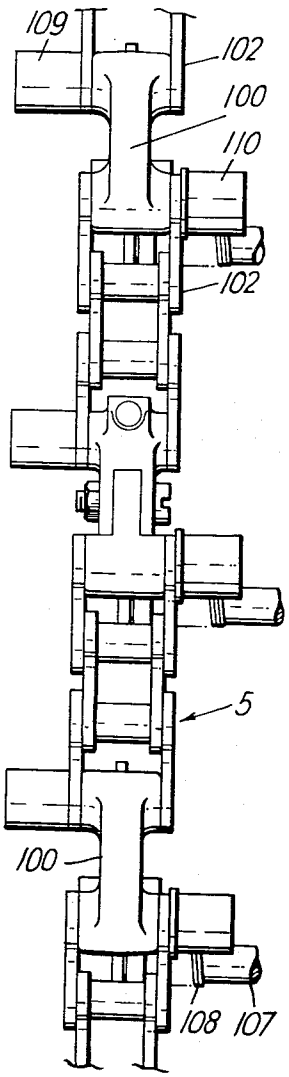


Fig. 4.



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MANUFACTURE OF FABRICS HAVING A TUFTED SURFACE

Filed Jan. 24, 1955 5 Sheets-Sheet 4

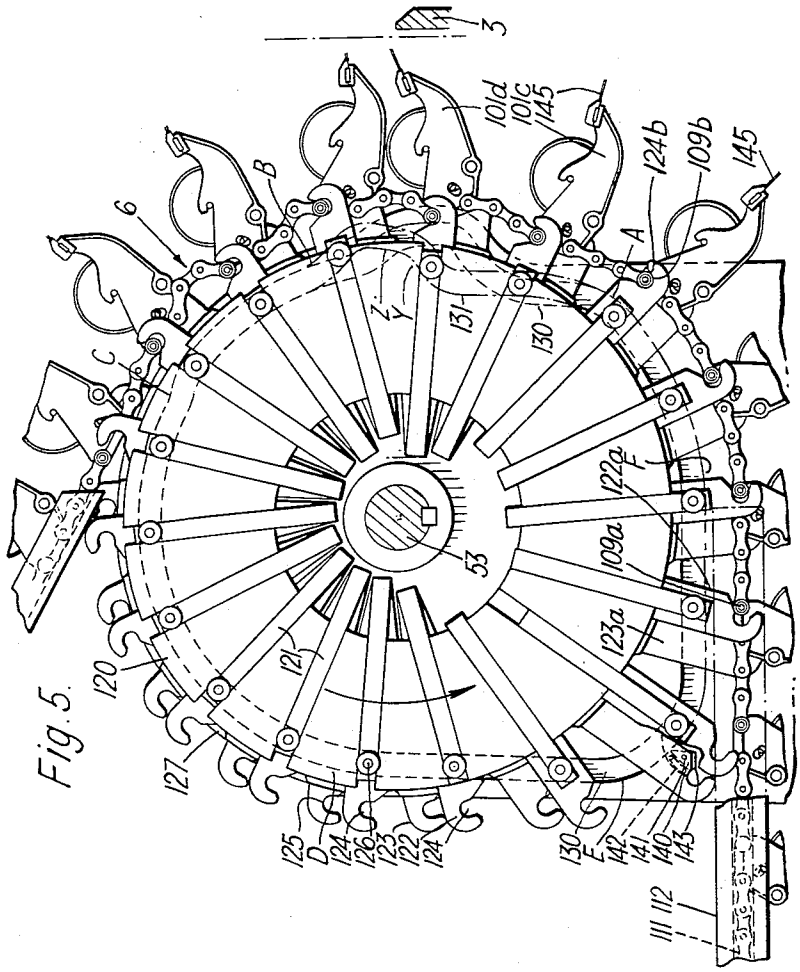

Fig. 5.

