Dec. 3, 1963 A. BRIGLIA 3,112,957

BRUSH-MAKING MACHINE

Filed April 27, 1960 3 Sheets-Sheet 1

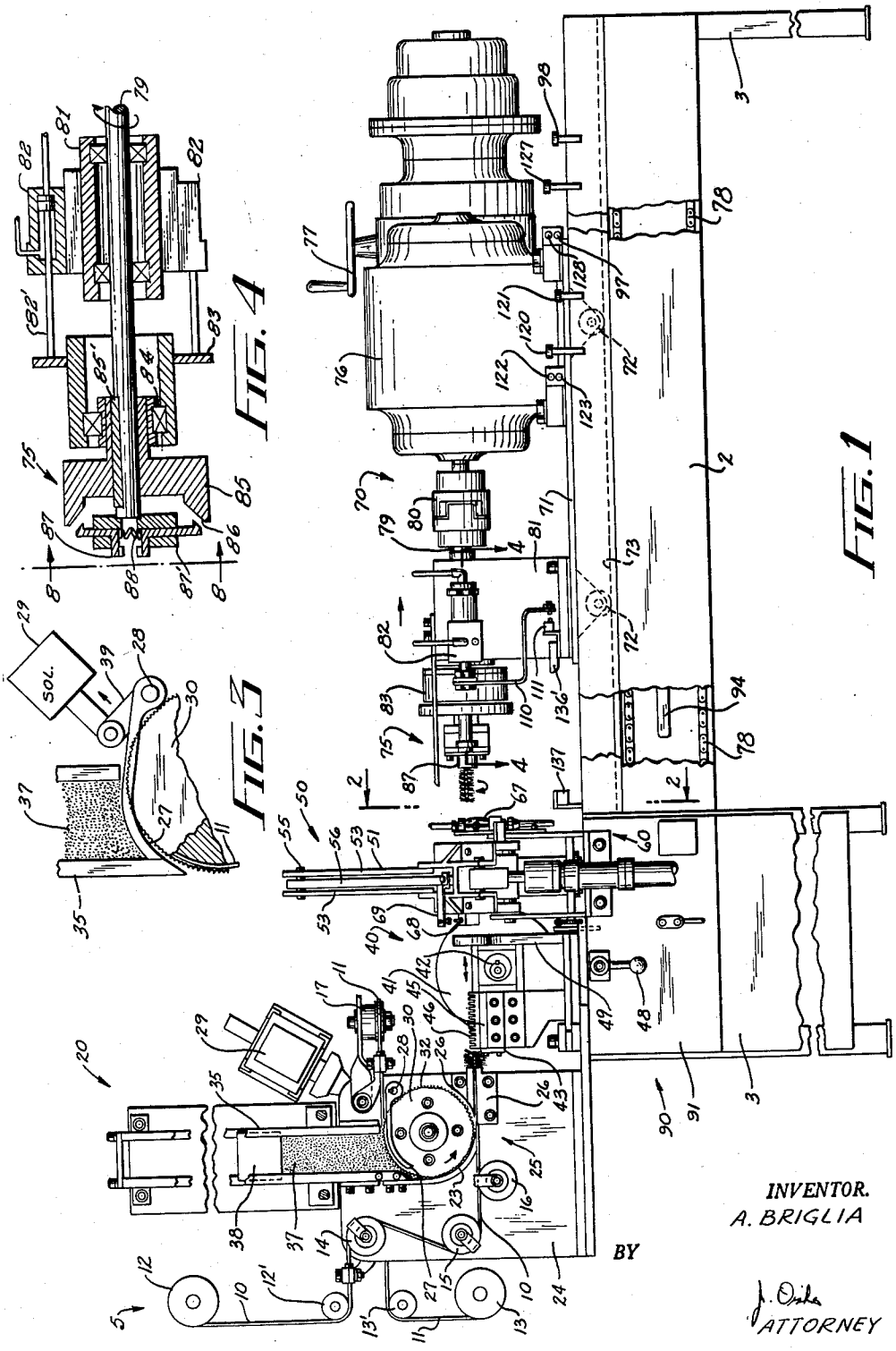


