April 17, 1956 T. MARKS 2,742,327

FULLY AUTOMATIC MACHINE FOR MAKING BRUSHES

Filed April 20, 1951 3 Sheets-Sheet 1

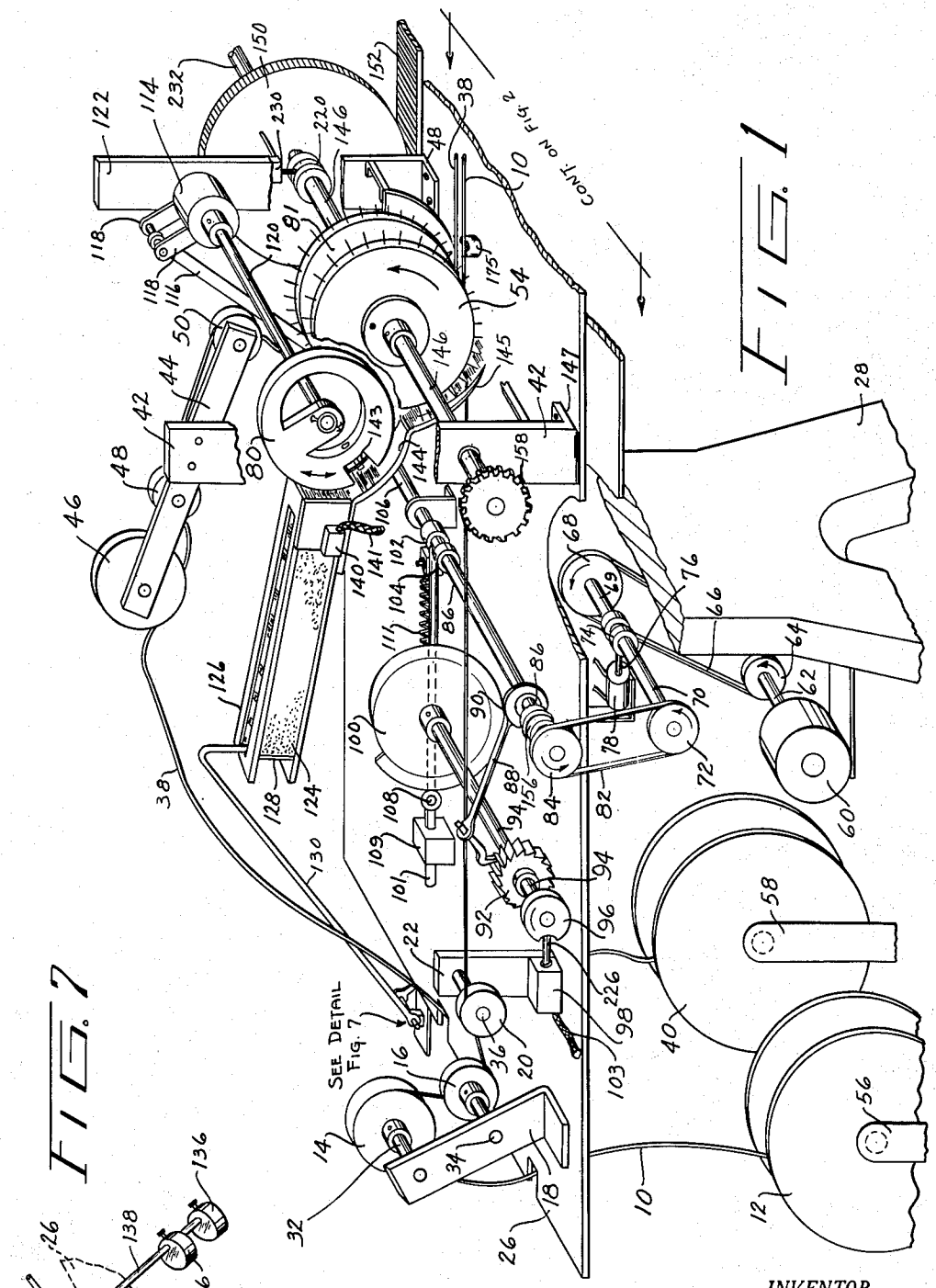


FIG. 1

FIG. 7

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FULLY AUTOMATIC MACHINE FOR MAKING BRUSHES

Filed April 20, 1951 3 Sheets-Sheet 2

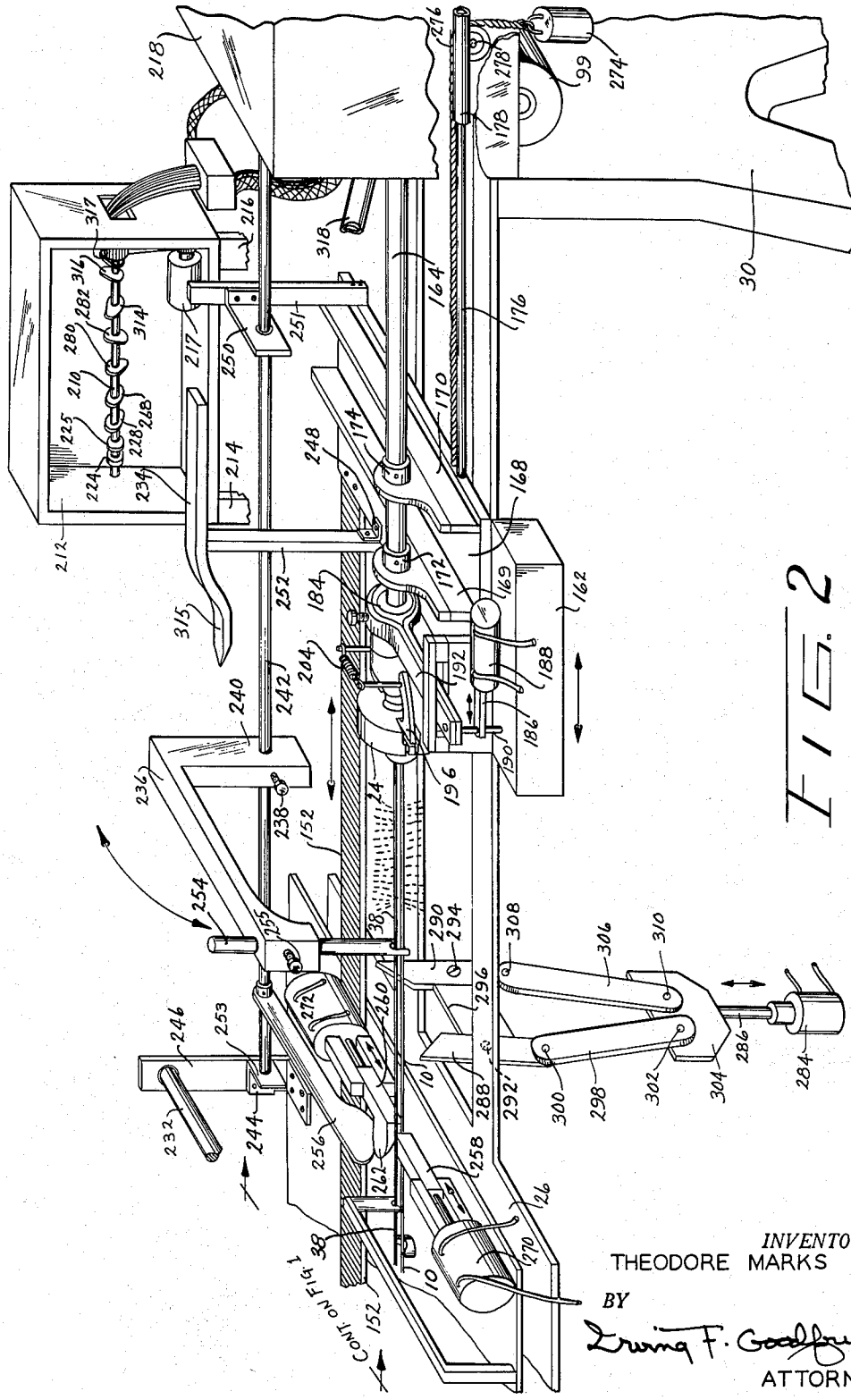


FIG. 2

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FULLY AUTOMATIC MACHINE FOR MAKING BRUSHES

Filed April 20, 1951 3 Sheets-Sheet 3

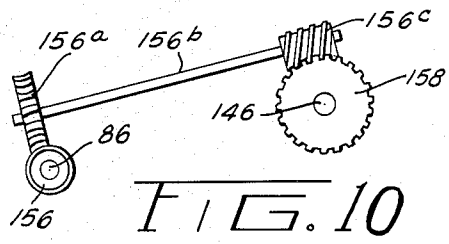


FIG. 10

FIG. 3

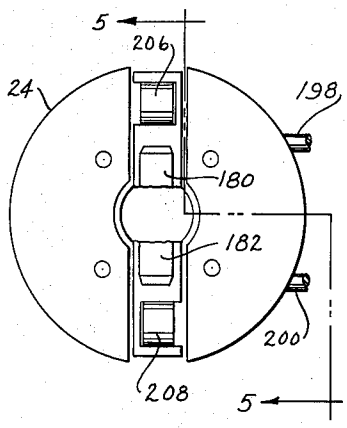


FIG. 4

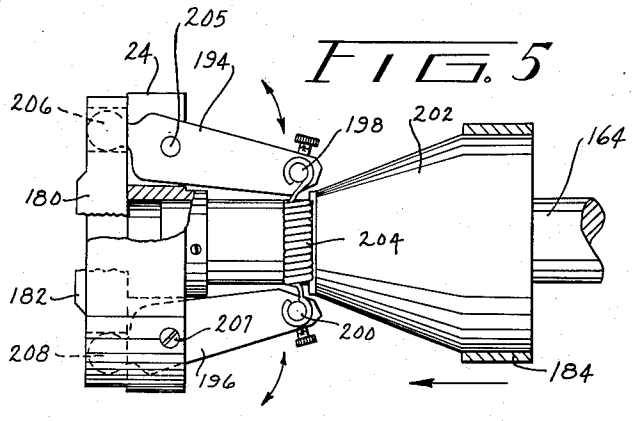


FIG. 5

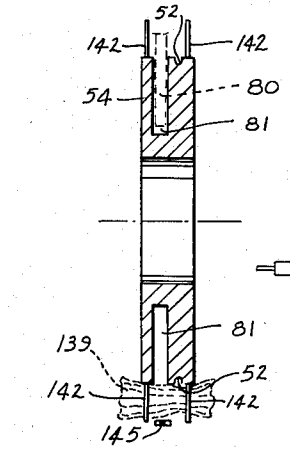


FIG. 6

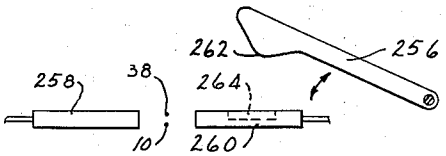


FIG. 8

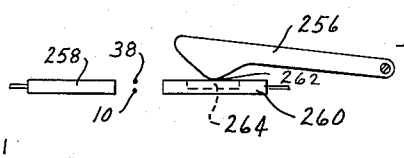


FIG. 9

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Patented Apr. 17, 1956

2,742,327

FULLY AUTOMATIC MACHINE FOR MAKING BRUSHES

Theodore Marks, Mount Vernon, N. Y.

Application April 20, 1951, Serial No. 222,007

17 Claims. (Cl. 300—2)

The present invention relates to a fully automatic machine for making brushes of the cylindrical type in which the bristles or fibers are held in spaced relation between strands of intertwisted wires.

Heretofore, such brushes have been formed in machines in which many of the operations are manually performed. Strands of wires were first cut into selected lengths corresponding to the desired length of the formed brush.

After this, in distinction to the method here contemplated, the cut strands of wires were mounted by the operator of prior brush forming machines in the wire twisting machine. The brush bristles or fibers were then also manually mounted in proper spaced relation between these cut wires and the twisting machine then operated to twist the wires to hold the bristles or fibers in the coils thus made and thereby form the brush.