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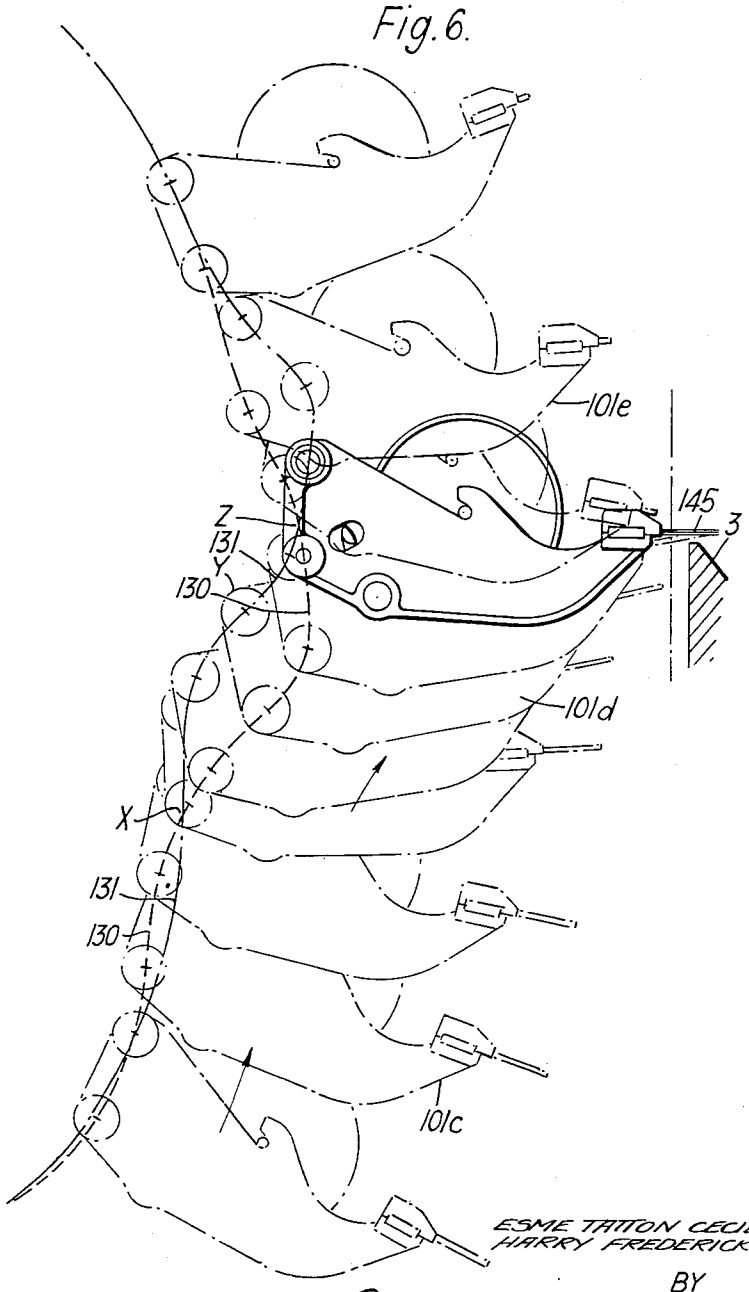
Filed Jan. 24, 1955 5 Sheets-Sheet 5

Fig. 6.



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United States Patent Office 2,747,647 Patented May 29, 1956

2,747,647

MANUFACTURE OF FABRICS HAVING A TUFTED SURFACE

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Application January 24, 1955, Serial No. 483,635

Claims priority, application Great Britain January 27, 1954

7 Claims. (Cl. 154—1.1)

This invention, a continuation-in-part of United States Patent Number 2,711,777, relates to the manufacture of carpets and similar fabrics having a tufted surface. The commonest method for the production of such fabrics is by means of a spool loom and, as described in U. S. Patent No. 2,711,777 the principle of the spool chain may also be employed in similar machines in which the tufts are secured to an adhesive-coated backing instead of being held in position by the normal weaving process.

The aforesaid specification describes a construction of machine in which the operation is greatly accelerated by passing each spool through the sequence of movements necessary to embody its row of tufts in the fabric without removing the spool from the chain and without stopping the chain. For this purpose each spool is given two separate components of motion by means of cam-followers working in appropriately shaped tracks and mounted respectively on the axis of the spool and on a radial arm extending from the spool. The object of the present invention is to produce a similar sequence of movements by means of an alternative form of mechanism.

