

Dec. 25, 1951

R. O. PETERSON ET AL

2,580,378

BRUSH MANUFACTURE

Filed Aug. 6, 1945

2 SHEETS—SHEET 1

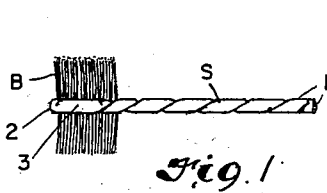


Fig. 1

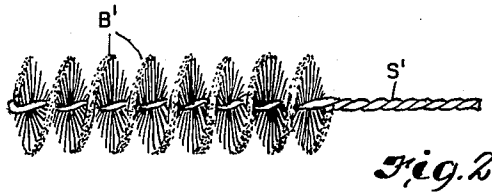


Fig. 2

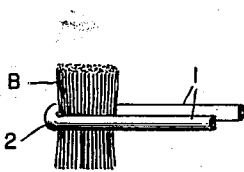


Fig. 3

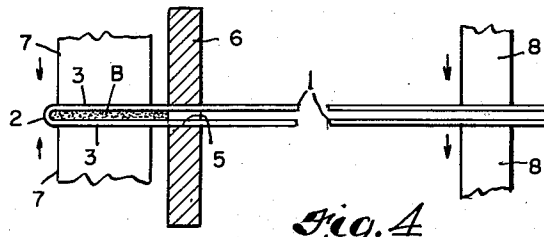


Fig. 4

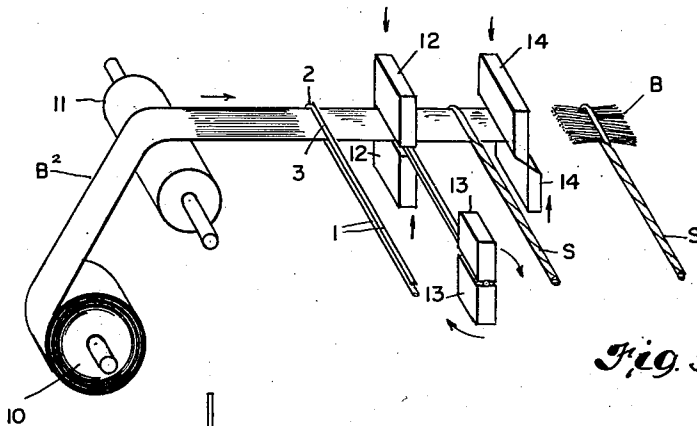


Fig. 5

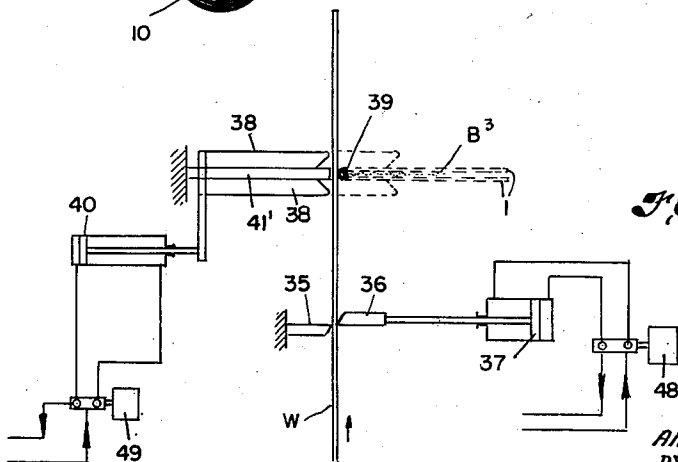


Fig. 9

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2 SHEETS—SHEET 2

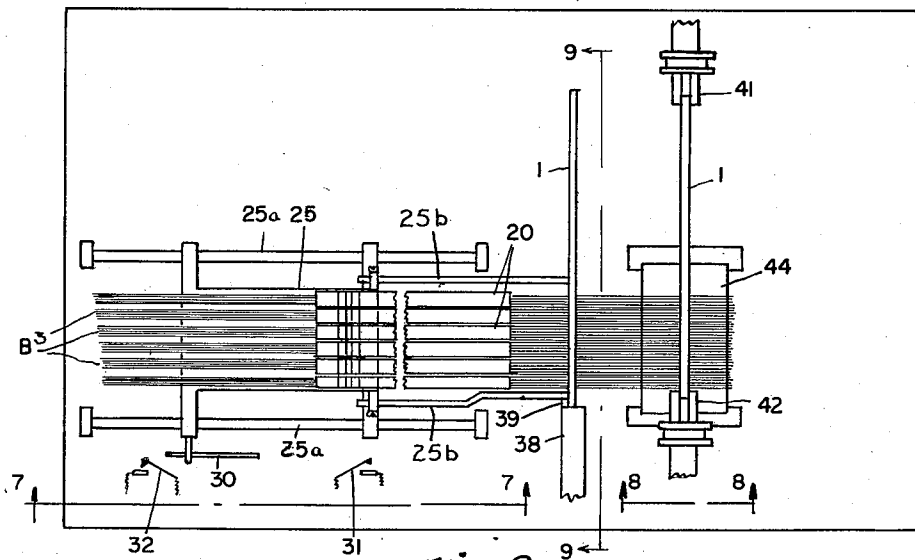


Fig. 6

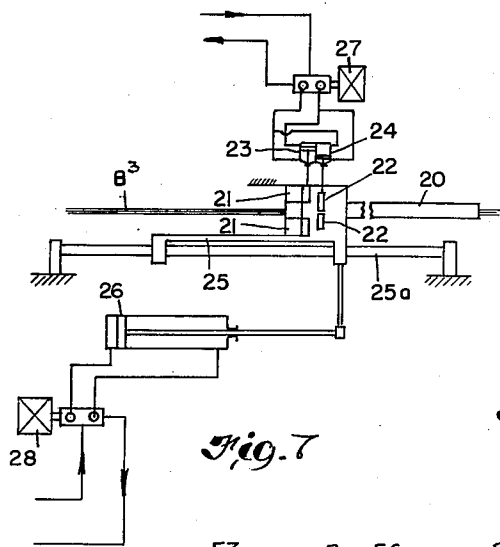


Fig. 7

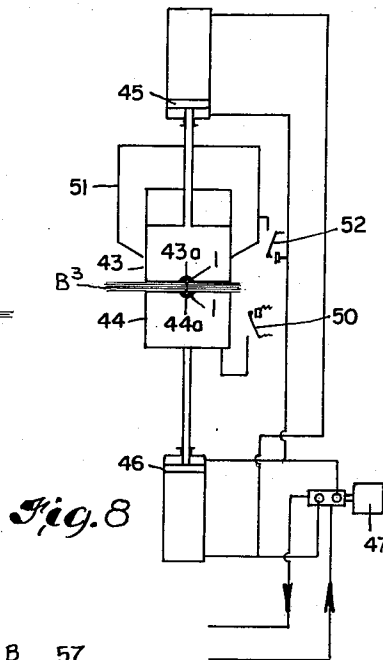


Fig. 8

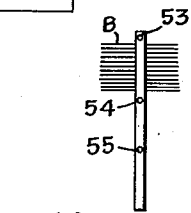


Fig. 10

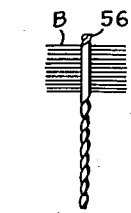


Fig. 11

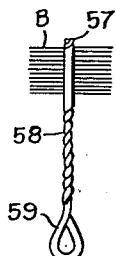


Fig. 12

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BRUSH MANUFACTURE

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Application August 6, 1945, Serial No. 609,280

23 Claims. (Cl. 300—21)

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The present invention, relating as indicated to brush manufacture, has more particular regard to the manufacture of brushes of the so-called twisted stem type, i. e. brushes in which the bristles or equivalent stranded brush material is secured between a plurality of parallel disposed wires which are then twisted about a common axis with the result that such brush material is disposed in the form of a helix about the resulting twisted stem. The present improvements equally relates to the manufacture of a modified form of such twisted stem type of brush as familiarly made, wherein the twisting of the stem members stops short of the inserted layer of brush material, the latter being retained between straight parallel sections of the stem wires which are pressed together with sufficient force to compact such layer and secure the same against dislodgement under conditions of use. The specific form of brush just referred to, it should be noted, forms the subject matter of a co-pending application filed by Messrs. Ruben O. Peterson and Vernon K. Charvat under date of November 22, 1943, Serial No. 511,256, of which this application is a continuation-in-part and which is now Patent No. 2,456,396, Mar. 29, 1949.