The present invention contemplates the provision of a machine in which all brush forming operations are continuously performed in proper sequence so that a cylindrical brush is produced from the various brush forming elements fed into the machine without any intervening manual operation.

The present invention therefore contemplates the provision of a machine which automatically performs the following sequence of operations:

(*a*) Feeds the strands of wires from continuous rolls thereof in lengths thereof which correspond to the length of the finished brush body.

(*b*) Picks the brush forming bristles in spaced tufts thereof and lays the picked bristles or fiber tufts between the wires in selected spacing as the strands of wires are fed.

(*c*) Holds the wires and twists them about the bristles to form the brush.

(*d*) Cuts the wires at the end of the formed brush to permit it to drop from the machine and

(*e*) Holds the severed ends of the wire strands prior to grasping them for repeating the above sequence of operations.

The present invention contemplates the provision of means whereby the above enumerated sequence of operations is automatically performed in a single brush making machine.

These, other and further objects and advantages of the present invention, and those by means of which the proper performance of a machine of this character is attained, will be clear from the description which follows and the drawings appended thereto, in which

Fig. 1 is a partial perspective side elevation of the leading section of a brush making machine according to my invention, with the reduction gearing between parts **156***a* and **156***c* omitted.

Fig. 2 is a similar view of the continuing succeeding section of such a machine.

Fig. 3 is a detail perspective view of the clutch and driving mechanism for the oscillating bristle or fiber picker.

Fig. 4 is an end view of the wire strand grasping chuck which may be used in the machine embodying my invention.

Fig. 5 is a side elevation and section on the line 5—5 of Fig. 4.

Fig. 6 is a section of a pin wheel used to feed the fibers or bristles between the strands of wires as they are pulled or fed into the machine.

Fig. 7 is a perspective view of a detail of the mechanism that holds the bristle or fiber stock in position to be picked by the oscillating picker.

Fig. 8 is an elevation of a detail showing the means, in raised position, for permitting a holding fork to be lowered into operative position after closing the wire holding vise for the wire twisting operation.

Fig. 9 is a similar view showing the position of the said means just prior to closing the vise.

Fig. 10 is a schematic view showing the reduction gearing between the ticker and the pin wheel.

Referring now to the drawings and more particularly to Fig. 1, the under wire **10** of a preferably cylindrical wire brush, which, since it is conventional and well known is not illustrated here, is fed from a continuous roll **12** of the wire to the roller wheel **14** and then looped under the succeeding wheel **16**, both of which wheels are carried by the bracket **18**.

The wire **10** is then pulled over the next tension roller wheel **20** carried on the bracket **22**. The arrangement described is but one of many which may be used to hold the wire under tension as it is pulled through my machine by the chuck, generally referred to by the reference character **24** (see Figs. 2, 4 and 5) in the manner which I shall further describe.

The brackets **18** and **22**, as well as the other elements of my mechanism are mounted on the table **26**, which is supported by the legs **28** (Fig. 1) and **30** (Fig. 2).

Corresponding brackets for supporting the shafts **32**, **34** and **36** at their other ends are mounted on the table **26** but are not shown since they are the same as the brackets **18** and **22** and would confuse the drawing by crowding it.

The upper wire **38**, which, with the under wire **10** is twisted to form the brush body, is fed and pulled by the chuck **24** from the roll **40** of continuous wire.

To impart to the upper wire **38** the desired tension, a means such as now described may be used. Mounted on the table **26**, I provide the supporting bracket **42** on which the arm **44** is fixed. Carried by the arm **44**, I provide the first roller wheel **46** under which the upper wire **38** is fed above the second tension roller **48** under the third tension roller **50** prior to its being laid in the grove **52** extending around the periphery of the pin wheel **54** (see particulary Fig. 6).

The rolls of wire **12** and **40** are carried for free rotation on the brackets **56** and **58**, which are preferably supported on the floor, as the wire is pulled through the machine by the chuck **24**.

In the machine of my invention, those parts that feed the selected length of wire strands into the machine, operate the fiber or bristle picker and the rotation of the pin wheel are driven by the main motor **60** which is supported on the legs **28**.

The main motor shaft **62** carries the pulley **64** which through the belt **66** rotates the pulley **68** on the countershaft **69**.

It will be understood of course that different drives will occur to those skilled in the art, for example, a chain and sprockets, train of gears, etc. and that shown and described by me is for illustration only.

Intermediate the driven pulley **68** and the driving sprocket **72** on the countershaft **70**, I provide the main clutch **74**, which is conventional in form and therefore need not be illustrated and described in detail.

The air controlled plunger **76** extending from the air cylinder **78** is used to engage and disengage the main clutch **74** so that, as will be seen, at the proper sequence in the operations, the oscillating picker **80** stops its movement, the pin wheel **54** stops rotation and the chuck **24** stops its movement from the leading part of the machine toward the end of the machine, that is from left to right of Figs. 1 and 2.

It will be understood that the picker wheel **80** is positioned and oscillates in the groove **81** in the pin wheel **54**. The wheel **54** in the illustration of Fig. 1 is broken away to show this relative positioning.

The clutch **74**, which is conventional and therefore need not be described in detail, comprises two parts which are brought together into engaging position by a spring and disengaged by movement of the air controlled plunger **76** between the two parts as illustrated in Fig. 1.

The driving sprocket **72** is connected by means of the chain **82** to the upper driven sprocket **84** on the second countershaft **86** on which countershaft **86** the pawl **88** is operatively secured by the collar **90**.

It will be recognized that any form of positive drive, such as a chain and sprockets, should be used for operatively connecting the movement of the shaft **70** and the shaft **86**. Since these two shafts rotate at the same speed, the diameter of the sprocket **72** is equal to the diameter of the sprocket **84**.

Each rotation of the countershaft **86** moves the ratchet wheel **92** through one tooth and correspondingly rotates the shaft **94**, complete rotation of the ratchet wheel **92** moving the shaft **94** through one revolution.

As will be seen, by reason of the action of the chuck **24**, so long as the motor **60** drives the countershaft **70** through the main clutch **74**, the wires **10** and **38** are pulled through my machine. Thus, the length of the brush is determined by the time of operative movement of the chuck **24**, which is controlled by disconnecting at the proper time its drive by the main motor **60**.