Thus in accordance with the invention, each spool is mounted in a carrier, which while it is passing through the region in which the tufts are to be embodied in the fabric, is engaged at points spaced apart in the general direction of movement by one of a number of pairs of arms, each of which slides in a substantially radial slot in a rotary spider turning in synchronism with the movement of the chain, the longitudinal position of each arm in its slot being controlled by a cam follower on the arm which co-operates with a stationary cam track. In this way the movements of all the spools in the vicinity of the point where the tufts are embodied in the fabric are controlled by successive pairs of arms with the result that the configuration of the length of chain in question is controlled by the relative positions of the successive pairs of arms, while the angular position of each carrier is controlled by the relative positions of the two arms in the pair by which it is engaged. By means of appropriate shaping of the cam tracks, each spool can thus be given the necessary composite motion to pass its row of tufts through the sequence of steps required to embody it in the fabric. It will be appreciated that this operation does not interferee at all with the continuous movement of the chain, nor does it necessitate the removal of the spools from the chain so that a high speed of operation is obtainable.

Preferably the points at which each carrier is engaged lie at the ends of the link of the chain to which it is secured so that the rocking movements are transmitted directly to the link, and the link itself is thus only required to move a small amount in comparison with the movement of the row of tufts. In order to effect the necessary engagement, each of the arms may be formed with a U-shaped jaw co-operating with a roller on or connected to each spool carrier. The cam tracks are so shaped that each pair of arms moves up behind the

respective spool carrier at a slightly greater speed until the jaws have engaged with the rollers. For a short while the arms move at the same speed as the chain, but subsequently the arms are withdrawn into the spider so that the spool carrier is caused to pass around a path of decreased radius with the result that its speed is slightly reduced and slack is introduced into the chain. This then allows the necessary rocking movements of the individual links to be carried out. When the sequence of steps necessary for embodying the tufts in the fabric has been completed, the arms are adjusted to a radius giving them a velocity slightly less than that of the chain as a whole so that as the chain moves away along a tangential path, each of the arms parts company with its roller.

In practice the second of the two arms, that is to say, the trailing arm has the major controlling effect on the motion of the spool as a whole, the leading arm serving mainly to produce the rocking movements. To ensure that the jaw on the trailing arm remains in engagement with its roller throughout, it may be fitted with a self-locking latch which engages and locks the roller in position and is freed by retraction of the arm into the spider shortly before it is due to disengage the roller.

The spider may conveniently comprise a central rotary plate formed on one side with slots for the leading arms of each pair and on the other side with slots for the trailing arms of each pair, the whole assembly turning between stationary side plates, one of which is formed with a cam track for controlling the leading arms, and the other of which is formed with a cam track for controlling the trailing arms. Apart from the mechanism for controlling the composite movements of the spools in the regions of the points where they are embodied in the fabric, the remainder of the machine may conveniently be constructed in substantially the same manner as that described in U. S. Patent No. 2,711,777. Such a construction of machine will accordingly now be described in more detail by way of example, parts which correspond with those in the previous machine being described only in outline. In the accompanying drawings:

Figure 1 is a side elevation of the front part of the machine;

Figure 2 is a front elevation of the right-hand side of the machine;

Figures 3 and 4 are a side view and a front view respectively of the chain carrying the spools;

Figure 5 is a sectional view of the spider mechanism for controlling the composite motion of the spools; and

Figure 6 is a diagrammatic view showing the composite motion in more detail.

Basically the machine is intended for the production of carpet by means of tufts secured to a backing of hessian drawn from a roll 1. The hessian passes through a device, indicated generally as 2, for coating it with adhesive, such as polyvinyl chloride, and it thereafter passes over a stationary electrode 3 co-operating with a reciprocating upper electrode not shown in the drawings, but operating in the same manner as described in the earlier patent specification. The tufts of yarn are laid on the backing material on the stationary electrode 3 by means of successive spools 4 carried by a continuously moving endless spool chain 5. The composite movement necessary for the embodying of the tufts in the fabric is produced by means of a spider mechanism shown generally at 6 and illustrated in detail in Figures 5 and 6. As each row of tufts is laid on the lower electrode 3, the upper electrode descends, a high frequency voltage is applied between the two electrodes and the di-electric heating effect thereby produced causes the adhesive to gel so that the row of tufts is anchored in position.