While brushes of the familiar twisted stem type have long been known as suitable for use in certain limited fields, they have never figured largely in industrial and shop uses, as for removing burrs, and cleaning and polishing metal parts, due to the fact that the stem wires have only in effect a point contact with the sides of the round strands of brush material so that the latter is subject under hard conditions of service to undue concentration of flexure with consequent rapid deterioration, particularly where wire strands form the material. It has also been found difficult to secure a sufficient body of the brush material between the wires of the stem so as to provide a brush capable of effecting burr removal, cleaning or polishing action in contact with metal parts.

In the improved brush with the manufacture of which the present invention is concerned, the wires between which the brush material is held are formed with flat opposed faces, so that the layer of brush material, whether twisted into helical form or left as a flat layer, will be transversely supported at its center portion for a distance equal to the width of the stem wires. As a result, not only is such material more firmly attached to the stem than where the latter is formed of ordinary round wire, but the layer of such material will be held in more compact con-

dition between the stem wires and also not tend to flare widely at its respective outer edges.

Furthermore, it has been found that by employing stem wires of the form just described, a layer of brush material may be placed therebetween and firmly compressed and gripped by the wires by forcibly pressing the latter together, irrespective of further gripping action obtained by twisting such wires about their common axis, as in the familiar twisted stem type of brush. Compression of the brush material by the application of pressure greater than can be generated by the action of twisting stem wires together in the conventional way, makes it possible to use, successfully, crimped or otherwise compressible brush material which is too stiff or too resistant to compacting to be suitable for use in brushes made by conventional methods. The amount or layer thickness of such brush materials can also be increased over that which is usable in brushes made by known methods of the art. Indeed, a layer of brush material of considerable longitudinal extent may thus be permanently retained in flatwise condition, i. e. without twisting the corresponding sections of the stem wires at all, and, equally important, such layer may thus be held in such compressed state without danger of displacement during the operation of twisting the stem wires. Based on the foregoing, a significant advance has been found possible in the manufacture of brushes of the type in question whereby they may be made from continuous strands of brush material so as to eliminate handling short lengths of such material, which entails a great deal of care. At the same time it is rendered possible automatically to perform the successive operations involved in making such brushes so that not only is a superior product obtained, but the cost of manufacture may be materially reduced.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means and one mode of carrying out the invention, such disclosed means and mode illustrating, however, but one of various ways in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a side elevation of the improved form of twisted stem brush referred to above, wherein the brush material is retained in the form of a

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flat layer, the twisting of the stem wires stopping short of said layer;

Fig. 2 is a similar side elevation of a twisted stem brush in which the twisting has been carried through the entire extent of the brush proper;

Figs. 3 and 4 illustrate more or less diagrammatically the manner in which brushes of the form illustrated in Fig. 1 may be assembled;

Fig. 5 is a similar diagrammatic perspective view illustrating the method of manufacturing a succession of such brushes from a continuous layer of brush material;

Fig. 6 is a diagrammatic plan view of an apparatus designed similarly to manufacture a succession of brushes from a continuous layer of brush material where the brush is either of the form illustrated in Fig. 1 or that illustrated in Fig. 2;

Fig. 7 is a diagrammatic view in side elevation of one portion of the apparatus illustrated in Fig. 6;

Fig. 8 is a similar side elevation of another portion of such apparatus;

Fig. 9 is a similar side elevation of still another portion thereof; and

Figs. 10 to 12 inclusive illustrate modified forms of the brush adapted to be produced in accordance with our new method.

In order better to understand the improved method and apparatus which constitute the present invention, the brush product designed to be made thereby, as illustrated in Fig. 1 and in modified form in Fig. 2, will first be described.