It will be noted that the length of the brush is thereby controlled by the number of teeth of the ratchet **92**, though it will be understood that any other satisfactory means of timing or counting the number of tufts may be used.

The clutch **74** is engaged when finger **76** has been withdrawn from it by means of air directed into the cylinder **78**.

The clutch **74** is disengaged when air pressure is removed from cylinder **78** permitting finger **76** to return by spring tension into the clutch and thus disengage it.

On operation, assume that the strands of wires have reached the position for the twisting operation.

At this time, in the sequence of operations, the clutch **74** is disengaged by a solenoid valve, operated in the manner that will be further described in detail.

This solenoid valve is held in open position by an electrical interlock which is conventional and therefore need not be described.

When the microswitch **98** is operated by the proper positioning of the groove in the cam **96**, this electrical interlock is broken and the solenoid valve is deenergized and the clutch **74** is disengaged.

The microswitch **98** is connected by means of a wire cable **103** to the electrical circuit controlling the said interlock.

As the cam **96** on the shaft **94** operates the microswitch **98**, as aforesaid, a circuit to the motor **99**, which rotates the chuck **24** to twist the wires and form the brush body is completed as will be further described.

Each tooth on the ratchet wheel **92** is designed to correspond to a length of three eighths of an inch of the brush wire strands **10** and **38**, the ratchet shaft making one complete revolution for each brush. As the shaft **94** is rotated by the ratchet wheel **92** and pawl **88**, the cam **100** is correspondingly rotated to pull the finger **101** from between the parts **102** and **104** comprising a conventional

spring controlled positive drive clutch which connects the shaft **86** to the shaft **106** (see Figs. 1 and 3).

When the roller or cam follower **108** rides on the high part of the cam **100**, the finger **101** is pulled away from between the clutch parts **102** and **104** to engage the clutch **110** (see Fig. 3) and the shaft **106** is rotated.

The cam **100**, if desired, may be designed with spaced rises and depressions so that the clutch **110** may be selectively and periodically engaged and disengaged to throw the picker **80** into oscillation through a given length of wire.

Thus, a means is provided for controlling the brush by counting the number of picks or tufts and the number of skipped picks or tufts to thereby form a plurality of brushes in a selected length of wire strands.

The finger **101** is reciprocated in the bracket block **109** by the cam **100** acting against the tension of the spring **111**.

The shaft **106** is connected to the link **112** (Fig. 3) which drives the collar **114** through the arm **116** and fingers **118**. The collar **114** is secured on the shaft **120** which drives the oscillating picker **80**, the shaft **120** being mounted for oscillating in the post **122** mounted on the table **26**.

Rotation of the shaft **106** by engagement of the clutch **110**, through the linkage just described oscillates the shaft **120** causing the picker wheel **80** to periodically pick tufts of bristles or fibers from the bottom of the stock pile **124** carried in the holder **126**.

The stock of bristles may be forced against the bristle or fiber picking wheel **80** by any satisfactory means, one of which is illustrated in Figs. 1 and 7.

The plate **128** is urged against the stock **124** by means of the weighted leverage comprising the upper arm **130** which is mounted for pivoted movement on the bracket **132** extending from the forward end of the table **26**. The upper arm **130** is gravitationally urged about the pivot pin **134** by the weights **136** on the lower arm **138** fixed to the upper arm.

Should the stock **124** of fibers or bristles become used up, the plate **128** will open a switch **140** which may be provided at the lower end of the holder **126**, to stop operation of the motors running my machine, controls for which motors are connected to the switch **140** by the cable **141**.

The bristle or fiber picker **80** is provided with a slot **143** of such size that the desired amount of bristles or fibers for the particular brush to be formed are picked out by it for each oscillation of the wheel.

As the tuft of bristles is picked out from the stock, it is fed by the oscillating picker **80** in a cluster **139** (see Fig. 6) of proper number of fibers or bristles onto the spaced pins **142** on each side of the rotating pin wheel **54**. The pins are spaced so that the bristles are fed onto the under wire **10**, which is pulled underneath the pinwheel **54** and plate **145**, so that the bristles are properly spaced from each other between the wires **10** and **38**.

In order to prevent the brush bristles or fibers from falling away from the groove **143** in the picker **80** and from the spaced pins of the rotating pin wheel **54**, the curved guide plates **144** and **145** are preferably mounted thereunder. The bristles are fed by the picker **80** from the plate **144** onto the pinwheel **54** between the pins **142** on which they are held by the plate **145**, the under wire **10** passing underneath the end of the plate **145**. The upper wire **38** passes immediately over the bristles positioned on the under wire **10** to grip them between the two wires, which are in tension.

The pin wheel **54** is mounted on the shaft **146** carried by the posts **42** and **122** supported by the brackets **147** and **148** mounted on the table **26**.

Driven by the shaft **146**, I provide the gear **150** which drives the rack **152** slidably mounted on the table **26** and which drives the chuck carriage from the leading position at the head of the machine, to the left of Fig. 1

and where the chuck grips the brush forming wires **10** and **38** to pull them toward the other or outer end of the machines, to the right of Fig. 2, for the twisting operation as I shall further describe.

The shaft **146** on which the pin wheel **54** is mounted is positively driven by the shaft **86**. This may be accomplished in any satisfactory manner, preferably by means of a train of gears, which for purposes of simplified illustration, is in Figs. 1 and 10 shown as the worm **156** on shaft **86** meshing with worm wheel **156***a* on shaft **156***b* carrying a worm **156***c* meshing with worm wheel **158** on shaft **146**.

For each revolution of the shaft **86**, the shaft **146** must be correspondingly rotated to bring one set of pins **142** in position to receive a tuft of bristles from the picker wheel **80**.

I provide a plurality of pins on the pin wheel **54** and therefore the same must be provided in the train of gears represented for illustration by the worm **156**, worm wheel **156***a*, worm **156***c* and worm wheel **158**.