The various stages of the operation of the machine will now be described in more detail. The hessian back-

ing material 10 is led off the bottom of the roll 1 and passes round a jockey roller 11 mounted on a shaft 12 and then round a further roller 13. The roller 13 is mounted on an arm 14 secured to the shaft 12 and this shaft also carries a further arm 15 to which is secured the end of a brake band 16. The brake band 16 passes round a brake drum 17 and is anchored at the other end at 18. Tension in the backing material 10 tends to rock the arm 14 in a clockwise direction against the effect of a spring 19, thereby slackening the brake band 16 and allowing the roll to rotate. As soon as tension in the band 10 is released, the brake is applied again.

The band of material then passes over rollers 25 and 26 and then over a large roller 27, the lower surface of which dips into the adhesive in a trough 28. This transfers a layer of adhesive to the underside of the band 10 which then passes around a roller 29 and past a fixed spreader cylinder 30 so that the material passing to the fixed electrode 3 carries a uniform coating of the adhesive. The band 10 is advanced step by step by means of mechanism similar to that shown in the earlier specification and not shown in the present drawings. As it moves forward each step so a row of tufts is laid in position and is anchored by the descent of the upper moving electrode, the anchored tufts being raked into position by means of a raking mechanism also as described in the previous specification.

The main drive to the machine is provided by means of an electric motor 35 driving a pulley 36 by means of a belt 37. The pulley 36 constitutes the input to a variable speed gearbox 38, of which the output pulley 39 drives a further pulley 40 through a belt drive 41. Also connected to the same shaft 42 as the pulley 40 is a handwheel 43 which can be used to operate the machine manually for purposes of adjustment. The handwheel 43 is connected to the shaft by means of a dog-clutch which is controlled so that, as the handwheel is engaged, the gearbox 38 is de-clutched and vice-versa. For this purpose a rocker shaft 44 (not shown in Figure 2) is controlled by a handle 57, and rocking movements of the shaft cause forks 58 and 59 to engage and disengage the two clutches simultaneously.

The shaft 42 drives (through gearing not shown) a cam shaft 45 carrying a cam 46. This cam controls the movements of a lever 47 pivoted at its lower end and at its upper end connected through a link 48 to a standard form of knife for shearing the tufts after they have been anchored in position. The knife mechanism itself is not illustrated, but it will be understood that it lies immediately adjacent the upper reciprocating electrode in much the same manner as illustrated in the earlier specification. Also driven from the shaft 45 by way of a chain drive 50 and a gearwheel 51 is a shaft 52, which in its turn drives a shaft 53 carrying a gearwheel 54. The wheel 54 drives a chain 55, which is guided by idlers 56 and provides the drive for the spool chain 5 at the rear of the machine. The shaft 53 provides the main drive for the spider mechanism 6 to be described in detail later.

The shaft 45 also drives through spiral gearing 60 a shaft 61 extending across the width of the machine. This shaft 61 carries a cam 62, which is duplicated on the other side of the machine and which controls the reciprocation of the upper electrode. For this purpose the cams 62 are provided with cam tracks 63, which control cam followers 64 connected to push rods 65, which in their turn support the upper electrode. This is mounted for adjustment by means of nuts 66 screwed on a threaded portion of each push rod 65 between the limbs of a C-shaped casting 67, which itself is connected to the upper electrode. By suitable adjustment of the two nuts 66, the electrode can be raised or lowered in relation to the push rods 65, again in the same manner as described in the earlier specification.

The shaft 61 also drives a half-speed cam 70, which is mounted on a sleeve 71 turning on the shaft 61. The half-speed drive to the cam 71 is obtained through gears 72 on the shaft 61, and 73 on a lay shaft respectively, and thence via gears 74 on the lay shaft and 75 on the sleeve 71.