FIG. 1

FIG. 4

FIG. 3

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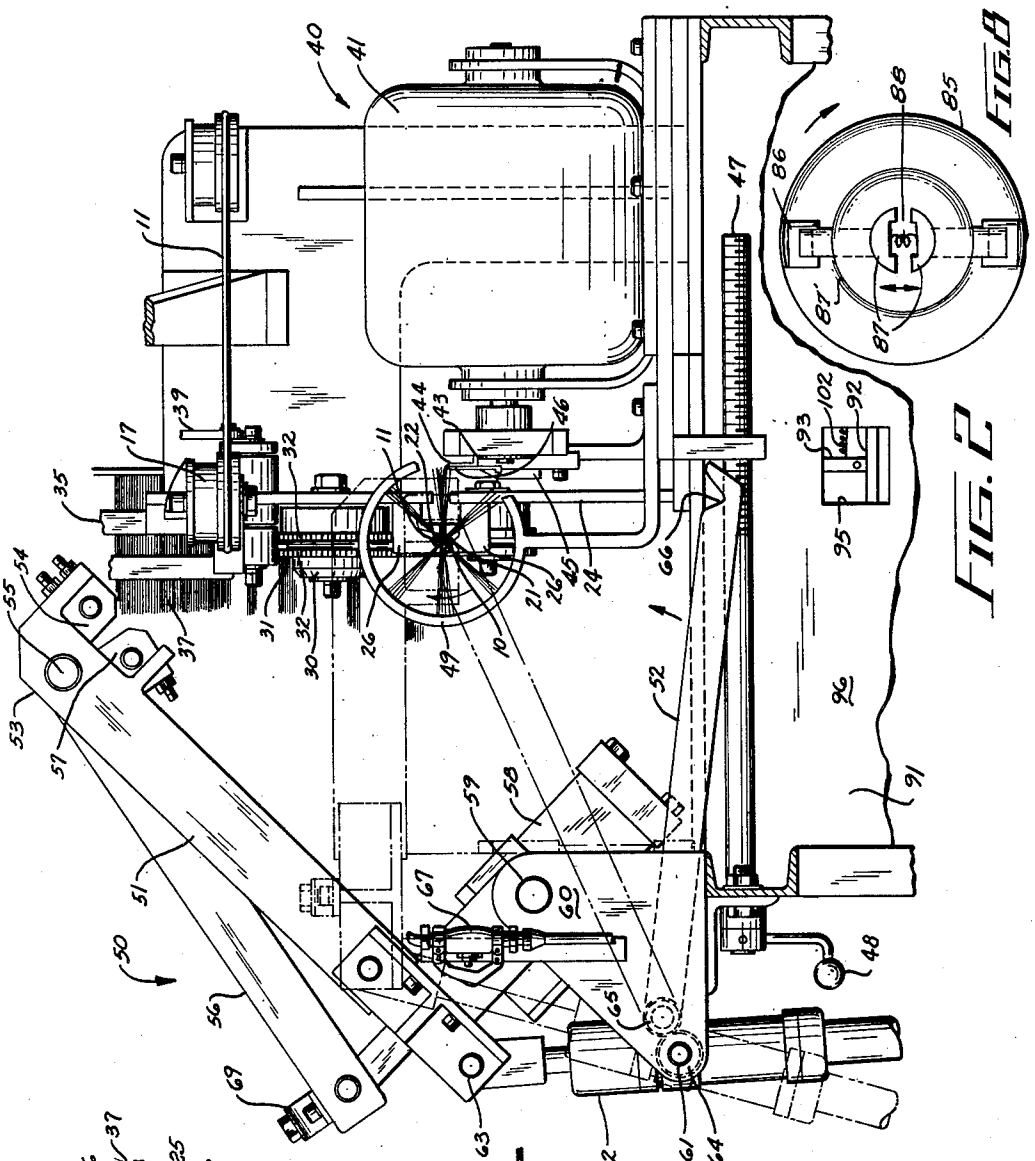


