This invention relates to improved apparatus for filling a rotary broom core, i.e. for applying bristles to such a core, and for removing the bristles from such a core for replacement.

The bristles on a rotary broom of the type used in mechanical street sweepers very frequently wear out and must be replaced. To allow for such replacement, the bristles are removably attached to the core of the broom, by means of a cable which is wound tightly within a helical groove in the core, with the bristles being retained in the groove between the cable and core. The general object of the present invention is to provide a machine for mechanically applying such a cable and bristles to a core, and for removing the cable and bristles from the core.

A machine embodying the invention includes means for mounting and rotating a broom core, and means for feeding the cable into the groove as the core turns. As the cable is wound, the bristles are fed to the core by additional means, preferably comprising an endless conveyor assembly having spaced bristle advancing fingers. A cable winding drum may be provided for removing the cable from the core during removal of a used set of bristles from the core. Desirably, both the cable and bristle feeding means are mounted to a carriage which moves axially of the drum during a winding or unwinding operation to follow the helical groove.

One difficulty previously encountered in broom filling devices has been the tendency for the cable or cable guiding means to engage the edges of the core groove in a manner chipping off portions of the groove walls during a winding operation. An important object of the invention is to provide means for assuring against such damage to a core. This is achieved in part by special mounting of the cable guiding means to direct the cable toward the core at an angle corresponding to the pitch of the groove. The cable guiding means may be mounted for bodily swinging movement to positions of different angularity for accurate adjustment to a particular groove pitch. Also, further protection is afforded the groove walls by provision of a special control for varying the rate of relative axial advancement of the cable and core if the width of the cable varies from the desired angularity. This control may be effected by an automatic clutch control on an axial feed screw drive.

An additional feature of the invention resides in a unique combing unit for assuring proper alinement of the bristles in mutually parallel relation as they are fed to the core. This unit may include a pair of combing elements adapted to move relatively apart and toward opposite ends of the bristles, desirably at the lower portion of a feed chamber or hopper.

The above and other features and objects of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawings in which:

Fig. 1 is a perspective view of a broom filling machine constructed in accordance with the invention;

Fig. 2 is a vertical transverse section taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary horizontal section taken on line 3—3 of Fig. 2;

Figs. 4 and 5 are fragmentary horizontal sections taken on lines 4—4 and 5—5 respectively of Fig. 2;

Fig. 6 is a fragmentary perspective view of a portion of the apparatus for controlling the speed of carriage advancement relative to the core which is being wound;

Fig. 7 is a rear view of the bristle combing apparatus, taken on line 7—7 of Fig. 2;

Fig. 8 is a fragmentary perspective view of an inner portion of the brush core which is to be filled;

Figs. 9 and 10 are fragmentary perspective views of the two bristle advancing chains;

Figs. 11a and 11b are sections taken on line 11 of Fig. 2, but showing the clutch controlling apparatus in two different conditions;

Fig. 12 is an enlarged section taken on line 12—12 of Fig. 1;

Fig. 13 is a fragmentary partially diagrammatic perspective view of the apparatus shown in a bristle removing condition;

Figs. 14a and 14b are enlarged vertical sections taken on lines 14a—14a and 14b—14b, respectively of Fig. 2;

Fig. 15 is an enlarged fragmentary transverse section taken on line 15—15 of Fig. 1;

Fig. 16 is a fragmentary vertical central section through the apparatus of Fig. 7;

Fig. 17 is a fragmentary vertical section showing a portion of the upper run of the cable and bristle guiding chain, and

Fig. 18 is an enlarged fragmentary partially sectional view of the cable and bristle advancing and guiding unit.

Referring first to Fig. 1, the drawings represent a device for applying bristles to, and removing bristles from, the core 10 of a conventional rotary brush or broom of the type utilized in mechanical street sweepers. A core of this type is essentially cylindrical, and has a helical groove 11 extending about the core and along its entire axial extent, for reception of the bristles 12 and a flexible cable or wire rope 13 for retaining the bristles on the core. As will be readily understood, the bristles have double or return bend portions which extend into the groove, and which extend about the inner side of the cable 13 which is also in the groove, so that the cable positively retains the bristles in their doubled and outwardly projecting condition. The opposite ends of cable 13 are attached to the ends of the core, as at 14, at least one of the ends of the core being detachable from the core to allow unwinding of the cable for removal and replacement of the bristles. At its two ends, core 10 has a pair of mutually alined shafts 15, each of which contains an axial keyway 16 for keying the shaft to a drive wheel or pulley when the brush is in use.

The illustrated broom filling machine includes a rigid frame 17 to which core 10 is removably mounted by a pair of upstanding supports 18 during a broom filling operation. The core 10 is power driven by a suitable motor 19, which also serves to drive a drum 20 onto which cable 13 is wound when it is removed from core 10. During the application of any bristles to core 10, the cable from drum 20 is directed toward helical groove 11 past a guide structure 21, while the elongated fibers or bristles 12 are fed to the core beneath the cable from a bristle supply unit or hopper 22 by a pair of endless feed chains 23, and a second chain 24 within guide unit 21. The cable and bristle feeding parts 20 through 24 are all mounted to a carriage structure 25 for bodily movement axially of core 10 during a winding or unwinding oper-
ation, to follow the helical groove 11. Also, all of these parts 25 to 28 mounted on drum 20, carried by a swinging structure 26 which is mounted on carriage 25 for horizontal swinging movement as well as the specified axial movement, to allow for alignment of the cable and bristle feeds with the angularity or pitch of groove 11 in the core.