The cam 70 controls the rocking movement of a rod 76 pivoted in the region of its centre and connected at its lower end to a connecting rod 77. This connecting rod in its turn serves to rock an arm 78 pivoted to the frame of the machine at 79. The top of the arm 78 is pivoted through a lost motion connection 80 to a corresponding upper arm 81 pivoted to the frame of the machine at 82. These two arms together control the operation of a combined brake and gripper mechanism described in detail in application No. 483,740 and not illustrated in the present drawings.

The purpose of this mechanism is to pull out a fresh length of yarn from each spool as it passes along the horizontal lower reach indicated in chain dotted lines at 90. By pulling out the yarns at this point, the composite motion which has to be produced by the spider mechanism 6 is correspondingly simplified and moreover the brake mechanism itself is also simplified since it has a greater amount of space in which to work. The application of the brake mechanism and the opening and closing of the gripper mechanism is controlled by means of pneumatic pressure, which must, of course, be applied in synchronism with the rocking of the arms 78 and 81 under the control of the cam 70. The sleeve 71 accordingly carries four further cam surfaces indicated generally at 91 which control respectively four switches 92 which in their turn control solenoid valves in the compressed air supply. In this way the operation of the brake and gripper mechanisms is synchronised with the remainder of the machine.

The details of the spool chain itself and the mounting of the spools on the chain is illustrated in detail in Figures 3 and 4. Every fourth link 100 of the chain 5 has secured to it a spool carrier 101, the intermediate links 102 being of normal construction. Each carrier 101 supports a spool 4 shown only diagrammatically in Figure 3, the spindle of the spool being received in a seating 103. In addition each carrier 101 bears a gate member 104 formed with partitions through which the ends of the yarns wound on the spool are led off. Each spool has its individual brake 105 provided with a brake shoe 106 bearing against the flange of the spool. The brake 105 rocks on a spindle 107 extending along the length of the spool and the brake is urged into contact with the flange of the spool by means of a coiled spring 108. In addition each brake 105 is formed with a small lug 109 by means of which the brake can be lifted while a common brake is being applied to the yarns on the spool as described in detail.

The ends of each link 100 are provided with bowels or rollers 109 and 110 respectively which are concentric with the pivots between the ends of the link 100 and the adjacent links 102. When slack is introduced into the chain, as described later, each link 100 can be rocked by gripping the rollers 109 and 110, thus leading to a corresponding rocking movement of the carrier 101 and of the associated row of tufts held by the gate member 104.

While the chain is travelling along the horizontal lower reach 90, the rollers 109 and 110 run in guide tracks 111 in horizontal members 112 as seen in Figure 5, which is a view from the opposite side to Figure 1. These guide tracks serve to steady the spool carriers and their associated spools over this portion of the circuit. As the rollers 109 and 110 approach the end of the guide tracks 111, they are engaged by the spider mechanism 6.

This comprises a central rotary plate 120 which is keyed to the shaft 53 referred to in the description of Figure 1. The plate 120 is formed on opposite sides with a series of slots 121 for the reception of arms, those lying in front of the plate 120 in Figure 5, being shown as 122, while those lying behind the plate 120 are shown as

123. The arms 122 and 123 are each formed on their leading edge with a U-shaped jaw 124 and 125 respectively, the jaws of a pair of arms being spaced apart circumferentially by a distance approximately equal to the distance between the rollers 109 and 110 on the links 100 of the chain. Each of the arms 122 and 123 is provided with a cam follower 126 co-operating with a stationary cam track. These cam tracks are formed in a pair of side plates, one of which is shown at 127 and the other of which is removed as shown in Figure 5. The cam followers of the arms 123 co-operate with a track 130 which is shown dotted where it is hidden by the plate 120, while the cam followers of the arms 122 co-operate with a cam track 131, which, as seen in Figure 5, is coincident with the cam track 130 over the greater part of the circle, but which diverges from it between the points A and B where it is shown by chain dotted lines.