FIG. 2

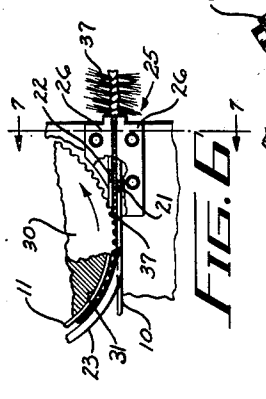


FIG. 6

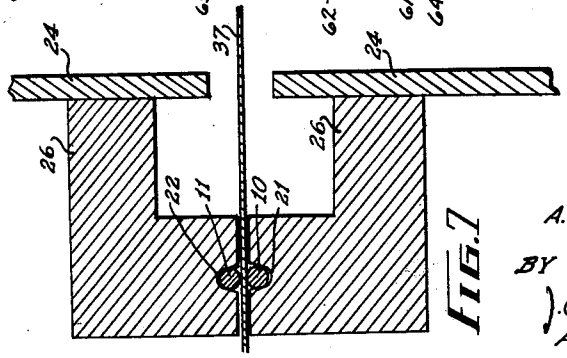


FIG. 7

FIG. 8

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BRUSH-MAKING MACHINE

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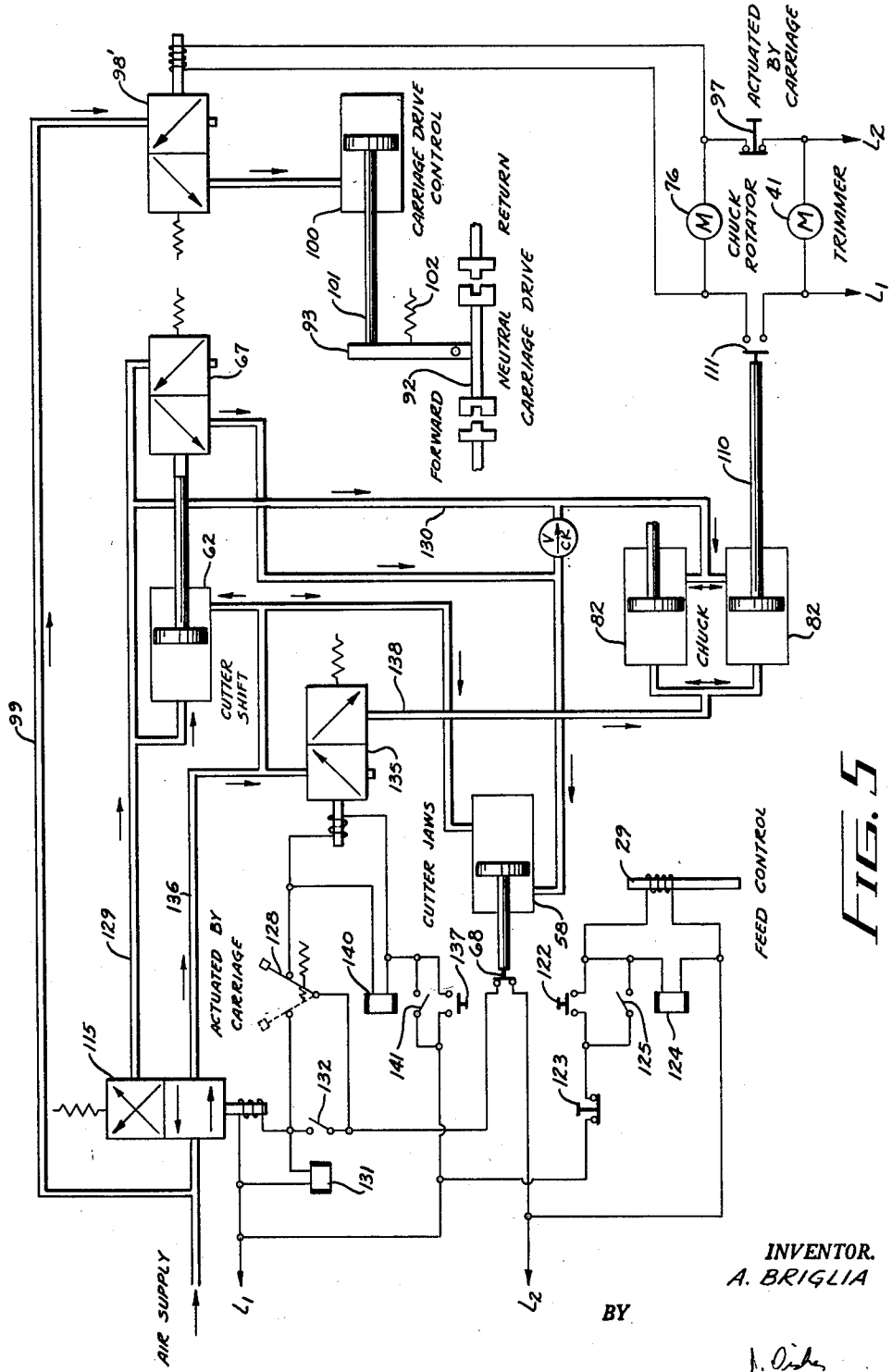


FIG. 5

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3,112,957

BRUSH-MAKING MACHINE

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Filed Apr. 27, 1960, Ser. No. 25,129
17 Claims. (Cl. 300—2)

This invention relates to a brush-making machine, for manufacturing brushes of the type comprising a series of transverse fibers or bristles mounted and fixedly held between twisted wires.

In the known method for manufacturing cylindrical or rotary type brushes, a pair of wires are fed or pulled in parallel relationship over the bed of a machine to a desired length. The fibers or bristles are provided between the parallel wires and held therein by the taut wires. Then, the free ends of the wires are twisted, permanently locking the bristles between the twisted wires. Next, the resultant brush is cut off from the wires, and then placed within a trimming machine to trim the bristles to a uniform diameter.

The main disadvantage of this method, and the machine incorporating the method, is its limited production possibilities. Under optimum conditions, a commercially-available machine of this type can produce at most 3,000 brushes per hour. Another disadvantage is that the trimming operation must be separately carried out on a different machine, which involves a loss in handling time as well as requiring the use of more personnel. A further disadvantage is that the construction of this prior art machine is quite cumbersome, since it requires synchronization between the bristle-feeding mechanism and the wire-pulling mechanism, which necessitates complex transmission systems that cause frequent breakdowns and are also generally subject to high maintenance costs.

The chief object of the invention is to provide an improved brush-making machine capable of substantially higher production rates than the known machines.

A further object of the invention is an improved brush-making machine which incorporates the bristle-trimming operation directly into the brush-forming operation.

Still a further object of the invention is the provision of a brush-making machine in which the bristle-feeding mechanism is actuated by the pulled wires constituting the brush core, thus eliminating any synchronizing means or other transmissions and greatly simplifying the machine construction and materially reducing its cost.

These and further objects of the invention are attained in my novel brush-making machine, which involves pulling the wire strands through a brush-feeding mechanism which feeds fibers or bristles between the wires in a predetermined density and array. The feeding mechanism is actuated by the wires themselves as they are pulled by a rotating chuck along the bed of the machine. Simultaneously as they are being pulled, the wires are being twisted, so that the brush is continuously being formed as it is being pulled along the bed of the machine. A trimmer mechanism is mounted adjacent the feeding mechanism and is adapted to trim the rotating brush bristles to a uniform diameter as they pass it by. With a machine performing this method, I have found it possible to manufacture at the rate of 6,000 brushes per hour, which is double the fastest rate possible with any known machine. Moreover, the brushes are complete after they are formed, as the trimming operation is carried out on the same machine as they are being formed thus eliminating the need for separate trimming machines and additional handling operations. Finally, the mechanism is relatively simple and troublefree, as the feeding mechanism is actuated by the pulled wires themselves, thus eliminating auxiliary driving mechanisms and any difficulties associated with such mechanisms.