It will be apparent that when the clutch **110** (Fig. 3) is disengaged, the picker **80** is not oscillated to pick a tuft of bristles and therefore tufts of bristles will not be placed between selected sets of pins **142**. Thus, operation of the cam **100** controls the number of pins which receive tufts of bristles or which are bare.

The under wire **10** is fed through a groove in the guide plate **145** at the end thereof. Tufts of the bristles or fibers are fed on the under wire **10** by the pinwheel **54** in spaced relation as the wire is pulled out by the movement of the chuck **24** from left to right of Figs. 1 and 2 by the gear **150** and the rack **152** as I shall describe in further detail.

As the wires are pulled by the movement of the chuck **24**, the tension imposed on them brings the two wires together with the tufts between them, the upper wire **38** pulling each tuft off the pin wheel.

The chuck **24** having gripped the two wires **10** and **38**, they are pulled by the movement of the chuck **24** to the rear of the machine under tension so that the upper wire **38** holds each tuft of bristles in spaced position on the lower wire **10**.

The rack **152** is mounted for reciprocable sliding between the leading or front portion of the machine, that is to the left of Figs. 1 and 2, and the following or end portion of the machine, that is to the right of Figs. 1 and 2.

Secured to the rack **152** and moved along therewith, I provide the carriage **162** on which the chuck **24** and the driving shaft **164** for rotating are mounted.

The carriage comprises the platform **168** and the cross pieces **169** and **170** in the bearings **172** and **174** in which the driving shaft **164** is mounted.

To commence the sequence of operations by which the brush is formed, the underwire **10** is fed into position below the periphery of the pin wheel **54** through a groove in the plate **145** (see Fig. 6) to receive brush bristles or fibers from the pin wheel **54**. The upper wire **38** is fed into the groove **52** of the pin wheel **54** and projects therefrom above the wire **10**, which latter rides on the bearing block **175** (see Fig. 1).

The carriage **162** is then driven forward to its initial position at the leading part or head of the machine by means of the plunger **176** operated by air directed into the cylinder **178** (see Fig. 2).

The chuck **24** is closed so that the free ends of the two wires **10** and **38** projecting in advance of the pin wheel and bearing block are gripped by the jaws **180** and **182** (see Figs. 4 and 5).

This is accomplished by movement of the jaw sleeve **184** from the open position illustrated in Fig. 5 by operation of the plunger **186** in the air cylinder **188** to move the sleeve **184** into jaw closing position to the left of Figs. 2 and 5.

Pivoted by means of the pin **190** to the plunger **186**, to accomplish this movement, I provide the arm **192** which is moved about the pin **190** as a pivot by the admission of air in the cylinder **188** against the plunger **186**.

This moves the sleeve **184**, which is cone-shaped between the pivoted chuck arms **194** and **196**.

The beveled faces of the arms **194** and **196** under the posts **198** and **200** ride on the cone **202** against the tension of the spring **204**.

The chuck arms **194** and **196** are pivoted at **205** and **207** in the chuck. The outer ends **206** and **208** of the chuck arms are spherical in shape so that movement of the cone **202** into the chuck face causes the jaws to close on the two wires and grip them.

Synchronous movements of the different elements of my machine are caused by the operation of the cam shaft **210** in the compartment **212** which is supported on the table **26**, as by the supports **214** and **216**.

The cam shaft **210** is driven by a synchronous motor **217** through a train of gears (not shown since it is conventional, and is masked from view by the compartment wall). Each cam operates a solenoid valve in the compartment **218** to discharge air from a tank into the particular air cylinder.

It will be understood that, as the cam shaft **210** is synchronously rotated, each cam closes a switch in back of it to energize in sequence a solenoid which opens an air valve to the air tank to direct air into the corresponding cylinder which actuates the corresponding element of my machine such as a clutch, chuck jaw actuating arm, carriage moving plunger, etc., all of which movements either has been or will be described.

It will be understood that in Fig. 1 and Fig. 2 the position of the various elements are those positions assumed by them just prior to the commencement of the formation of a brush body by twisting the wires. The main clutch **74** and clutch **220**, the function of which latter I shall point out, are in disengaged condition so that the picker wheel **80** has ceased its oscillation, the pin wheel **54** its rotation, and the carriage **162** is not being driven by the gear **150** and rack **152**.

The carriage **162** has been moved to the rear of the machine and is about to twist the wires and thereby be moved toward the front end of the machine, that is to the left of Fig. 2 and form the brush, which is then cut off.

To sum up, prior to the commencement of the brush forming operations, which I shall now describe in their correct sequence, it should be noted that the cut ends of the wire have been released from the grip of the jaws **206** and **208** of the chuck **24**. The clutch **74** is in disengaged condition and the microswitch **98** has been operated to deenergize the solenoid valve through which the clutch **74** has been disengaged. Further, at this point the motor **99** has been operated to rotate the chuck **24** and twist the wires **10** and **38** and form the brush. The brush has been formed and cut so that the open ends of the wires **10** and **38** are in position to be gripped by the chuck jaws, the carriage **162** having been moved forward, that is, from right to left of Figs. 1 and 2, in position to grip the open ends of the wires **10** and **38**.

At this point in the sequence of operations, the wires **10** and **38** are gripped by the chuck **24** through the action of the cam **224** on the cam shaft **210**, which is synchronously rotated to energize a solenoid in the compartment **218** to direct air into the cylinder **188** and thereby move the cone-shaped sleeve **202** into jaw closing position to the left of Fig. 5.

The clutch **74** after the formation of the brush and the gripping of the open ends of the wires **10** and **38** is closed by directing air into the cylinder **78**, which is accomplished by energizing a solenoid valve through the cam **225** on the cam shaft **210**.

This causes operation of the shaft **94** and the closing of the microswitch **98**, which is then in position to control an electrical interlock for the purposes stated before.

At the same time, the shaft **146** commences rotation thereby causing the pin wheel **54** to rotate and receive brush bristles or fibres from the picker **80**, gathered as a tuft thereof in the slot **143** from the stock **124**.

Concurrently, the cam **228** on the cam shaft **210** energizes a solenoid in the compartment **218** to direct air into the cylinder **230** and connect the shaft **232**, on which the gear **150** is mounted, to the driving shaft **146** by means of the clutch **220**.