The frame 17 may be mounted on a number of wheels 27 to allow movement of the entire unit to a desired location on a supporting surface or floor. The frame preferably includes a pair of horizontal members 28 at its opposite ends to which are mounted upstanding frame members 29, with a number of longitudinal rigid frame members 30, 31, 32 and 33 extending between and interconnecting the end members 28 and 29. The two longitudinal frame elements 22 and 23 are spaced one above the other, and may be of externally cylindrical and tubular configuration, to serve as guiding means for the horizontally movable carriage structure 35. The two core supporting upstanding members 18 are attached at spaced locations to a longitudinally extending pipe 34, whose opposite ends receive a pair of short tubes or shafts 35 to mount pipe 34 for rotary movement about shafts 35, in a manner such that core supporting members 18 may swing downwardly and forwardly from their Fig. 1 broom filling positions to a position in which the core member 11 rests on the floor surface to allow mounting and dismounting of the core. At their upper ends, elements 18 carry a pair of bearing elements 36 which may be removably mounted within bearing housings 37, and which receive and journal the two shafts 16 at opposite ends of core 10.

One of the supports 18 is mounted for axial movement along the carrying pipe 34 to allow insertion of shafts 15 into bearings 36, this mounting being effected by providing the lower end of that element 18 with a foot structure 38 having rollers 39 guided for only axial movement within an axially extending groove 40 formed in the outer surface of pipe 34. A pair of straps 41 carried by foot structure 38 extends about pipe 34 to retain rollers 39 in groove 40, and are tightening by screws 42 to releasably fasten foot structure 38 and the carried element 18 in any set position along pipe 34. The two core supporting elements 18 are actuable between their upstanding positions and their forwardly swung positions by means of winding and unwinding of a flexible cable 43 on a reel 44 turned by crank 245. Cable 43 first extends about a pulley 44 secured to frame member 31, then extends about pulleys 45 and 46 attached to members 47 projecting rearwardly from elements 18, and finally connects at 48 to winding cable 43 on reel 44, through windings 18 and a carried core 10 upwardly to the winding position illustrated in Fig. 1. The core may be retained in this position by tightening of any suitable lock element, typically represented at 49, against reel 44.

During the application of a cable 13 and bristles to a core 10, the core is power driven by motor 19 through a sprocket wheel 50, which is mounted on and keyed to one of the end shafts 15 of the core. This sprocket wheel 50 is driven by an endless chain 51 which extends about sprocket wheel 50 and a sprocket wheel 52 connected to the output shaft 53 of a speed reduction gear assembly 54, which is in turn driven by the motor 19. Chain 51 also extends about a sprocket wheel 55 which is connected to a one direction braking unit 56. This unit 56 does not exert a braking force against core 10 when turning in a direction to wind cable 13 on the core within groove 11, but does exert a braking force for preventing reverse or cable unwinding rotation of the core, to maintain cable 15 at all times during a winding operation.

The horizontally moving carriage 25 includes two vertically spaced horizontally extending parallel rigid members 57, interconnected by a pair of vertically extending spaced parallel pipes or tubes 58. The horizontal members 57 rotateably carry rollers 59, which are curved in correspondence with, and engage upper and lower sides of, frame members 32 and 33, to mount the carriage 25 for movement longitudinally of elements 32 and 33. Carriage 24 is moved axially of core 10 by means of a power driving lead screw 60, which extends parallel to the axis of core 10, and which is rotatably journaled at its opposite end of frame members 29 and 33. Screw 60 is rotatably driven in timed relation to the rotation of core 10 by means of a drive system including a sprocket wheel 62 on shaft 53, a chain 63, sprockets 64 and 65 and a countershaft 66 journaled in frames carried bearings 67, a chain 68, and a sprocket wheel 69 attached to the end of screw 60. Screw 60 is rotatably and threadedly engaged a relatively rotatable nut 70, which is rotatably journaled within but retained against axial movement relative to a bearing 71. This bearing 71 is in turn rigidly attached to a support member 25 which may be rigidly secured in any suitable manner to the upper one of the carriage members 57.

As will be apparent, if nut 70 is allowed to rotate within bearing 71, rotation of screw 60 will not be effective to axially or horizontally advance carriage 25. However, if the nut 70 is retained against such rotation, the screw rotation will serve to axially advance the carriage 25. To this end, the clutch or brake unit 73 (see Figs. 1, 2 and 15), which includes an inner rotatable member 74 attached to nut 70 for rotation therewith. Also, the clutch or brake unit 73 includes a pair of semi-circular brake bands or shoes 75, having friction lining 76, which shoes are retained against rotation by attachment at their upper ends to a member 77 which is in turn attached to the carriage structure through element 72. The two bands or shoes 75 are so mounted that their lower ends 78 are free for relative movement toward and away from each other between position in which they do and do not retain nut 70 against rotation. A spring 79 yieldingly urges the lower ends 78 of the bands 75 toward each other and to a braking position, and the bands are actuated apart to released position by rotation of a vertical control shaft 80 whose operation will be discussed in greater detail at a later point.

The cable winding drum 20 is mounted for rotation about an axis parallel to the axis of core 10, being rotatably supported by a support or bearing structure 81 which is typically attached to the upper element 57 of carriage 25. The cable winding drum 20 is adapted to be rotatably driven by screw 60 in the manner applied to shaft 52 which extends parallel to screw 60 and is journaled within frame carried bearings 83. Shaft 82 is driven from countershaft 66 by means of a chain 84 engaging a pair of sprocket wheels 85 and 86. For providing a drive connection between shaft 82 and the relatively axially movable drum 20, I employ a sprocket wheel 87 which is carried about and rotatably keyed to shaft 82, but is axially movable relative to that shaft. Wheel 87 in turn drives a chain 88, which meshes with and drives a sprocket wheel 89 connected to drum 20. The sprocket wheel 87 may be rotatably mounted to carriage 25 by means of a bearing structure 90 attached to a member 91 which extends angularly upwardly from carriage element 57. In order to key the sprocket wheel 87 to shaft 82, the sprocket wheel of course is provided with a lug or keying projection fitting into the spline recess 92 of shaft 82.