Referring to the form illustrated in Fig. 1 (see also Fig. 3, which shows the same form of brush in process of being made), it will be noted that half-round wires 1, or the equivalent doubled portions of a single wire of half-round section, are twisted together to form the stem S of the brush. However, the layer of brush material B instead of being inserted between such inter-twisted wires with resultant helical disposition of the material, is inserted only adjacent the end or point 2, where the component wires of the stem are doubled on each other, and the twisting of the wires begins beyond, but immediately adjacent, such inserted layer of brush material. In other words, the sections 3 of the wires 1, between which the brush material is held, are not only parallel but straight, and the brush material projects therefrom in corresponding straight form, i. e. extends through and cross-wise of the stem in the form of a flat tuft. In order that such flat tuft may be securely held between the stem wire sections 3, the latter, following insertion of the layer of brush material, are forcibly compressed together, it having been found that where the opposed faces of the stem wires are flat, as described, they will upon being thus compressed have sufficient frictional engagement with the brush material to secure against displacement a layer of the latter of substantial longitudinal extent, as shown in Figs. 1 and 3, even under severe conditions of use.

Where it is desired that the brush have the typical form of the familiar twisted stem type, the twisting of the components 1 of said stem will be simply continued to include the layer of brush material previously inserted and compressed in the manner just described. In such case it will ordinarily be desirable to employ a layer of brush material B' of greater longitudinal extent, which upon completion of the twisting operation will assume the helical form

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illustrated in Fig. 2, the stem S' being formed of two wires, or doubled wire portions, having opposed flat faces, just as in the first-described form of brush. It should be observed that at an intermediate step in the manufacture of such fully twisted form of brush the latter will be substantially identical with the form illustrated in Fig. 1, the layer of brush material being initially placed in flat form between the opposed faces of the stem wires and the latter being pressed together with sufficient force to retain such layer against displacement at least during the further twisting operation which results in the helical form of brush as illustrated in Fig. 2.

Figs. 3 and 4 illustrate one way in which the simpler form of brush shown in Fig. 1 may be conveniently made. After inserting the layer B of brush material between the doubled portions of the wires 1 adjacent the point 2, the projecting portions of the wires which are to constitute the twisted stem are passed through an aperture 5 in a fixed abutment 6. Such wires are then pulled forcibly, i. e. to the right as illustrated in Fig. 4, so as to press the layer of brush material against said abutment and crowd the same compactly into the space between the wires allotted to such material, so as to insure a desired optimum thickness of such layer, as well as that the strands composing the same be compacted closely together. Thereupon the portions 3 of the wires 1 between which the layer of brush material B has been thus inserted and compacted are forcibly pressed together between movable jaws 7, 7, so as to close such portions laterally upon the layer of brush material; following which the portions of the wires 1 lying beyond abutment 6 are gripped as between jaws 8, 8 which are mounted for rotation about the longitudinal axis of the brush so that upon being rotated the portions of the wires in question will be tightly twisted together to constitute the stems of the brush, as illustrated in Fig. 1.

It will be understood that in the step of compacting the layer of brush material between the doubled portions of the wires 1 the latter require to be deformed beyond the yield point of the material whereof they are composed so that such portions, with the compacted brush material lying therebetween, will remain substantially in the relation produced by the action of the jaws or dies 7, 7. To secure this result the stem wires should have certain cold working properties, such as possessed by several types of stainless steel instead of being formed of highly resilient or spring steel. Such compression step, furthermore, will desirably effect a substantial reduction in the area of the space between the stem wire portions in which the layer of brush material is confined and thus compacted. Particularly in the case of crimped or otherwise compressible brush materials, such area may be reduced so as to be only from 10% to 15% of the original area defined by such wire portions when the layer of brush material is inserted therebetween. By thus providing the greatest practical area possible for the insertion of the brush material, the assembly operation is greatly facilitated; then upon reduction of such area, by externally applied pressure to the extent indicated, the brush material will be very firmly gripped through the entire extent of the contacting portions of the stem wires. A measure of the compression achieved is afforded by the ratio of the original area of the loop in which the brush material is inserted compared with the loop area after it is reduced by the externally

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applied pressure. Maximum reduction would of course be obtained if the loop were initially of circular outline and then flattened until its sides were parallel and closely adjacent, the amount of such reduction being varied depending upon the degree of compressibility of the brush material. Thus if the latter be composed of nylon strands, for example, less reduction will be required to secure a firm grip than if composed of fine crimped wires. If crimped brush material, for example, be compressed by pressures on the order of 10,000 to 20,000 lbs./sq. in. or more, a wire retaining member which may have a tensile strength of only 100 lbs. will generally be of sufficient strength to retain such material in substantially such compressed condition although the retaining member obviously would have pulled apart if it had been attempted to compact such material to any such degree through tightening of such member about such material.