As the gear **150** is rotated, it drives the rack **152** from the initial position at the left of Figs. 1 and 2, where the wires have been gripped by the chuck jaws toward the end of my machine at the right of these figures.

Movement of the rack **152** conveys the carriage **162** toward the rear end of my machine, that is to the right of Fig. 2, pulling the wires **10** and **38** out by the chuck **24**. As the wires are pulled out, they pass through the pin wheel groove **52** and the groove in the plate **145** as aforesaid, the bristles or fibers being arranged in spaced tufts on the underwire **10** between the pins **142**.

As the pin wheel rotates, the upper wire **38** is brought over the underwire **10** with the spaced tufts of bristles therebetween and held by the tension imposed on the wires.

The carriage **162**, which is fixed to the rack **152** is carried by it to a point at which the strands of wires assume the length of the brush before it is twisted, which is determined by the cam **96** operating the microswitch **98**, the latter, as previously described, causing the clutch **74** to be disengaged.

As the carriage **162** is moved toward the rear of the machine, the cam-like arm **234** is pulled from underneath the cross arm **236**. The cross arm **236** is secured by means of set screw **238** and vertical member **240** to the longitudinally disposed rod **242**.

The rod **242** is mounted for rotation in the bracket **244** on the post **246** secured to the table **26** and a bracket on the compartment **218** (which bracket is not shown).

The cam-like arm **234** is mounted on the post **252** secured to the platform **168** of the carriage **162** by the bracket **248**. The rod **242** extends through an opening in the vertical arm **240** and an opening in the horizontal arm **250** secured to the post **251** mounted on the bed of the machine. The horizontal arm **253** is carried by the post **246** and supports the shaft **242**.

As the cam-like arm **234** is removed from underneath the cross arm **236** by rearward movement, to the right of Fig. 2, by the carriage **162**, since the latter is no longer supported, it gravitates downward, the rod **242** rotating in a counterclockwise direction as viewed in Fig. 2.

This brings the wire holding fork **254** down toward the wires but not in ultimate position, the wires being drawn through the open space of the fork by the rearwardly moving chuck **24**.

This wire holding fork **254** is preferably removably held in the horizontal arm **236** by means of the set screw **255**.

At the same time, the fork controlling means or arm **256** is rotated in a counterclockwise direction as viewed in Figs. 2, 8 and 9 toward the jaws **258** and **260** of the vise, which holds the strands of wire for the twisting operation by the movement of the rod **242** to which it is secured so that it is lowered from the position illustrated in Fig. 8.

Counterclockwise movement of the horizontal arm **236** and the controlling means or arm **256** brings the nose **262** against the block **264** on one of the jaws **260** thereby preventing further rotation of them until the jaws of the vise are closed at the proper sequence in the brush forming operations, which latter position is illustrated in Fig. 9. Thus, until the jaws are closed, as will be described, both the arm **256** and the fork **254** are held in somewhat raised position.

When the proper length of wire strands have been pulled out by movement of the carriage **162** to its ultimate outward position, that is to the right of Fig. 2, as previously pointed out, cam **268** on the cam shaft **210** energizes a solenoid valve to disengage the clutch **74** thereby disconnecting the main motor **60**, it being understood that oscillation of the picker **80**, and rotation of the bristle feeding pin wheel **54**, is stopped.

When the stationary position of the carriage **162** is reached and before the motor **99** is operated to twist the wires, the cam **280** operates a solenoid valve in the compartment **218** to direct air into the cylinders **270** and **272** to thereby move the jaws **258** and **260** of the vise against the wires **10** and **38** to hold them stationary for the wire twisting and brush twisting and brush forming operation.

The jaw **260** is moved thereby to the left of Fig. 9 causing the block **264** to release the nose **262** on the arm **256** so that it may gravitate into ultimate position and thereby bring the fork **254** down against the wires **10** and **38** to straddle them. The action of the fork thus prevents the wires from twisting at the left of Fig. 2.

When this stationary position of the carriage **162** is reached, the motor **99**, rotation of which twists the wires to form the brush, is operated by a cam **282** on the cam shaft **210**.

At the same time, in order to eliminate any drag by the gear **150** and the rack **152** by placing them in a free running condition, cam **228** directs air into the cylinder **230** to disengage the clutch **220** and so shaft **232** from the shaft **146** which through linkage is connected to the main motor **60** and sundry intervening elements.

As the wires are twisted by the motor **99** which rotates the shaft **164** by any satisfactory means, such as a train of gears (not shown as it is conventional), they are tightly held by the jaws of the vise.

Fig. 2, it is to be noted, is somewhat out of proportion in the distance between the wire gripping vise and the fork **254** in order to give ample room to illustrate the elements between them.

The twisting of the wires locks the bristles between them and forms the brush, the length of the wires between the chuck **24** and the vise being shortened by the twisting operation. The fork **254** also serves to prevent the wires from being twisted, beyond it, so that there will be an open end projecting for the jaws of the chuck to grip after the wires have been cut.

In order to keep the wires **10** and **38** under tension during the twisting operation, I preferably connect the carriage **162** to the counterweight **274** by means of the rope or the like **276** passing over the roller **278** on the underside of the table **26** (see Fig. 2).

This wire twisting operation pulls the carriage **162** to the left of Fig. 2, the carriage and the rack **152** being free running since they have been disconnected from the shaft **146** by the clutch **220**.

Each brush comprises a selected number of twists, each of which twists has one tuft of bristles or fibers and therefore when the selected number of twists are formed, the motor **99** is stopped. This is preferably accomplished by connecting to the twisting motor switch a conventional counter.

When the proper number of twists have been formed in the wires and the carriage **162** again held stationary, since the twisting motor **99** has ceased operation, air is directed by the cam **314** and corresponding solenoid valve into the cylinder **188** to now move the arm **192** and the cone-shaped collar into the clutch jaw open position illustrated in Fig. 5, which releases the open ends of the wires, which have formed the brush. Immediately thereafter, air is directed by the cam **316** into the cylinder **284** to move the plunger **286** upward (as viewed in Fig. 2) to clip the wires **10** and **38**, at the rear of the fork **254**, and between it and vise jaws **258** and **260**, by the knives **288** and **290**.