My invention will now be described in greater detail with reference to the accompanying drawings, in which:

FIG. 1 is a front view of my new brush-making machine;

FIG. 2 is an enlarged view of the machine illustrated in FIG. 1 along the line 2—2;

FIG. 3 is a detail view of the feeding mechanism;

FIG. 4 is a cross-sectional view of the chuck;

FIG. 5 is a combined electrical and pneumatic circuit diagram of my new machine;

FIG. 6 is a front detail view of the feeding mechanism;

FIG. 7 is an enlarged cross-sectional view of FIG. 6 along the line 7—7;

FIG. 8 is a front view of the rotatable chuck.

FIG. 1 of the drawing is a front view of my new machine. It comprises a wire supply and feeding system 5, a bristle-feeding mechanism 20, a trimmer mechanism 40, a cutter 50, a rotatable chuck and puller 70, and the drive 90 and control means for the pulling mechanism, trimmer, and cutter. Generally speaking, the machine operates as follows. Two wires 10, 11 are supplied from suitable friction-retarded spools 12, 13. The bottom wire 10 passes over several pulleys 12', 14, 15, and 16 and is then led through a wire-holding mechanism 25 terminating in notched or grooved wire-gripping jaws 26. The top wire 11 is fed over several pulleys 13', and 17, and then embraces a notched feeding wheel 30 having a center slot 31 around which the top wire passes and which wire is in frictional engagement with the wheel 30 via the slot. The wheel 30 is free to move, and its periphery with its notches passes underneath a chute 35 containing a supply of bristles 37 which are urged by means of a weight 38 against the top surface of the toothed wheel 30. As the wheel is rotated continuously in one direction (counterclockwise) by the pulled top wire 11, bristles 37 are trapped in the notches 32 on its periphery and carried downward between the top and bottom wires 10, 11. The bristle feeding can be interrupted when desired by a shaped arm 27 which can be moved upwardly, moving the bristles 37 out of contact with the wheel 30 and closing the exit opening from the chute 35. The two wires 10, 11 exit through the notched or grooved jaws 26 of the wire holder with the bristles trapped and tightly held between them. The wires are driven by means of a pulling mechanism comprising an air-actuated chuck 75 which tightly grips the wire ends and which is mounted on a carriage 71 which is chain driven back and forth along the bed of the machine. The chuck itself is rotatable and is driven by a variable-speed motor mounted on the carriage 71. As the carriage carries out its forward or pulling stroke, the chuck is continuously rotated, so that as the wires 10, 11 with the bristles 37 trapped between exit from the jaws 26 of the wire holder, they are continuously rotated and the wires are thus continuously twisted as they are pulled out from the exit jaws of the bristle feeder. The notches or grooves in the exit jaws 26 prevent the twisting from extending back into the feeder mechanism.

As the brush is thus formed and is continuously being rotated as it is being pulled along the length of the bed, a reciprocating trimmer positioned at the side of the bed adjacent the feeding mechanism engages the ends of the rotating bristles and trims them to a uniform size. Thus, the brush, while it is being formed by a twisting and pulling process, is then simultaneously trimmed. As the pulling chuck completes the pulling stroke, suitable control means are actuated which cut the wires at a point in front of the bristle feeder, the chuck jaws open, and the completed brush falls down into a suitable container positioned beneath the machine bed. Finally, the pulling mechanism returns to the feeding mechanism and suitable control means are actuated causing the jaws of the chuck

to grip the cut ends of the wires, and the cycle can then be repeated.

Referring now to FIGS. 1, 2, 6 and 7 for a more detailed description, my novel machine comprises a bed 2 supported on legs 3. At the left end of the machine, supported on the bed, is the feeding mechanism 20. Supplied to the feeder 20 are two wires 10 and 11 which originate on continuous spools 12 and 13, which usually have their own supports, but for simplicity are shown here schematically. These continuous wire spools 12, 13 are supplied with conventional friction retarding means (not shown) to maintain the pulled wires taut. The bottom wire 10 passes over guide pulleys 12', and 14, 15 and 16 which are supported on the feeder mechanism support 24, and then inside a guide groove 21 in the bottom wire gripping jaw 26 terminating in a notched opening, which opening and groove have about the same size as the wire diameter. The bottom jaw 26 is bolted to the support 24. The top wire 11 passes over pulley 13' and then behind the support 24 and around the pulley 17 into contact with the feeding wheel 30.

The feeding wheel 30 comprises a circular wheel, journalled for free and unimpeded rotation on the support 24, and having a toothed periphery, or notches 32, for receiving, holding, and transporting bristles. About five to ten bristles can be received by each notch. The feed rate can be controlled by providing different feed wheels with different sized notches. The center of the wheel periphery contains a slot 31 of a width slightly larger than the wire diameter, and the top wire strand 11 engages that slot 31 in a frictional relation so that motion of the wire strand 11 will cause the wheel 30 to rotate. The wire 11 embraces the wheel 30, in engagement with the slot 31, over about a 180° arc, and thus ends up parallel with the bottom wire 10 as it passes through a guide groove 22, parallel to the groove 21, also terminating in a notch in the top jaw 26 and having a contour matching that of the top wire 11 (FIGS. 6 and 7). The top jaw 26 is also bolted to the support 24.