The drive to shaft 82 is controlled by means of a clutch 93 (see Fig. 12), which may be controlled by the motor 19. A clutch is engaged by the movement of sprocket wheel 86. For this purpose, the sprocket wheel 86 may be provided with ratchet or clutch teeth 94 for engaging corresponding teeth 95 formed on an element 96 secured to shaft 82. As will be apparent from Fig. 12, the drive connection to shaft 82 is broken by merely manually displacing sprocket wheel 86 axially along shaft 82 to the broken line posi-
tion of engagement with stop shoulder 97, so that teeth 94 and 95 do not engage. When the motor is turning in
motion, when drum 20 turns cable 13 around pin 10, the direction of rotation of sprocket wheel 86 is such that
the angular teeth surfaces 98 automatically cam sprocket wheel 86 axially to its broken line inactive position, so
that the motor does not turn drum 20.

The horizontally swinging structure 26 is mounted to carry members 99 and 100 of horizontal parallel plate-like members 99, which have tubular bosses 100 at their opposite ends slidably received about vertical members 88 for vertical adjusting movement. Set screws 101 in bosses 100 are tightenable against elements 88 to releasably fasten parts 99 and the carried swinging structure in any desired vertical position. In order to coun-
terbalance the weight of the vertically movable parts, to facilitate adjustment of these parts, the lower member 99 may be urged upwardly by a pair of springs 102 at-
tached at their lower ends to element 99 and at their upper ends to carriage member 57.

The swinging structure 26 carries a downwardly projecting shaft 103 which is journaled within a tubular boss 104 carried by the lower member 99, while the upper member 99 carries a downwardly projecting tubular member 105 journaled within a boss 106 attached to swinging structure 26, to thus mount structure 26 for swinging movement about the common vertical axis of parts 103, 104, 105 and 106. The structure 26 may include a pair of vertical side plates 107 (see Fig. 1) hav-
ing rearwardly extending lower portions 108, and inter-
connected at the front structure 26 by a pair of verti-
cally spaced plates 109 and 110 over which the bristles and cable are fed forwardly to core 10.

During winding of a cable onto core 10, the cable extends downwardly from drum 20 through the tubular members 105 and 106, and then about a variable diameter pulley 111, and along the underside of chain 24 of guide unit 21 to the core. For retaining the cable very tight during such advancement toward the core, there is provided a unidirectional brake 112, which offers re-

cistance to the unwinding of the cable from drum 20.

Brake 112, however, allows free rotation of drum 20 in the reverse direction during the winding of cable 13 onto the drum. Preferably, brake 112 comprises a hy-
draulic pump 112a driven by drum 20, and acting when driven in one direction to pump fluid in a closed system through a preset pressure relief bypass valve 112b leading back to a reservoir 112c from which the pump takes suction. When drum 20 turns in the reverse direction (cable unwinding direction), pump 112a has no pumping action. As seen in Fig. 13, drum 20 has a short stub cable 113 carrying a connector 114 at its end which is capable of releasably connecting to cable 13 when the apparatus is in use. This cable 13 is sufficiently long to allow complete winding of the cable 13 onto core 10 before cable 113 is detached from cable 13.

The cable guiding unit 21 includes a body formed of sheet metal which is bent to form a pair of parallel ver-
tically extending side plates 115 interconnected by an upper portion 116 of the body. The guide chain 24 is mounted for endless movement between the side plates 115 by a number of sprocket wheels or rollers 117 rot-

tably mounted to the side plates. The links of chain 24 have a series of pairs of bristle advancing fingers 118 projecting downwardly from their opposite sides, between which fingers the cable 13 is received as it advances toward core 10 (see Fig. 10). Outwardly beyond chain 24, the side plates 115 of guide unit 21 rotatably carry between them an outer roller 119 (see Fig. 14), adapted to extend into groove 11 and laterally engage its sides, to control the positioning of unit 21 relative to the groove. The various sprocket wheels or rollers 117 mounting chain 24 may direct the lower run of the chain along essentially a straight line, except at the location of the forwardmost sprocket wheel 117a (see Fig. 18) which

is offset above and forwardly of the other wheels 117, to direct chain 24 generally parallel to the surface of the core 10. Referring now to Figs. 2 and 17, the unit 21 includes also a removable pin 400 which is remov-
ably insertable into a pair of registering openings 401 in the two side plates 115 of unit 21, which, when so positioned, extends across the path of bristle engaging fingers 118 of chain 24, to lock the chain against endless movement.

The cable guide unit 21 is hinged at 121 to plate 110 of swinging structure 26, for upward swinging move-
ment between the active position of Figs. 1, 2 and 14 (in which roller 120 extends into groove 11), and an
upwardly retracted inactive position. Unit 21 is retain-
able in its active position by clamping units 122 (see Figs. 1 and 2), which may comprise screws 123 adapted to swing laterally into and out of notches 124 in an ele-
ment 125 carried by unit 21, the screws 122 carrying nut elements 126 which are tightenable against element 125 to retain that element against plate 110 to which screws 122 are pivotally attached. A counterbalance spring 321 may be provided for yieldingly suspending a portion of the weight of unit 21, being connected at its lower end to the plates 115 and at its upper end to member 72.

The fibers or bristles 123 are fed to the apparatus by being manually placed on an upper portion 124 of a feed chute or hopper structure 125. When placed on chute 125, bristles 123 are in mutually parallel relation, and are confined between a pair of side walls 126 at opposite sides of the chute or hopper. The bristles first advance along a gradually inclined upper portion of chute 125, and then fall downwardly along a more incli-

cned portion 127 of the chute, and onto the upper sur-
face of a horizontal bristle feed plate 128. A vertical wall 129 of the hopper confines the bristles at the for-
ward side of the hopper, and may carry an electric vibra-
tor 130 which actuates bodily vibrate the entire hopper including its parts 125, 126 and 129, to effect the desired advancement of the bristles toward the lower end of the hopper. To allow for such vibration of the hopper, the entire hopper 125, 126, 129 is resiliently mounted by two sets of coil springs 131 at opposite sides of the hopper, which springs may be supported on elements 132 attached to the rearwardly extending side portions 108 of swinging structure 26. If desired, the hopper structure may include a trough 133 within which a supply of fibers may be positioned in preparation for their being manually fed into the hopper.