Once such material is thus compressed it tends to retain its compacted form since much of the heavy pressure employed was necessary to do the work of deforming the components of such material and to overcome frictional resistance of such components relative to each other.

The method of manufacture just described not only insures that the brush material will be securely held in desired form between the straight portions of the doubled stem wire, but also greatly facilitates the manufacture of the brush by reducing such manufacture to several relatively simple operations. Moreover, such method of manufacture lends itself to a further improvement in operation whereby brushes of the type in question may be made from continuous strands of brush material, so as to eliminate handling short lengths of the latter, which has always presented a serious problem in the manufacture of twisted stem type brushes.

Such continuous method of making brushes of the form illustrated in Fig. 1 is schematically illustrated in Fig. 5 where the layer of brush material B² is of indefinite longitudinal extent, being drawn from a supply roll 10 over a guide roll 11 and thence being subjected to the operation of a series of instrumentalities on the order of those illustrated in Fig. 4 in the manufacture of such brushes individually. It will be understood that such layer of brush material will be advanced with a step-by-step movement through these instrumentalities, by means of suitable clamps which engage with the layer, and in addition to producing such intermittent movement thereof serve to retain the stranded material of the layer under the desired degree of tension. Since similar clamping means are employed in the further modified form of apparatus illustrated in the remaining figures of the drawings, it has been deemed unnecessary to include a showing thereof in Fig. 5, which, as stated, is wholly schematic.

Accordingly, it will suffice to state that the layer B² of brush material lying beyond, i. e. to the right of roller 11, will be advanced at intervals a fixed distance so as to present successive portions of such layer for operations, as will now be described, to be performed thereon. The first such operation will consist in placing transversely of the layer, which in effect constitutes a continuous web, a pair of stem wires 1, preferably forming parts, as previously explained, of a doubled wire, flat on one side and with the flat faces opposed. Such wires may be thus doubled so as to encompass the web, or the doubling may

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be previously performed and the wires then slipped crosswise of the layer or web of brush material. The next step illustrated in such figure is the forceful compression upon the layer of the sections 3 of the wires 1 which contact therewith, such compression being performed between opposed relatively movable jaws 12, 12 which correspond with previously described jaws 7, 7, and are located in alignment with a pair of rotatable jaws 13, 13, that correspond with jaws 8, 8 of the apparatus illustrated in Fig. 4. While the jaws 12, 12 are pressed together, the rotatable clamping jaws 13, 13 will be rotated, just as in the case of such previously described construction, so as to twist the stem wires together up to the edge of the layer of brush material. The stem wires will thus become attached to the layer and be carried along therewith to the next stage.

While the stem wires are shown as being applied to the continuous layer or web B² of brush material at a point in advance of jaws 12, 12, it will be obvious that such application of the stem wires may be made at the point of location of the jaws when the latter, as well as the rotatable gripping jaws 13, are properly spaced apart. The extent of the successive advance movements of the layer or web of brush material should equal the transverse width of the flat tuft B to be severed from such layer to form the finished brush. Accordingly, the severing means, which will conveniently comprise two coacting shear blades 14, 14, will be located a distance beyond the clamp jaws 12 which will equal one and one-half times the width of the flat tuft in question. In Fig. 5 the finished brush which is shown as just having been severed from the continuous layer or web of brush material is shown removed a short distance beyond the line of severance. The means whereby the layer or web is advanced in the manner described may be conveniently located between the jaws 12, 12 and the shear blades 14, 14, such means operating of course only when said jaws are separated.