The bristles 37 are supplied from a chute 35, mounted on the support 24, and comprising a rectangular box or channel with an open top for supporting the bristles, or like straight fibers, in a position perpendicular to the plane of the drawing of FIG. 1. A weight 38 provided on top of the bristles 37 urges them downward. By removing the weight 38, further bristles may be placed within the chute 35. The chute 35 extends above the wheel 30, though to the left of its center, so that the bristles 37 contact the wheel periphery and lie in its notches 32. When the wheel 32 is rotated counterclockwise, the bristles 37 caught in the notches 32 over the top wire 11 are carried downward from the chute along the wheel periphery, and are prevented from falling out of the notches by a curved guide surface 23 which surrounds the wheel 30 between the chute exit and the jaws 26. The bottom end of the guide surface 23 is forked and overlaps the bottom wire 10 (FIG. 6). The bristles 37 are thus fed in a fairly uniform density and in succession into a path between the nearly intersecting wires 10, 11 at the jaws 26, whereat the bristles become tightly held or trapped between the almost contacting, taut, top and bottom wires 11, 10 and in that horizontal position pass out through the wire gripping jaws 26 of the feeder.

The wires 10 and 11 are not driven by the feeder mechanism, but to the contrary, the top wire 11 by its motion rotates the wheel 30 and thus causes bristles to be fed between the wires. So long as the wires are moving will the wheel 30 rotate. However, the feeding of the bristles can be interrupted, and this is accomplished by actuating the shaped arm 27 upwardly, which arm is pivoted on the support 24 at its right end 28. When the arm 27 is moved upwardly, it lifts up the bristles 37 in the chute 35 out of contact with the wheel 30 periphery, thus terminating the bristle feeding. In addition, it closes off the chute exit, as additional protection against inadvertent feeding. This position of the arm 27 is shown in FIG. 3. The arm 27 is lifted when the solenoid 29 is energized, by means of a simple connecting link 39 as illustrated in FIG. 3. When the solenoid 29 is deenergized, its heavy plunger falls down due to the force of gravity, thus moving the arm 27 downward to the position illustrated in FIG. 1. If the wheel 30 is rotating, the bristle feeding will resume. In this manner, it becomes possible to form several brush lengths during a single pulling cycle, separated by bristle-free gaps whereat they can later be severed.

The wires 10, 11 are pulled from their spools 12 and 13 through the feeder mechanism 20 by the puller 70. The puller comprises a reciprocating carriage 71 which rides on wheels 72 on rails 73 on the machine bed 2. On the carriage 71 and movable therewith is mounted a chuck 75 for gripping the ends of the brush wires 10, 11. The chuck 75 is rotated by an adjustable speed motor 76, whose speed may be adjusted by rotation of a handle 77. The adjustable speed motor 76 is of conventional construction. The carriage 71 is reciprocated along the machine bed by means of an endless chain drive 78, which is secured to the carriage 71 and journalled at opposite ends of the bed 2. The chain itself is driven by a motor assembly and transmission 91 located underneath the trimmer 40 and cutter 50 mechanisms. The motor assembly and transmission are of conventional construction. It comprises an electrical motor coupled via a clutch mechanism 92 (see also FIG. 5) and suitable gearing to a sprocket (not shown) that drives the chain. The clutch 92 is actuated by a spring-biased shift yoke or bar 93, in the following simple manner. When the carriage 71 reaches the end of its forward stroke, the carriage drive being in the forward position, a normally-closed microswitch 97 on the carriage 71 is actuated and opened by a dog 98 mounted on the machine bed 2. The temporary opening of this switch 97 (see FIG. 5) interrupts the energizing current (the switch 111 having been closed) for the chuck motor 76, which thereupon stops rotating, and also deenergizes the solenoid circuit of a three-way, directional, pneumatic valve 98' of a standard commercial type, supplied with air pressure from a conventional compressor via a hose or line 99, which in turn interrupts the air pressure previously afforded at an air cylinder 100, whose piston 101 is coupled to the shift bar 93 and had been maintaining the latter in the forward drive position. As a consequence, a compression spring 102 pushes the shift bar 93 into its return drive position, whereat the drive sprocket for the chain 78 reverses its rotation and returns the carriage 71 to the feeder end of the bed, the switch 97 then closing. This is accomplished at a relatively higher speed than the forward stroke to avoid waste of time. To shift from the return to the forward drive position, the bar 93 is first moved to a center neutral position, in which the motor drive is decoupled from the drive sprocket and the carriage 71 remains motionless. This shifting of the bar 93 from the return drive position to neutral is accomplished by a cam rod 94 (FIG. 1) mounted on the front of the carriage 71 and extending horizontally below the rails 73. The cam rod 94 is positioned to enter an opening 95 in the drive housing 96, when the carriage 71 approaches the feeder mechanism 20 on its return stroke, and the cam bar 94 engages the shift bar 93 with its leading edge moving it from its return drive position toward the right to its neutral position. The carriage drive is shifted from the neutral to the forward drive position when, as will be later explained, the chuck jaws 87 are closed, thereby closing a microswitch 111 which energizes the solenoid of the air valve 98' providing pressure at the cylinder 100 and pulling the shift bar 93 to the right. When the shift bar 93 is pulled to the right, the drive sprocket for the chain is coupled via slow speed gearing to the drive motor causing the carriage 71 to carry out, at relatively low speed, its forward or pulling stroke. Appropriate gearing is provided to obtain

this result of slow forward stroke and fast return. However, as means for accomplishing this particular result are well within the skill of those in this art, and many different kinds of conventional mechanisms are available for this purpose, I have refrained from showing the drive mechanism in more detail as unnecessary to a complete understanding of my invention.