Between the points C and D the coincident cam tracks 130 and 131 follow a circular arc and each pair of arms 122 and 123 consequently merely rotates with the plate 120 without any sliding motion. Beyond the point D, however, the cam tracks 130 and 131 follow a straight line path as far as the point E so that over this portion of the revolution, the pair of arms is extended and consequently the velocity of the jaws 124 and 125 is increased. Just beyond the point E, the tracks turn a corner through slightly more than a right-angle but are maintained at their full extension. At this point the jaws 124 and 125 move into the line of the chain 5, which is so adjusted in relation to the operation of the spider mechanism that tha arm 122, which is the leading arm of the pair, lies behind a roller 109 on the chain, while the arm 123, which is the trailing arm, lies behind a roller 110. Thus the leading arm 122*a* is seen to lie just behind the roller 109*a*, while the corresponding trailing arm 123*a* lies the same distance behind the roller 110*a*, which is out of sight. In view of the fact that the arms are extended beyond their normal radius, they are travelling faster than the chain and consequently the jaws 124 and 125 begin to catch up on the rollers 109 and 110. At the same time the radius of the cam tracks 130 and 131 begins to decrease until when the point F is reached, the radius is such that the jaws 124 and 125 are travelling at the same speed as the chain, and full engagement of the trailing arm (which cannot be seen) is reached at this point. This continues as far as point A and provides a constant velocity pull for the chain passing the brake and gripper mechanisms previously referred to. During this time there is a clearance between the roller 109 and the jaw 124 which only disappears at A in readiness for rocking movement of the links of the chain.

Each of the jaws 125 on the trailing arms 123 is provided with a self-locking latch, one of which is seen at 140, the corresponding arm 122 being broken away for the purpose since these latches are normally invisible. Each latch is pivoted at 141 and is provided with a small leaf spring 142 which rocks it into the position shown. As the arm 123 catches up with its corresponding roller 110, the roller engages a heel portion 143 of the latch, rocking the latch against the action of its spring until the roller is firmly in the jaw 123, when the latch rocks back again and then prevents the withdrawal of the roller. After the point F, the trailing arms 123 have the major controlling effect on the spool carriers 101 and the latches 140 thus ensure that the rollers are firmly engaged by the jaws 125.

After passing the point A, the two cam tracks 130 and 131 turn inwardly, serving to withdraw each pair of arms so that the jaws 124 and 125 are moving more slowly than the main body of the chain. This continues between the points A and B and since the chain here is moving more slowly, a certain amount of slack is introduced which enables the links 100 to be rocked so as to give the spool carriers 101 the necessary movement for embodying the tufts shown as 145 in the carpet.

Initially the track 130 turns inwardly very slightly more than the track 131 so that the leading jaw 124 is moved very slightly to the right in relation to the trailing jaw 125 and the spool carrier shown as 101*c* is given a slight clockwise rotation. Shortly after this, however, the tracks 130 and 131 cross at the point shown as X, seen most clearly in Figure 6, and the tracks 131 turns inwardly, moving the leading jaw 124 to the left in relation to the trailing jaw 125, and giving the spool carrier a rocking movement in a counter-clockwise direction. Thus the spool carrier seen as 101*d* has its row of tufts inclined upwardly. Immediately after this both tracks 130 and 131 move to the right together at the point Y so that without appreciable rocking motion the spool carrier is moved bodily to the right to lay its row of tufts 145 on the backing 10 supported by the stationary lower electrode 3.

After this, the track 130 turns inwardly again to cross the track 131 at Z and gives the spool carrier a clockwise rocking movement. This clockwise rocking movement combined with the general upward movement of the chain momentarily holds the tufts 145 stationary on the backing, and during this instant the upper electrode descends and the knife comes into operation to shear the row of tufts. As soon as this operation is complete, the clockwise rocking movement stops and the spool carrier proceeds upwardly in approximately the same attitude as seen at 101*e*. Thereafter the track 130 inclines inwardly until once again it coincides with the track 131, after which further rocking movement of the spool carriers ceases.

The jaws 124 and 125, however, continue in engagement with the respective rollers 109 and 110 until the point C is reached when both arms are withdrawn into their slots by a single step. This withdrawal has a dual effect. In the first place it rocks each of the latches 140 in a clockwise direction owing to engagement between the latch and the side of the slot 121 in the rotary plate 120. This frees the roller 109 from the jaw 125 and at the same time the fact that the jaws are moving along a decreased radius causes them to slow down in relation to the respective rollers and thereafter to part company as seen in Figure 5. Thereafter each pair of arms continues along a constant radius path until the point D is reached when the cycle is again repeated and each pair of arms takes over the control of a fresh spool.