As previously indicated, the further modified construction of apparatus illustrated in Figs. 6 to 9 inclusive embraces additional automatic features for forming brushes of the twisted stem type including means for twisting the stem wires throughout their entire length so as to present the layer of brush material in helical form, as shown in Fig. 2, instead of in the form of a flat tuft as shown in Fig. 1. In this machine, as in the one last described, a continuous layer of brush material B³, i. e. one of indefinite length, is utilized, just as in the apparatus last described. As shown in Fig. 6, such layer may be subdivided into a series of parallel layers or webs which are guided through a corresponding series of tubes 20 past opposed pairs of clamp jaws 21, 21 and 22, 22 which are designed to be alternately closed upon and so grip the layer or web of brush material. These jaws are respectively operated by hydraulically actuated pistons 23 and 24, which are in turn controlled by a system of electric circuits and limit switches, as will be presently described. While jaws 21, 21 occupy a relatively stationary location, the other pair of jaws 22, 22 are mounted on a carriage 25 that is reciprocable on suitable ways or guides 25a, aligned with the direction of travel which it is desired to impart to the layer or web B³ of brush material. This carriage is thus reciprocated by an hydraulically actuated piston 26, operation of which is controlled in proper correlation with that of pistons 23 and 24, so that on pressing a button (not

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shown) which turns on the electric power for the controls and for starting an hydraulic unit operating the various cylinders, oil under pressure will be supplied through valve 27 alternately to the cylinders which actuate the pairs of jaws 21, 21 and 22, 22, and through valve 28 alternately to opposite sides of the cylinder in which piston 26 reciprocates. Thus when jaws 21, 21 are in open position, jaws 22, 22 will be closed to grip the layer of brush material therebetween and simultaneously piston 26 will be actuated to move the carriage 25 forwardly, i. e. to the right as illustrated in Figs. 6 and 7. Upon completion of such movement, jaws 21, 21 will in turn be closed, jaws 22, 22 thereupon opened, and simultaneously said piston 26 will be moved in the reverse direction to return the carriage, and thus such last-mentioned jaws carried thereby, to starting position.

The extent of the forward movement of the carriage 25 will be controlled by contact of an arm 30 adjustably mounted thereon with a limit switch 31, the action of which, through the electrical control circuit, is to reverse piston 26. Upon return of the carriage it sets a second limit switch 32 which is then subsequently energized to start another cycle of operations, as will be presently described after completing the description of those which follow the intermittent forward feeding of the brush material.

In the mounting of clamp jaws 21, 21 and 22, 22 it is necessary that provision be made for adjusting the position of each pair longitudinally of the layer of brush material, as well as for adjusting the extent of forward movement of the carriage and thus of said second pair of clamp jaws. The distance through which such movement is had will, as in the previously described construction, equal the transverse width of the successive sections to be severed from the continuous layer or web of brush material to enter into the formation of the individual brushes which the machine is set to make. The first step in the actual fabrication of the brush is to assemble with successive sections of the layer or web B³ of brush material the doubled pieces of wire which are to form the stems of the brushes. Such wire W (see Figs. 6 and 9), is designed to be fed vertically upwardly closely contiguous to one edge of the layer of brush material just beyond the path of movement of the clamp jaws 22, 22, as they are moved forwardly to advance successive sections of such layer. Adjacent such point, but located on a plane an adjustable distance below the layer, are two opposed shear blades 35 and 36, the latter of which is adapted to be moved by an hydraulically actuated piston 37 to cut off the upwardly projecting section of said wire W. The adjustment of this cutting-off device will be such that the section of the wire thus severed will have its mid-point located opposite to the edge of the layer of brush material. Adjacent such mid-point of the section of wire thus severed are two spaced-apart forming dies 38 which, when moved transversely of said layer of brush material, are adapted, in conjunction with a stationary pin 39, to bend the severed section of wire so as to laterally enfold such layer. Dies 38 are thus reciprocated by an hydraulically actuated piston 40, operation of which is in turn controlled conjointly with that of piston 37 which actuates shear blade 36 as well as piston 26 which serves to reciprocate carriage 25. A stop 41, which lies between the forming dies 38, serves to hold the wire after being doubled over the layer

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of brush material from returning on the withdrawal of the forming dies 38. The doubled-over portions of the severed section of wire W, it will be seen, constitute the stem wires 1 of the brush previously described.