The rotatable chuck mechanism is shown in more detail in FIGS. 4 and 8. It comprises a rotatable drive shaft **79** coupled at **80** to the chuck motor **76** shaft on the right, and directly on the left to a chuck-jaw-actuating mechanism. The latter comprises a fixed housing **81**, supported on the carriage **71**, on which are mounted two air cylinders **82** at opposite sides which operate in conjunction with one another. The pistons **82'** of the two air cylinders are coupled by way of a plate **83** and a thrust bearing **84** to a jaw-closing member **85** having a tapered cam surface **86**. The chuck jaws **87**, which are radially movable within a housing **87'**, have a matching follower surface engaged by that of the jaw-closing member **85**. The chuck jaws **87** are biased by means of a spring **88** to their open position. As will be noted, when the shaft **79** rotates, it drives the jaw-actuating member **85**, the jaw housing **87'**, and the chuck jaws **87**. When pressure is applied to the air cylinders **82**, the plate **83**, bearing **84**, and actuating member **85** are moved a short distance to the left along the shaft **79**, the member **85** being keyed **85'** thereon, thereby moving the chuck jaws **87** inward to their closed position, enabling them solidly to grip the brush core wires **10**, **11**. Coupled to the plate **83** and movable therewith is a bent lever **110** (FIG. 1). When the plate **83** is shifted to the left, closing the chuck jaws **87**, the bent lever **110** actuates a microswitch **111**, mounted on the support **81**, which closes the energizing circuit (FIG. 5) for the chuck motor **76**, causing the shaft **79** and the chuck jaws **87** gripping the wire ends to rotate, bringing about the twisting of the brush wires.

The trimmer mechanism **40** is mounted on the machine bed **2** on its rear side and adjacent the feeder mechanism **20**. It comprises an electrical motor **41** driving an eccentrically-pivoted cam **42**, which in turn actuates as a follower an enclosing sliding cutter or shear plate **43**. Rotation of the eccentric cam **42**, as is well known, causes horizontal reciprocation of the shear plate **43**. The shear plate **43** is provided with upwardly extending plural fingers **44** having side cutting edges. Associated with the shear plate **43** is a fixed bearing member **45** comprising a matching set of upwardly extending fingers **46**. As shown more clearly in FIG. 2, the rotating brush bristles, properly positioned by an encircling fixed guide **49**, will enter the slots between the fingers **46** of the stationary bearing member **45**. The cutting edges of the reciprocating fingers **44** on the shear plate **43**, which reciprocate across the slots between the fingers **46**, slice off or shear off any bristles that extend beyond the fingers **46** and thus trim the brush bristles to a uniform diameter as the rotating brush is pulled by. By displacing the entire trimmer mechanism to the right or left in FIG. 2, the brush diameter can be accurately controlled. Provision for this is afforded by a lead screw **47** rotatable by a handle **48**.

The cutter mechanism **50** functions to sever the brush wires close to the end of the pulling or forward stroke. It comprises a cutter **51** and a wire holder **52** (see FIG. 2). As will be noted, in the non-cutting position, the cutter **51** is positioned above the brush, and the wire holder **52** is positioned below, to allow the carriage **71** to pass between. The cutter **51** comprises an outer frame or housing **53** to which is secured a fixed cutting jaw **54**. Within the outer housing **53** is pivoted **55** a rod **56** provided with a movable cutting jaw **57**. Directly coupled to the opposite end of the rod **56** is the piston of an air cylinder **58**, which is pivotably mounted **59** on a support **60** secured to the machine bed **2**. At the bottom end of the support **60** is pivoted **61** another air cylinder **62**, whose piston is pivotably connected **63** to the end of the cutter frame **53**. When air pressure is provided at the left side of the piston of the cylinder **62** (FIG. 5), it is moved upwardly in FIG. 2, pivoting the cutter **51** to the horizontal position shown in phantom in FIG. 2 with the open cutter jaws **54**, **57** on either side of the brush core wires **10**, **11**. Preferably the bristle feeding has been suitably interrupted so that no bristles are present at this area. A spur gear **64** coupled to and rotatable with the cylinder **62** drives a follower gear **65** at the end of the wire holder **52**, pivoting it upwardly so that its notched end **66** contacts the wires **10** and **11** and braces them for the cutting operation. Simultaneously, the movement of the cutter into cutting position actuates a sequence pneumatic directional valve **67** of conventional construction, which immediately directs air pressure to the left side of the cylinder **58** (FIG. 5) pulling the pivotable bar **56** inward and closing the cutting jaws **54**, **57**, thereby severing the brush wires **10**, **11**. When this action is completed, a lever **69** (FIG. 1) coupled to the end of the rod **56** actuates and opens a normally-closed microswitch **68**, which in turn deenergizes a four-way pneumatic directional valve **115** of conventional construction, which had been supplying air pressure along the line **129** (FIG. 5), and which thereupon provides air pressure along the line **136** to the right side of the cutter shift cylinder **62**, swinging the cutter upward, and the wire holder **52** downward, and also providing pressure at the right side of the jaw-actuating cylinder **58**, thus opening the cutter-jaws. These actions also close the switch contacts **68**, and an internal spring shifts the valve **67** back to its initial condition.