It will, of course, be understood that the spool chain may carry as many as several hundred spools so that a considerable period may lapse until the same spool returns once again. During the period when the rollers 109 and 110 are engaged by the jaws 124 and 125, the spool carrier is controlled solely by the shape of the two cam tracks 130 and 131. Any shaping of these tracks which results in a common movement of the two arms results in bodily displacement of the spool carrier and of the associated row of tufts, while any shaping of the cam tracks resulting in relative movement of the two arms of a pair results in a rocking movement of the spool carrier, and by a combination of these two possibilities the required composite motion of the row of tufts is produced. The chain moves continuously throughout and there is, of course, no question of removing the spools from the chain.

Although as shown the chain comprises a series of main links 100 separated by three intermediate links 102, these may be replaced by longer links with slotted lost-motion connections between them so that each link bears a spool carrier. This simplifies the construction of the chain and avoids any possibility of the links jamming together when it is required to produce slack in the chain for the purpose of rocking the spool carrier.

Although as shown in the drawings, the cam tracks are designed to produce a composite motion which is simplified by the omission of the step of pulling out the fresh lengths of yarn, which is carried out independently by the brake and gripper mechanism, the tracks can, of course, be designed to include this additional step. They

can in fact be designed to given any required series of steps, such, for example, as those required for a normal spool loom where the tufts are woven into position rather than being secured to a backing as in the present example.

We claim:

1. A machine for the production of fabric having a tufted surface in which tufts of yarn from a plurality of spools each having a plurality of lengths of yarn wound thereon are attached to a backing, comprising a chain having mounting means for supporting said spools with the ends of said lengths of yarn projecting, a plurality of means supporting said chain in a closed circuit, means for driving said chain around said closed circuit, first and second engagement means connected to each said mounting means, said engagement means being spaced apart in the general direction of movement of said chain, a rotating spider, driving connection means between said spider and said driving means, said spider being formed with a plurality of substantially radial slots in its opposite faces, a plurality of first arms located for sliding movement in said slots in one face of said spider, each said first arm being shaped for cooperation with said first engagement means, a plurality of second arms located for sliding movement in said slots in the other face of said spider, each said second arm being shaped for cooperation with said second engagement means, a first cam-follower connected to each said first arm, a first cam-track cooperating with each said first cam-follower, a second cam-follower connected to each said second arm, a second cam-track cooperating with each said second cam-follower, whereby during rotation of said spider said first and second arms are given a sliding movement in said slots, thus giving a corresponding movement to successive said first and second engagement means to give the composite motion to said yarn ends necessary for embodiment in said backing, means for driving said backing in a path adjacent the path of said composite motion, means for securing said yarn ends to said backing, and means for severing said yarn ends.

2. A machine according to claim 1, in which the first and second engagement means lie at the ends of the link of the chain to which it is secured.

3. A machine according to claim 2, in which each of the arms is formed with a U-shaped jaw co-operating with a roller on each spool carrier.

4. A machine according to claim 3, in which each second arm is provided with a self-locking latch which engages the corresponding roller and is freed by movement of the arm shortly before it is due to disengage the roller.

5. A machine according to claim 1, in which the spider comprises a central rotary plate formed on one side with slots for the first arms of each pair and on the other side with slots for the second arms of each pair, the whole assembly turning between stationary side plates, one formed with a cam-track for controlling the first arms, and the other formed with a cam-track for controlling the second arms.

6. A machine according to claim 1, in which the yarns are pulled out from the spools at a point other than that at which they are embodied in the fabric, the cam-tracks being shaped to give a sequence of steps which excludes that of pulling-out the yarns.

7. A machine according to claim 6, in which the tufts are secured to an adhesive-coated backing and the cam-tracks are shaped to give a composite motion comprising the steps of laying the tufts on the backing and maintaining the lengths of yarn constant while they are severed.

No references cited.