As the lower end of the inclined feed wall of hopper 22 nears plate 128, the hopper wall may curve forwardly at 134 to a location spaced beneath the lower end of vertical wall 129, which may carry a transverse element 135 whose lowest edge is spaced a short distance above plate 128. Plate 128 is mounted for vertical ad-
justment relative to walls 125 and 129, and element 135, by means of a number of vertical screws 136 which project upwardly from elements 137 extending transversely between the rearwardly extending side portions 108 of swinging structure 26. As seen in Fig. 2, screws 136 are rigidly attached at their upper ends to the plate 128, and carry nuts 138 above and beneath elements 137, so that adjustment of the nut will vertically adjust plate 128.

The bristles 12 are advanced along the upper side of plate 128, and toward the left as seen in Fig. 2, by a pair of endless chains 23 disposed at opposite sides of plate 128, and having spaced upwardly projecting fingers 139, for engaging and advancing the bristles. Chains 23 are mounted for endless movement by a pair of plate-like members 140 lying in vertical planes and having upper horizontal edge surfaces along which the upper runs of chain 23 extend. At its underside, each of the plates 140 has a central downwardly projecting portion 141, whose bottom edge acts as a guide for the lower run of
2,927,820 7 chain 23 at 142. Chains 23 are power driven in a direction for advancing bristles 12 to the left as seen in Fig. 2, the drive being effected by a pair of sprocket wheels 143 engaging the undersides of the chains 23 respectively, and carried by a common horizontal shaft 144 which is journaled in side plates 107 of structure 26. At one of its ends, shaft 144 carries an additional sprocket wheel 145 (see Fig. 1) which is driven by a sprocket wheel 146 through a chain 147. Wheel 146 is in turn carried and driven by a shaft 148 which extends parallel to shaft 144, being journaled by suitable bearings 149 attached to the rear side of element 110. The previously discussed adjustable diameter pulley 111 (see Fig. 2) is attached to and drives shaft 148, so that as chain 13 advances past and in engagement with pulley 111, the resulting rotation of that pulley acts through parts 148, 146, 147, 145, 144, and 143 to drive chains 123 in timed rotation to the cable advancement. Thus, bristles 12 are fed to the underside of the cable chains 23 as the cable advances. The rate of advancement of the bristles relative to the cable may be adjusted as desired by adjustment of the diameter of pulley 111.

As the bristles 12 fall downwardly within hopper 22, some of the bristles may initially be in improperly aligned positions. In order to align these bristles and to automatically advance them to properly extending relation, I provide a camming mechanism which is illustrated best in Figs. 3, 4, 7 and 16. Referring to these figures, and particularly first to Figs. 7 and 16, this mechanism includes a pair of elongated combing elements or fingers 150, which project through an elongated horizontal slot 151 formed near the lower end of the rear wall 125 of bristle feeder hopper 122. The two fingers 150 are actuated relatively apart from locations adjacent the center of bristles 12, to effect the desired combing action. These two combing elements 150 are mounted to and project forwardly from a pair of vertically extending swinging arms 152, which are hinge at 153 to individual carrier plates 154 for rearwardly swinging movement about a horizontal axis extending longitudinally of the bristles. Each of the arms 152 is yieldingly urged forwardly by a spring 155 to a position in which the carried fingers 150 project through slot 151 into the engagement with the bristles 12. The swing plate 151 extends vertically, and are mounted by rollers 156 for horizontal movement longitudinally of the bristles along a guide rail 157.

Referring now to Fig. 3, the two carriers 154 are alternately moved in opposite directions along guide rail 157 by two parallellogram linkages 158, each of which includes an arm 159 pivoted at 160 to a member 161 rigidly attached to plates 108. The opposite end of each arm 159 contains a slot 162 into which a pin 163 carried by the associated carrier element 154 projects, so that swinging movement of arm 159 causes horizontal movement of carrier 154. The parallellogram structure includes also two links 164 and 165 connected at 166 and 167 to elements 161 and 159 respectively and themselves pivotally connected together with some freedom for relative movement at 168. The link 164 of each parallellogram structure has a projection 169 which extends into an axially wavering cam groove or recess 170 in an element 171 which is carried and driven by the previously discussed shaft 144. The various parts of this drive linkages of Fig. 3 are so proportioned that the rotation of elements 171 acts through cam grooves 170 to alternately move carriers 154 relatively toward and away from positions in which combing elements 150 engage central portions of the bristles 12, and positions in which those elements are near the outer ends of those bristles.

The separating movement of combing elements 150 of course functions to comb the bristles into the desired mutually parallel relation if any initially improperly aligned. On the returning movement of carriers 54 relatively toward each other, the combing elements are cammed out of engagement with the bristles, by a pair of cam tracks 172 (see Fig. 4) which are attached to the hopper structure, and are engaged by rollers 173 rotatably mounted to the upper ends of arms 152. As the carriers 154 commence their movement relatively toward each other, rollers 173 first engage angularly extending portions 174 of elements 172, to cam combing elements 150 out of contact with the bristles, following which rollers 173 slide along portions 175 of elements 172 to ultimately be returned by springs 176 forwardly past end portions 176 of elements 172 prior to the next movement of combing elements 150 relative apart. This reciprocating movement of combing elements 150 is sufficiently rapid to properly align all of the bristles successively forwardly through hopper 22. The operation of the combing elements 150 is timed with respect to chains 23, so that fingers 139 of the chain and the combing elements 150 act to control the number of bristles which pass onto the chain. More particularly, fingers 139 are so timed as to remain in their Fig. 2 position 130 after passing through the concave hopper 22 until one pair of the elements 139 have reached their Fig. 2 positions directly beneath wall 129. At this point, fingers 139 (which have already moved a short distance toward each other) are cammed rearwardly out of slot 151 in the hopper to allow another metered amount of bristles in the desired angularly extending relation, past the front of the next pair of elements 139. The fingers 139 then return forwardly to stop the downflow of bristles until that next pair of elements 139 reach a position directly beneath wall 129. The previously discussed vertical adjustment of plate 128 affords an adjustment of the rate of the slot 151 formed near the lower end of the rear wall 125 of bristle feeder hopper 122.