The remaining controls and operations will now be described. The bristle feeding is interrupted and caused to resume by mounting two dogs **120** and **121** on the machine bed **2**, which dogs actuate in turn microswitches **122** and **123**, respectively, mounted on and movable with the carriage **71**. When the normally-open contacts of the top microswitch are closed by the dog **120**, as shown in FIG. 5, the solenoid **29** is energized, moving the feed interrupter **27** upwardly. A holding circuit comprising a relay **124** with contacts **125** maintains the energization of the solenoid after the switch **122** reopens as the carriage continues its motion to the right. The terminals in the circuit of FIG. 5 designated L_1 and L_2 are, of course, connected to the line voltage source. When the normally-closed contacts of the lower microswitch **123** are opened by the dog **121**, the solenoid circuit is deenergized, and gravity moves the feed control **27** downward, causing the bristle feed to resume. These dogs mounted on the machine bed **2** are adjustable in position to control the sequence in any order or pattern desired. Of course, if desired, additional pairs of dogs may be provided on the bed **2** whenever interruption in the feeding is desired.

A further dog **127** on the machine bed **2** actuates a microswitch **128** on the movable carriage **71**, just before the carriage completes its forward stroke. The microswitch **128** is a double-throw switch, spring-biased closed to the position shown in FIG. 5. When the microswitch **128** is actuated, it makes the contact shown in phantom in FIG. 5. In this position, the solenoid of the four-way valve **115** is energized, which directs air pressure along the line **129** shifting the cutter into cutting position, and also along the line **130** to the chuck cylinders **82**, opening the chuck jaws. A holding circuit comprising a relay **131** and contacts **132** maintains the energization of the valve **115**. As the carriage continues its motion to the right, the switch **128** springs back to the position shown in solid lines in FIG. 5, thereby partially closing the circuit for energizing the solenoid of a three-way pneumatic directional valve **135** of conventional construction. Meanwhile, the closing cutter jaws have severed the brush, which now falls down in a container below the machine bed, and have opened microswitch **68**, thus deenergizing the solenoid of the directional valve **115**, which terminates the pressure in the line **129** and now provides pressure in the line **136**. By this time, the carriage has

reached the end of its pulling stroke, which thus pulls the severed brush from the open chuck jaws, and the last dog **98** actuates microswitch **97**, which stops the chuck rotation and returns the carriage to the feeder mechanism as previously described. Just before the carriage strikes home at the feeder end, a tripper **136'** on it actuates a microswitch **137** located on the bed **2** near the cutter **50**. This closes the directional valve **135** solenoid circuit, which becomes energized providing air pressure in the line **138**. A holding circuit comprising a relay **140** and contacts **141** maintain this solenoid **135** energized. By this time, the open chuck jaws **87** have passed over the free ends of the twisted severed wires **10, 11**. The establishment of pressure in the line **138** closes the chuck jaws **87** on the free wire ends, which as will be seen from FIG. 5, results when the pistons in the air cylinders are moved to the right. And the latter action closes microswitch **111**, which remains closed as long as the chuck jaws are closed. Closing microswitch **111** energizes the chuck motor **76**, which thus begins to rotate the chuck jaws twisting the wires. Simultaneously, the carriage has rammed home, actuating the shift bar **93** to neutral, and energization of the solenoid valve **98'** drives it into its forward, pulling position. As the wires are now pulled, bristles are fed between them, and these bristles are rotated by the rotating, twisting wires as they exit from the wire gripping jaws **26**. The wires thus twist from the wire gripping jaws **26** onward to the rotating chuck **75**, as it pulls the wires with the trapped bristles therebetween over the machine bed. The gripping action and tight holding of the fixed jaws **26**, through which the wires are pulled, prevents the twisting from extending back into the feeder mechanism. Within the grooves **21** and **22**, the wires **10, 11** remain parallel.

While I have described my invention in connection with specific embodiments and applications, other modifications thereof will be readily apparent to those skilled in this art without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In a brush-making machine, means for supplying a pair of wires, fixed means for bringing the wire ends together and holding them against twisting, means beyond the holding means for gripping the wires and drawing them through the holding means along a given path and simultaneously, whenever the wires are gripped, always rotating the gripped wires to twist them, and a feeder wheel rotatable by one of the drawn wires for feeding bristles to and laying them between the wires, whereby a brush is formed when the twisted wires lock the bristles therebetween.

2. A machine as set forth in claim 1 wherein the feeder wheel comprises a rotatable wheel having recesses in its periphery for receiving and carrying bristles to the wires.

3. A machine as set forth in claim 2 wherein the feeder wheel comprises a slot around its periphery for receiving one of said wires, said wire frictionally engaging the walls of said slot and rotating the wheel when the wire is drawn.

4. A machine as set forth in claim 3 wherein means are provided for moving the bristles out of contact with the moving wheel periphery to interrupt the bristle feeding.

5. In a brush-making machine, means for supplying a pair of wires, means for bringing the wire ends together and holding them against twisting, means for gripping the wire ends and drawing them through the holding means along a given path and simultaneously rotating the gripped wires during their travel along substantially the entire given path to twist them, and means actuable by one of the drawn wires for feeding bristles to and laying them between the wires, whereby a brush is formed when the twisted wires lock the bristles therebetween.

6. A machine as set forth in claim 5 wherein the bringing and holding means comprises a member having a notched opening through which the wires with the bristles clamped therebetween pass.

7. A machine as set forth in claim 5 wherein the gripping and drawing means comprises a rotatable, motor-driven, pneumatically-actuated chuck.