The knife **288** is secured intermediate its ends by the pivot **292** and the knife **290** intermediate its ends by the pivot **294** to the horizontal arm **296**.

At its lower end, the knife **288** is secured to the upper end of the link **298** by the pivot **300**, the link **298** being secured at its lower end by the pivot **302** to the connecting plate **304**.

The knife **290** is secured at its lower end to the upper end of the link **306** by the pivot **308**, the link **306** at its lower end being secured to the connecting plate **304** by the pivot **310**.

The plate **304** at its under edge is secured to the plunger **286** so that movement of the plunger moves the knives into proper cutting position and operates them to cut off the formed brush, which drops through the opening **312** in the table **26** (see Fig. 2).

After the brush is cut off by the knives **288** and **290**, the plate **304** is lowered by directing air into the cylinder **284** by the cam **314** and its corresponding solenoid valve in the compartment **218**.

The machine is now in condition to automatically return the chuck into position to grip the open ends of the wires **10** and **38** and commence the sequence of operations by which the brush is formed.

Air is now directed by the cam **317** and corresponding solenoid valve into the cylinder **178** to move the plunger **176** forward, that is, from right to left of Fig. 2, thereby pushing the carriage **162** and the chuck **24** against the theretofore cut and open ends of the wires **10** and **38**.

As the carriage **162** is moved forward, the nose **315** of the cam-like arm **234** engages the horizontal cross arm **236** to raise it out of the path of movement of the chuck **24** to the front of the machine.

This rotates the rod **242** in a clockwise direction as viewed in Fig. 2 concurrently rotating the arm **256** to the raised position illustrated in Fig. 8.

When the chuck **24** has been moved into position, so that the open ends of the wires are received between the jaws **180** and **182**, air is now directed into a valve controlling the cylinder **178** so that the plunger **176** is released and is now free to go back toward the rear of the machine, that is from left to right of Fig. 2, under the influence of the carriage **162** as it is driven by the gear **150** and rack **152**.

Simultaneously, cam **224** operates to direct air into the cylinder **188** so that the jaws **180** and **182** grip the wires at their open ends and cam **317** through its cooperating solenoid valve directs air into cylinders **270** and **272** to open the vise.

Immediately thereafter, cam **225** operates to direct air into the cylinder **78** thereby through the clutch **74** connecting the motor **60** to drive the oscillating picker **80**, the pin wheel **54** and the gear **150** and rack **152** to repeat the sequence of operations forming the brush just described.

Air from a conventional compresser (not shown) is supplied to an air tank (not shown) in the compartment **218** through the supply pipe **318** (Fig. 2) and maintained at the proper pressure by means of a conventional automatic pressurestat (not shown).

It will now be recognized that I have provided a brush forming machine which is fully automatic and feeds open ended wires from rolls thereof in position to receive between them spaced tufts of brush fibers or bristles, twists the wires to lock in each coil formed thereby each tuft of bristles or fibers and cuts the continuous wires in back of the last coil of the twisted wires to form the brush.

It will further be recognized that the automatic machine herein described and illustrated may be used to preferably make a brush of the cylindrical type in which the bristles or fibers are held between strands of intertwisted wires in spaced relation to each other.

It will be further recognized that the machine or apparatus of my invention feeds thereinto pre-selected lengths of wire strands to form the desired size of the brush having the proper number of coils or twists, between each of which a selected number of bristles or fibers are held.

Only so much of the members or elements of my machine as are necessary for an understanding of my invention have been shown in the drawings, it being understood that conventional controls and valves may be used to direct air to the cylinders and conventional clutches used to connect and disconnect various shafts.

My invention may be embodied in other specific forms without departing from the essential characteristics.

Hence, the details of the embodiment of my invention just described is therefore to be considered in all respects merely as illustrative and not as restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all modifications and variations as fall within the meaning and purview and range of equivalency of the appended claims are intended to be embraced therein. It will be understood that in the specification and the claims the words "fibers" and "bristles" are used interchangeably as meaning any brush filament suitable for use in making twisted wire brushes, such as either animal hairs or plant fibers, or synthetic filaments or the like brush elements, or material which could be interposed between the wires to be gripped thereby when the wires are twisted.

I claim:

1. In a fully automatic machine for forming a brush having spaced sets of fibers held between a pair of twisted wires, means for supporting a roll of continuous wire, means for supporting a second roll of continuous wire, a support open at its inner end, for supporting a stock of brush fibers in said support with the fibers extending from the open inner end of said open support, an oscillating picker wheel having a means for removing a selected quantity of fibers from the stock at the open inner end of the support, a first curved plate underneath the said removing means to hold the said selected quantity of fibers in said removing means, a rotating pin wheel adjacent the oscillating picker wheel, spaced pins extending from the periphery of the pin wheel at each side thereof to form pairs of parallel pins for receiving on each pair of parallel pins a set of fibers from said removing means, said pin wheel having a groove for arranging therein a first wire from one of the rolls to form an upper wire, a second curved plate under the rotating pin wheel to hold the said sets of fibers on the pairs of parallel pins, a second wire from the other roll being adapted to form an under wire and positioned under the second curved plate to receive from the pairs of parallel pins spaced sets of fibers, means for gripping the wires adjacent the rotating pin wheel, means for imposing tension on the wires to hold spaced sets of fibers between the wires, means for drawing the wires to a selected length thereof, means for twisting the wires with the spaced sets of fibers therebetween and means for cutting the wires to form the brush.

2. In a fully automatic machine for forming a brush having spaced sets of fibers held between a pair of twisted wires, means for supporting a continuous under wire free at one end, means for supporting a continuous upper wire free at one end, means for feeding onto the underwire and between it and the upper wire fibers spaced from each other, means for drawing the under wire and the upper wire with the spaced fibers therebetween to a selected length, means for twisting the wires to lock the fibers therebetween, and means for cutting the twisted wires to form the brush whereby the twisted wires are open at each end of the brush.