After the bristles 12 move to the left beyond edge 177 of plate 128 (Fig. 2), the bristles advance onto a pair of elongated laterally spaced support and guide elements 178 which extend along opposite sides of the depending fingers 110 of chain 24. As the cable advances to the left along the underside of chain 24, the resultant movement of chain 24 acts through fingers 118 to advance the bristles which are conically positioned between elements 24 and 178 to the left. Chain 24, in advancing toward core 10, progressively advances downwardly relative to guide fingers 178, so that the bristles are progressively accumulated in any suitable manner onto plate 128 in structure 26, and may have their left ends 178a turned somewhat upwardly in essentially the same direction as chain 24, to maintain the bristles in their bent U-shaped form as they advance into groove 11.

Swinging structure 26 is adjusted relative to the rest of carriage 25, by virtue of the pivotally connected formed by elements 103 to 106, to a position in which the guide chain 24 and aligned roller 119, as well as the cable 13 which extends along the underside of the chain toward the core, are all disposed at an angularity or pitch corresponding to the angularity or pitch of the helical groove 11 in core 10. That is, chain 24 directs cable 13 to the core at an angle to a transverse plane of the core corresponding to the pitch angle of groove 11 with respect to the same transverse plane of the core (i.e. a plane disposed transversely of the core axis). At the same time, the cable 13, as it extends toward the core, is substantially totally forced toward each other and spaced between positions in which combing elements 150 engage central portions of the bristles 12, and positions in which those elements are near the outer ends of those bristles.

The bristles 12 received between fingers 118 of chain 24 of course are disposed directly transversely of cable 13, as well as chains 24 and elements 178. Further, chains 23 extend and move parallel to chain 24 and the engaged portion of cable 13, and hopper 22 is positioned to deposit bristles of the bristles are deposited directly transversely of chains 23, cable 13, and chain 24.

By allowing for the specified alignment of cable 13 with the angularity of groove 11, I provide for feeding the
cable to the core in a manner minimizing the possibility of damage to the side walls of groove 11, and also assuring provision is made to the side walls of groove 11, and also assuring provision is made to

The swinging structure 26 and carried cable and bristle feeding means are retained in a desired rotary position relative to the rest of carriage 25 by means of a chain 180 whose opposite ends are connected by a pair of coil springs 181 to horizontally spaced connectors 182 carried at the sides of carriage 25 as in Fig. 6. This chain 180 extends about a sprocket wheel 183 which is rigidly attached to and rotatable with a member 383 journaled for rotation about a vertical axis within a bearing 185. Bearing 183 is rigidly attached to the non-swinging portion of carriage 25, as by a pair of mounting elements 186 connected to the upper element 99 of the carriage. Chain 180 is held against detachment from sprocket wheel 183 by a metal retaining element or tab 187 removably attached by screws 188 to bearings 185. The chain 180 is set to engage the teeth of sprocket wheel 183 in a particular relation which will hold guide unit 21 and cable 13 at the angularity corresponding to groove 11. This setting may be changed by removing tab 187, then moving the position of chain 180 on sprocket wheel 183 for a distance corresponding to one or more teeth as may be necessary, and then retauching tab 187 to hold the chain against separation from wheel 183. Tab 187 of course allows movement of the sprocket wheel and chain relative to the carriage. Such locking of shaft 80 against rotation renders the above discussed automatic control apparatus including element 191 in a position for locking shaft 80 in the Fig. 11b position, to thus maintain brake 73 inactive in locking in this condition is for any reason desired. A wire 195 may be pivoted to locking element 191, and be adapted to swing about shaft 80 to a position releasably retaining lock element 191 in the Fig. 11b position.

To now describe the complete broom refilling operation performed with the illustrated apparatus, the first step is to actuate crank 245 and its reel 44 in a manner loosening cable 43 in a manner allowing elements 18 to swing forwardly and downwardly to positions adjacent the floor surface. In these positions, a brush of the illustrated type having worn bristles is connected into bearings 36, and straps 41 are tightened to retain the associated element 18 in a proper brush retaining position. Crank 45 is then turned in a reverse direction to swing elements 18 and the carried brush upwardly to the intermediate unwinding positions represented in broken lines in Fig. 2 and in full lines in Fig. 13. In this position, sprocket wheel 50 is attached to one of the shafts 15 of the brush, and drive chain 51 is positioned in driving engagement with this sprocket wheel and the two wheels 52 and 55. A pan 198 of a length and width slightly greater than the brush is placed on the floor beneath the partially raised brush, to catch the worn bristles which are taken off from the core (see Fig. 13). The cable 13 of the brush is then loosened at the left end of the brush as seen in Fig. 1, and the cable is connected to stub cable 113 attached to drum 20, this stub cable being passed through tubular elements 105 and about pulley 111, guide unit 21 preferably being swung upwardly about hinge 121 to an inactive position (this guide unit being retainable in that position by any suitable holding means).