8. In a brush-making machine, means for supplying a pair of wires, stationary means for bringing the wire ends together and holding them against twisting, means on the side of the stationary means remote from the supplying means for gripping the wire ends and drawing them through the holding means along a given path and simultaneously rotating the gripped wires along substantially the entire given path from the holding means onward to twist them, means on the side of the holding means adjacent the supply means and actuable by one of the drawn wires for feeding bristles to and laying them between the wires, whereby a brush is formed when the twisting wires lock the bristles therebetween, and trimmer means located adjacent the holding means on the same side as the drawing means for trimming the bristles of the rotating brush to a uniform length.

9. A machine as set forth in claim 8 wherein the trimmer means comprises a slotted member extending parallel to the said given path and arranged so that the bristle ends of the rotating brush engage the slots, and reciprocating means adjacent said slotted member for shearing off the bristle ends.

10. In a brush-making machine, means for supplying a pair of wires, stationary means for bringing the wire ends together and holding them against twisting, means including chuck jaws for gripping the wire ends and drawing them through the holding means along a given path, means rotatable in a single direction and actuable by one of the drawn wires for feeding bristles to and laying them between the wires, and means actuable whenever the chuck jaws close for rotating the chuck jaws whereby the wires are twisted as they are drawn along the given path thus forming a brush.

11. A machine as set forth in claim 10 wherein the gripping means comprises a pair of air-actuated cylinders located in opposition for closing the chuck jaws.

12. A machine as set forth in claim 10 including means for trimming the brush bristles and means for severing the brush after it is formed.

13. In a brush-making machine, a pair of fixed, closely-spaced, wire-holding jaws having parallel opposed grooves, means for supplying a pair of wires each of a size approximately corresponding to that of a groove, means for bringing the wires together and directing them each through a groove in closely-spaced parallel relation, means for feeding bristles between the wires just before they enter the grooves, means including a rotatable chuck mounted on a reciprocable carriage located beyond the wire-holding jaws for gripping the wires and pulling them with the bristles held therebetween through the grooves in the fixed wire-holding jaws along an extended path away from the wire-holding jaws, means always operable upon gripping of the wires near the wire-holding jaws for simultaneously rotating the chuck whereby the wires while being pulled along the extended path are twisted from the wire-holding jaws onward, but not within the jaws, to permanently clamp the bristles therebetween and to rotate the bristles, and means stationed along the said extended path for trimming the rotating bristle ends to a uniform desired size.

14. A brush-making machine as set forth in claim 13 wherein means are provided for severing the twisted wires at a location near the beginning of the extended path upon the reciprocable carriage reaching the end of said path, and means are also provided for opening the chuck and for returning the carriage to the beginning of the extended path.

15. In a brush-making machine, a pair of fixed, closely-spaced, wire-holding jaws having opposed grooves, means for supplying a pair of wires each of a size approximately corresponding to that of a groove, means for bringing the wires together and directing them each through a groove in closely-spaced parallel relation, means for feeding

bristles between the wires just before they enter the grooves, said jaws being spaced apart a distance approximately equal to the bristle thickness, means including a rotatable chuck mounted on a reciprocable carriage located beyond the wire-holding jaws for gripping the wires and pulling them through the grooves in the fixed wire-holding jaws with the bristles held therebetween, means always operable upon pulling of the wires for simultaneously rotating the chuck whereby the wires while being pulled through the wire-holding jaws are twisted from the wire-holding jaws onward, but not within the jaws, to permanently clamp the bristles therebetween and to rotate the bristles, and means stationed alongside the rotating bristles near the wire-holding jaws for trimming the bristle ends to a uniform size.

16. In a brush-making machine, a pair of fixed wire-holding jaws having closely-spaced, opposed, grooved portions, means for supplying a pair of wires each of a size approximately corresponding to that of a grooved portion, means for bringing the wires together and advancing them each through a grooved portion in closely-spaced parallel relation, means for feeding straight bristles between the parallel wires, means located beyond the wire-holding jaws for gripping the wires as they advance through the grooved portions in the fixed wire-holding jaws with the bristles held therebetween, and means operable when the wires are gripped and advanced relative to the wire-holding jaws to simultaneously rotate the gripping means whereby the wires twist as they advance onward from the wire-holding jaws, but not within the jaws, to permanently clamp the bristles between the wires and form a brush.

17. In a brush-making machine, a pair of fixed wire-holding jaws having closely-spaced, opposed, grooved portions, means for supplying a pair of wires each of a size approximately corresponding to that of a grooved portion, means for bringing the wires together and advancing them each through a grooved portion in closely-spaced parallel relation, means for feeding straight bristles between the parallel wires before they enter the grooved portions, said jaws at the grooved portions being spaced apart a distance approximately equal to the bristle thickness, means located beyond the wire-holding jaws for gripping the wires as they advance through the grooved portions in the fixed wire-holding jaws with the bristles held therebetween, means operable when the wires are gripped in the vicinity of the wire-holding jaws and when they are advanced relative to the wire-holding jaws to simultaneously rotate the gripping means whereby the wires twist as they are advanced onward from the wire-holding jaws, but not within the jaws, to permanently clamp the bristles between the wires and form a brush, and means stationed beyond the wire-holding jaws and alongside the wires where they are twisting and operative to trim the bristle edges of the rotating brush to form a desired bristle dimension.

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