3. The machine of claim 2, said means for drawing the under wire and the upper wire to a selected length comprising a rotatable gear, a chuck for gripping the free ends of the wires, a carriage for the chuck and a rack driven by the gear and secured to the carriage.

4. The machine of claim 2, said means for feeding the fibers onto the under wire comprising an oscillating picker

wheel having a slot of selected dimensions and a rotating pin wheel adjacent the picker wheel.

5. In a fully automatic machine for forming a brush, means for automatically operating in the following sequence: means for gripping the free ends of an under wire and an upper wire parallel and adjacent to each other; means for feeding onto the under wire between it and the upper wire spaced sets of fibers and means for concurrently moving the gripping means to pull the wires to a selected length; means for twisting the wires to lock the bristles or sets of fibers therebetween in spaced relation; means for cutting the wires to form the brush; and means for returning the wire gripping means to position to grip the cut ends of the wires.

6. In a fully automatic machine for forming a brush, means for supporting an upper and a lower wire in substantially parallel adjacent relation; each wire being continuous and having a free end, means for drawing the wires through the machine with the open ends in the lead, means for feeding sets of spaced bristles onto the lower wire and between the upper and lower wire and means for twisting the wires to lock the spaced bristles therebetween.

7. In a machine of the character described, a support open at one end and adapted to contain a stock of bristles in the support and extending from said open end, a picker wheel having an open ended slot extending into the periphery of the wheel, means for oscillating the picker wheel whereby the open end of the slot is moved across the stock of bristles extending from open end of the support to thereby pick from the stock of bristles a selected quantity of bristles, a pin wheel having radially extending spaced pairs of pins adjacent the picker wheel and means for rotating the pin wheel concurrently with oscillating the picker wheel whereby sets of bristles are received in spaced relation from the picker wheel on the pin wheel, and means to periodically stop the oscillation of the picker wheel during rotation of the pin wheel.

8. In a machine of the character described, means for supporting a pair of wires, each wire having a free end, means for feeding spaced sets of bristles between the wires, a chuck for gripping the free ends of the wires, means for operating the bristle feeding means and means for moving the chuck to pull the wires gripped thereby in synchronism with the operation of the picking means to a pre-selected length and to receive bristles in spaced relation between the wires, said chuck moving means comprising a carriage for the chuck, a movable rack secured to the carriage and a gear driven by the means for operating the bristle feeding means.

9. In a machine of the character described, a motor, a motor shaft, a driven shaft, a clutch for engaging and disengaging the driven shaft and the motor shaft, means for supporting a stock of brush bristles, a picker wheel adjacent the stock of brush bristles to pick therefrom a selected quantity of bristles, means for operatively oscillating the picker wheel driven by the driven shaft, a pin wheel for receiving spaced sets of brush bristles from the picker wheel and rotated by the driven shaft and means for supporting a pair of spaced continuous wires, each having a free end, for receiving therebetween in spaced relation thereon spaced sets of bristles from the pin wheel.

10. The machine of claim 9, and including a means for gripping the free ends of the wires, a carriage for said gripping means, a movable rack secured to said carriage and a gear for driving said rack driven by said driven shaft.

11. In a machine of the character described, means to hold a stock of brush bristles, a picker wheel adjacent the brush bristles and having a groove open at the periphery of the wheel and extending in therefrom toward the center of the wheel, means for oscillating the picker wheel from a normal position whereby the groove therein is wiped across the stock to pick therefrom a selected quantity of brush bristles held in the groove and a pin wheel having radially extending spaced pairs of pins for rotation to receive said bristles from the groove in spaced sets, said groove in the picker wheel returning to normal position upon completion of oscillation of the wheel, and cam controlled means to periodically stop the oscillation to the picker wheel.

12. The machine of claim 11 and including curved guide plates, one of said plates beneath the picker wheel to prevent the picked bristles from falling from the open end of the groove and the second curved plate beneath a selected portion of the pin wheel to prevent the bristles received by the pin wheel from falling from the selected portion of the pin wheel.

13. In a machine of the character described, means for supporting a pair of continuous wires in substantially parallel adjacent relation, each wire having a free end, means for feeding spaced sets of bristles between the wires, means for gripping the free ends of the wires and movable to pull the wires to a selected length with spaced bristles therebetween, means for gripping the wires remote from the free ends thereof with the bristles between the free ends and the means for gripping said wires remote from the free ends and means for twisting the wires from the free ends and the gripping means remote from the free ends to thereby lock the bristles between the wires.

14. The machine of claim 13, said gripping means remote from the free ends including a fork adapted to be positioned on the wires to permit the wires to be drawn therethrough.

15. The machine of claim 13, a carriage for said means for gripping the free ends of the wire, a cammed arm on said carriage, a rod rotatably held in the machine, a second arm in the path of movement of the cammed arm toward said second arm and secured to the rod, a fork mounted on the second arm and adapted to be positioned upon the wires upon rotation in one direction of the rod, a third arm secured to the rod for locking the gripping means remote from the open ends of the wires upon rotation of the rod in said one direction to position the fork on the wires, said cammed arm upon engagement of the second arm moving said fork up from the wires to rotate said rod in a second direction and thereby move the third arm to unlock the gripping means remote from the open ends of said wires.

16. In a fully automatic machine for forming a brush, means for supporting an upper and a lower wire with leading portions susbtantially parallel and adjacent to each other, each wire being continuous with its leading portion having an exposed end, means for drawing the wires through the machine with said ends in the lead, means for feeding bristles onto the lower wire between it and the upper wire, means for twisting the wires to lock the bristles therebetween, and means for cutting the twisted wires to form the brush.

17. In a fully automatic machine for forming a brush, means for supporting an upper and a lower wire with leading portions substantially parallel and adjacent to each other, each wire being continuous with its leading portions having an exposed end, a reciprocatable and rotatable chuck for gripping said ends of the wires, means for moving the chuck to pull the wires gripped thereby a predetermined distance, means for feeding bristles onto the lower wire between it and the upper wire as said wires are being pulled by the chuck, means for gripping the wires remote from the exposed ends, and means for rotating the chuck to twist the wires and lock the bristles therebetween.

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