Sprocket wheel 86 is displaced axially along shaft 82 to the full line active position of Fig. 12, to thus become effective to rotate drum 20 in a winding direction. The motor 19 is then placed in operation to drive drum 20 and wind cables 113 and 13 on that drum, thus freeing the worn bristles 12 to fall off of core 10 and into pan 198. This rotation is continued until the cable is unwound completely from core 10, thus freeing all of the bristles and supporting elements 18 upwardly to their upright positions of Figs. 1 and 2. Drive chain 51 is then placed in its operative position of extension about sprocket wheels 50, 52 and 55, so that the motor can be effective to drive core 10 in a winding direction (counterclockwise as seen in Fig. 2). Before a core winding operation, sprocket wheel 86 (Fig. 12) may be displaced to its broken line inactive position, or if desired the cam surfaces 98 may be relied upon to automatically displace wheel 86 to that inactive position when the core winding operation begins.

With the core in its Figs. 1 and 2 position, motor 19 is placed in operation in a direction for turning the core in a counterclockwise direction as seen in Fig. 2. It will of course be understood that motor 19 is a two-direction motor, and is driven in one direction for winding the cable onto drum 20, and in the reverse direction for winding the cable back onto core 10. When motor 19 turns, cable 13 advances from drum 20 through tubular elements 105 and 106, about pulley 111, and along the underside of chains 24 and wheel 119 into helical groove 11 in the core. Such advancement of the cable acts through pulley 111, wheel 146, chain 147, sprocket wheel 145, shaft 144, and sprocket wheels 143, 142 and drive chain 23 in a direction for advancing bristles.
from supply hopper 22 to chain 24 and this cable advancement also serves to drive chain 24 in a manner advancing bristles 12 along the underside of that chain toward the core. Vibrator 130 acts to vibrate hopper 22 in a manner progressively feeding the bristles downwardly onto support 128 for advancement by chain 123, while the operator progressively adds more bristles onto the top surface of hopper 21 permitting the advancement of chain 123 to be advancement downwardly therethrough. In the manner previously discussed, combining elements 150 are intermittently actuated relatively apart while contacting the bristles 12 through aperture 151 in the hopper wall, to assure conduction of all of the bristles into the desired bristles parallel relationship. As will be apparent, the length of slot 151 longitudinally of the bristles should of course be less than the length of the bristles themselves, to prevent the bristles from slipping through that slot.

As the bristles advance to the left in Fig. 2 under chain 24, the bristles being advanced by engagement with the depending fingers 118 of the chain, the bristles ultimately advance to a position closely adjacent the core, in which position the central portions of the bristles are doubled back and confined between cable 13 and the two guide fingers 118 (see Fig. 140). When the leading bristle surface is advanced to this position closely adjacent the core, pin 400 is inserted into its active locking position of Figs. 2 and 17, and the drum 20 is then driven in a direction to unwind cable 13 from core 10, while pin 400 holds chain 24 against such reverse movement with the chain. This reverse movement of the cable is continued until the cable is completely unwound from the core 10, though still attached to it, with the chain 24 holding the bristles against reverse movement along its underside. The winding rotation of core 10 is then resumed (with pin 400 removed), to commence winding the cable and bristles onto the core, the bristles being threaded into groove 11 from its very end by virtue of the described pre-feeding of the bristles to the core location. The winding action of course continues along the entire length of core 10, to secure bristles to the core along the length of the helical groove, with the end of core 10 ultimately being secured to the left end of the core as seen in Fig. 1 to retain the cable and bristles on the core. After the winding operation is completed, crank 45 of Fig. 1 may be actuated to allow elements 18 and the carried brush to swing downwardly and forward to a position in which the brush rests on a flange face, following which the core may be removed from bearings 36 for use. It is noted that, because the bristle advancing action is controlled entirely by movement of the cable itself, through pulley 111 and the described connected mechanism, and through direct actuation of chain 24 by the cable, the bristles are always fed to the core in a very uniform manner, regardless of any variations in the operating speed of the apparatus.

I claim:

1. A broom filling machine comprising means for holding a broom core having a helical groove, means for directing a bristle retaining cable toward said groove at a predetermined angle to the core corresponding to the pitch of said groove, means for rotating one of said first two means relative to the other about the core axis to wind the cable into said groove, means for advancing one of said core and cable relative to the other axially of the core during said rotation, means for feeding bristles to the core between the cable and core to be retained in the groove by the cable, control means responsive to a change in angularity of the cable with respect to the core, and means responsive to said control means to cause said axial advancement of the core and cable to return the cable toward said position of predetermined angularity to the core.

2. A broom filling machine as recited in claim 1, in which said last mentioned means comprise a screw and nut drive connection for relatively axially advancing said core and cable, and a clutch actuable by said control means for interrupting the drive through said connection when the cable is improperly centered.

3. A broom filling machine as recited in claim 1, including means mounting said cable directing means for swinging movement generally axially of said core to vary said angularity of the cable to the core, said control means being responsive to said swinging movement of said cable directing means to vary said axial advancement.

4. A broom filling apparatus comprising means for mounting and rotating about a generally horizontal axis a rotary broom core having a helical groove, a carriage mounted for movement axially of said core as the core turns, means for interrupting the drive through said connection when the cable is improperly centered, and means for interrupting the drive through said connection when the cable is improperly centered.

5. A broom filling apparatus as recited in claim 1, in which said core is wound upon itself, said drum being carried by and rotatable relative to said carriage and movable therewith axially of the core and from which the cable is unwound for winding onto the core, said baffle feeding means including means feeding a series of bristles, generally horizontally and generally parallel to the axis of the core, progressively toward the core from beneath the cable, to be secured in the groove by the cable, and guide means on and movable with said carriage for receiving the cable from the drum and operable at all positions of the cable as it is released from the drum to bring the cable into and maintain it in substantial alignment with the core groove for winding thereon while transmitting the cable tension between the drum and core, and to bring the cable into and maintain it centered relative to said baffle feeding means, whereby the cable always locates the bristles at its point of contact thereon.

6. A broom filling apparatus as recited in claim 1, in which said cable feeding means includes means for rotatably driving said drum to wind the cable thereon during removal of the cable from the core.

7. A broom filling apparatus as recited in claim 1, in which said core is wound onto itself, said drum being carried by and rotatable relative to said carriage and movable therewith axially of the core and from which the cable is unwound for winding onto the core, said baffle feeding means including means feeding a series of bristles, generally horizontally and generally parallel to the axis of the core, progressively toward the core from beneath the cable, to be secured in the groove by the cable, and guide means on and movable with said carriage for receiving the cable from the drum and operable at all positions of the cable as it is released from the drum to bring the cable into and maintain it in substantial alignment with the core groove for winding thereon while transmitting the cable tension between the drum and core, and to bring the cable into and maintain it centered relative to said baffle feeding means, whereby the cable always locates the bristles at its point of contact thereon.

8. A broom filling apparatus comprising means for mounting and rotating about a generally horizontal axis a rotary broom core having a helical groove, a carriage mounted for movement axially of said core as the core turns, means on and movable with said carriage for feeding a cable into said groove as the core turns, and means on said carriage and movable therewith for feeding bristles toward a location between said cable and core for retention by the cable in said groove, said cable feeding means including means feeding a series of bristles, generally horizontally and generally parallel to the axis of the core, progressively toward the core from beneath the cable, to be secured in the groove by the cable, and guide means on and movable with said carriage for receiving the cable from the drum and operable at all positions of the cable as it is released from the drum to bring the cable into and maintain it in substantial alignment with the core groove for winding thereon while transmitting the cable tension between the drum and core, and to bring the cable into and maintain it centered relative to said baffle feeding means, whereby the cable always locates the bristles at its point of contact thereon.

9. A broom filling apparatus as recited in claim 8, in-
excluding means attaching said bristle feeding means to said cable feeding means for said swinging movement thenceforward.

10. Broom filling apparatus comprising a frame, bearings carried by the frame for mounting a core having a helical groove for rotation about a generally horizontal axis, a motor for driving said core, a carriage mounted on the frame for movement generally horizontally and axially of said core, a cable drum onto which a cable from said groove may be wound, an endless guide unit for directing a cable from said drum along the underside of said guide unit and toward said groove for winding about the core, a swinging structure carrying said guide unit and drum, and mounted to said carriage for swinging movement about a generally vertical axis to align the cable and guide unit with said groove, a pair of spaced endless flexible members mounted to said swinging structure for advancing bristles in parallel relation generally horizontally toward the core to be held between the cable and core in said groove, flexible members having spaced upwardly projecting bristle engaging fingers, and a feed chamber for feeding said bristles downwardly into engagement with said endless members.

11. Broom filling apparatus as recited in claim 10, including a lead screw for horizontally advancing said carriage, a clutch for breaking the drive connection from said lead screw to the carriage, means for actuating said clutch in response to swinging movement of said carriage caused by misalignment of the cable with the groove to thereby correct for said misalignment, and means yieldingly retaining said swinging structure in a predetermined position.

12. Broom filling apparatus as recited in claim 11, including a pair of combing elements engaging said bristles at the bottom of said feed chamber, means for actuating said combing elements relatively apart and then toward one another to comb said bristles into alignment, cam means for deflecting said combing elements out of contact with the bristles during said movement toward other end, and means mounting said bearings for swinging movement between the active position and a lowered core mounting position.

13. Broom filling apparatus comprising a frame, bearings carried by the frame for mounting a core having a helical groove for rotation about a generally horizontal axis, a motor for driving said core, means for guiding a cable into said groove as the core turns, means for feeding bristles to a location between said cable and core in the groove, and means mounting said bearings for swinging movement between an active cable winding position and a retracted core mounting position.

14. Broom filling apparatus comprising means for holding a broom core having a helical groove, an endless flexible unit for directing a bristle retaining cable toward said groove, projections on said unit for advancing bristles with the cable toward the core means for driving said core in a direction to wind the cable thereon, means for unwinding the cable from the core, and means for releasably locking said flexible member against endless movement in cable unwinding direction as the cable is being unwound from the core by said last mentioned means, whereby said projections can retain said bristles against movement away from the core with the cable.

15. Broom filling apparatus as recited in claim 14, including a horizontally swinging structure mounting said unit for said endless movement, said locking means comprising a pin connectable into said structure at a location to engage one of said projections and thereby prevent movement of the unit in said cable unwinding direction.

16. Broom filling apparatus comprising means for mounting and rotating a rotary broom core having a helical groove, means for feeding a cable into said groove as the core turns, said cable feeding means including a drum from which the cable is unwound for winding onto to the core, means for feeding bristles toward a location between said cable and core for retention by the cable in said groove, a carriage mounted for movement axially of said core as the latter turns and carrying said drum for movement therewith, and means resisting unwinding of the cable from the drum to hold the cable taut during winding of the cable onto the core, said last mentioned means including a fluid pump carried by and movably axially with said carriage and driven by said drum during said unwinding rotation thereof and having its discharge and inlet sides in communication but with sufficient restriction to resist said rotation and keep the cable taut.

17. Broom filling apparatus comprising means for mounting and rotating a rotary broom core having a helical groove, means for feeding a cable into said groove as the core turns, a conveyor structure for feeding bristles toward a location between said cable and core for retention by the cable in said groove, a hopper for holding a supply of said bristles and having an opening at its bottom through which the bristles fall onto the conveyor structure, an element projecting into said hopper at a location near but spaced a short distance above said conveyor structure, said element extending between a small lower group of bristles and the rest of the bristles thereabove, and means for moving said element essentially horizontally and longitudinally of said bristles to assist in separating out and feeding onto said conveyor structure predetermined amounts of said bristles.

18. Broom filling apparatus as recited in claim 17 including means for vertically adjusting the level at which said conveyor structure supports the bristles relative to said element.

19. Broom filling apparatus as recited in claim 17 in which there are two of said elements projecting into said hopper, said last mentioned means including means for intermittently moving said elements relatively apart and toward opposite ends respectively of said bristles.

20. Broom filling apparatus as recited in claim 17 in which there are two of said elements projecting into said hopper, said last mentioned means including means for alternately moving said elements relatively apart toward opposite ends of the bristles and then relatively together, said last mentioned means including means for shifting said elements essentially out of engagement with the bristles during said movement relatively together.

21. A broom filling machine comprising means for mounting and rotating a rotary broom core having a helical groove, guide means for feeding a bristle retaining cable into said groove, and means for feeding bristles to a location between the cable and core and beneath the cable to be retained in the groove thereby, said guide means including an endlessly movable member above the cable against which the cable is engageable upwardly, said member having spaced lugs projecting downwardly at opposite sides of the cable for engaging and advancing the bristles therebeneath.

22. A broom filling machine as recited in claim 21 including guide means for progressively bending said bristles upwardly at opposite sides of the cable as the cable advances toward the core while being held down by said endlssly movable member.

23. A broom filling machine comprising a first section for holding a broom core having a helical groove, a guide section for feeding a bristle retaining cable into said groove, means for relatively rotating and relatively axially advancing said sections to wind said cable in said groove, means for feeding bristles in mutual parallel relation toward the core to be retained in the groove by the cable, said bristle feeding means including a generally horizontal support member along the upper surface of which the bristles advance, a pair of endless advancing members at opposite sides of the support member and beneath the level of said upper surface thereof.
and having spaced upwardly projecting bristle advancing fingers extending upwardly above the level of said surface to engage and advance the bristles thereon, a hopper for feeding bristles downwardly onto the support member, and means for adjusting said support member vertically relative to said hopper and said endless members.

24. Broom filling apparatus as recited in claim 13 in which said frame is adapted to rest on a supporting surface, and said mounting means supports the bearings and a carried core for swinging movement downwardly from an elevated active position to a lowered retracted position close to said supporting surface.

25. Broom filling apparatus comprising means for mounting and rotating a rotary broom core having a helical groove, a carriage mounted for movement axially of said core as the core turns, means on and movable axially with said carriage for feeding a cable into said groove as the core turns, and means on said carriage for feeding bristles toward a location between said cable and core for retention by the cable in said groove, said cable feeding means including a drum carried by said carriage and movable therewith axially of the core and from which the cable is unwound for winding onto the core, said core mounting means comprising a support, bearings for rotatably holding said core, and means mounting said bearings to said support for swinging movement with a carried core between an active broom filling position and a lowered retracted position.

26. Broom filling apparatus comprising means for mounting and rotating a rotary broom core having a helical groove, a carriage mounted for movement axially of said core as the core turns, means on and movable axially with said carriage for feeding a cable into said groove as the core turns, and means on said carriage for feeding bristles toward a location between said cable and core for retention by the cable in said groove, said cable feeding means including a drum carried by said carriage and movable therewith axially of the core and from which the cable is unwound for winding onto the core, said bristle feeding means comprising endless conveyor means on the carriage progressively advancing said bristles generally horizontally toward the core and having spaced upwardly projecting fingers engaging and advancing the bristles, and a hopper on the carriage for containing said bristles and feeding them downwardly onto said conveyor means, there being a pair of movable combing elements at a lower portion of said hopper projecting into engagement with said bristles, and means for moving said combing elements relatively apart and toward opposite ends of said bristles to align the bristles.

27. A broom filling machine comprising means for mounting and rotating a rotary broom core having a helical groove, means for feeding a cable into said groove as the core turns, said cable feeding means including a rotary element turning in predetermined timed relation to the rate of linear advancement of the cable toward the core regardless of the size of core being used, means for feeding bristles toward a location between said cable and core for retention by the cable in said groove, and mechanism operatively connecting said bristle feeding means to said rotary element for actuation in predetermined timed relation therewith, to thereby feed the bristles and cable to the core in exact predetermined correspondence with one another regardless of differences in the diameter of core used.

28. A broom filling machine as recited in claim 27, in which said rotary element is a wheel which is engaged and turned by the cable as it advances toward the core, said mechanism further comprising mechanism driven by said wheel and driving said bristle feeding means in timed relation to the rotation of said element.

29. A broom filling machine comprising means for holding a broom core having a helical groove, means for directing a bristle retaining cable toward said groove at a predetermined angle to the core corresponding to the pitch of said groove, means for relatively rotating said core mounting means to wind the cable into said groove, means for relatively advancing said cable directing means axially of the core during said rotation, means for feeding bristles to the core between the cable and core to be retained in the groove by the cable, control means responsive to a change in angularity of the cable with respect to the core, and means responsive to said control means to vary said relative axial advancement of the cable directing means to return the cable toward said position of predetermined angularity to the core.

30. A broom filling machine as recited in claim 4, in which said cable feeding means includes a pulley turning about a generally horizontal axis and against which the cable extends in passing to the core, said cable extending about the underside of the pulley and then forwardly to the core to be held in essential alignment with the core groove by the pulley, said drum, bristle feeding means and pulley all being at one side of an upright plane which includes the core axis.

31. A broom filling machine as recited in claim 30, in which the bristle feeding means comprises endless moving conveying means positioned to advance the bristles to a location between said pulley and the core.

32. The structure defined in claim 4 including means engaged with the drum for resisting rotation thereof in an unwinding direction to thereby wind the cable tight on the core.

33. The structure defined in claim 8 including means engaged with the drum for resisting rotation thereof in an unwinding direction to thereby wind the cable tight on the core.

34. The structure defined in claim 8 in which the means mounting the cable feeding means for bodily swinging movement also mounts the bristle feeding means for bodily swinging movement with said cable feeding means.

35. The structure defined in claim 8 in which the cable feeding means includes guide means and movable with the carriage and swingable relative thereto for receiving the cable from the drum and operable at all positions of the cable as it is released on the drum to bring the cable into and maintain it in substantial alignment with the core groove for winding therein and to bring the cable into and maintain it centered relative to the bristle feeding means, whereby the cable always bisects the bristles at its point of contact therewith.

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