Following the application to the layer of brush material, the next advance movement of the latter will deliver such doubled stem wires 1 to clamps 41 and 42. These are mounted for rotation about the common axis of the stem wires, and means for rotating said jaws, as well as for opening and closing the same, will be automatically controlled so that these operations will occur in proper sequence with other operations which remain to be described.

Located between the rotatable jaws 41 and 42 are two relatively vertically reciprocable dies 43 and 44, one disposed to lie above and the other below the layer of brush material with doubled stem wires attached thereto as described, said dies having depressions 43a and 44a in their opposed faces adapted to receive such wires. Such depressions, however, are of less depth than the thickness of the wires so that when the dies are forced together by means of hydraulically actuated pistons 45 and 46, respectively connected therewith, the dies will exert pressure directly on the wires and forcibly compact the layer of brush material therebetween. An electrically controlled valve 47 controls in turn the supply of pressure fluid whereby said pistons are actuated, the timing being such that while said dies 43 and 44 are forced together to compress the stem wires tightly into place with the brush material therebetween, a valve 48 which controls the actuation of piston 37, and valve 49 which similarly controls the actuation of piston 40, will cause a fresh section of wire W to be severed, and such section doubled upon the portion of brush layer B³ which is to enter into the next succeeding brush.

Upon completion of the closing movement of the clamps or dies 43 and 44, a limit switch 50 is actuated to start power driven means (not shown) whereby clamp jaws 41 are caused to rotate a sufficient number of times to twist the stem wires held therebetween up to the point where the latter are pressed between said dies 43 and 44. After said jaws have completed such predetermined number of turns, cutting-off mechanism in the form of a reciprocable double shear 51 will be operated by an hydraulically actuated piston (not shown) to sever the layer of brush material on the near side of the closed dies or jaws 43 and 44 and trim off any protruding strands on the further side of said dies.

On completion of the operation of cutting off the brush material, a limit switch 52 is actuated, such switch in turn actuating valve 47 to open the jaws or dies 43 and 44, the shear or cutter 51 being at the same time withdrawn. If a brush of the flat type illustrated in Fig. 1 is desired, such brush is now completed and may be discharged from the machine by opening the aligned rotatable jaws 41 and 42 whereby the respective ends of the stem wires 1 have been gripped during the operations last described above. On the other hand, if a helically formed brush, such as illustrated in Fig. 2, is desired, following separation of dies 43 and 44 and withdrawal of the shear or cutter 51, a further rotative movement is imparted to said jaws 41 in the same direction as before so as to complete the twisting of the remaining portions of the stem wires between which the brush material has been pressed by action of said dies. As previously explained, the

compressive action of the latter is sufficient so that the severed section of the layer will be securely held between the stem wire portions during this further twisting operation, i. e. the component strands will not be displaced so that after the requisite number of turns a finished twisted stem brush of helical form is produced. The latter will then be ejected from the machine by opening the rotatable jaws 41 and 42 and the machine thus prepared for another cycle of operations.

It will be understood that the brush material B³ will be supplied to the machine from a suitable rotatably supported spool or spools (not shown) located at the left thereof as illustrated in Fig. 6. Such material may consist of any of the usual materials employed in making brushes of the type in question, such as crimped brush wire, crimped or straight nylon or other synthetic brush material, cord, or any other filamentous material that may be conveniently provided in continuous lengths. While, as in the case of the simpler form of mechanism illustrated in Figs. 4 and 5, such material may be directly drawn from the spool on which it is supplied in the form of a flat layer, where the width of such layer is increased in order to make a brush of correspondingly greater longitudinal extent, such material will have a tendency to bunch unevenly in the course of its passage through the machine. This difficulty is overcome by sub-dividing the material by means such as the tubes 20 illustrated in Fig. 6 which serve to maintain an even distribution of the material transversely of the layer or web. The tubes 20 are located closely adjacent each other so that upon emerging from such tubes and being engaged by the dies 43 and 44 such sub-divisions of course entirely disappear, and the component strands will be spread uniformly throughout the entire transverse width of the layer or web.

Figs. 6 to 9 inclusive being wholly schematic, it has been deemed unnecessary to illustrate the electrical circuits in which the several limit switches are included, since the interconnections of such devices for the purpose of effecting the sequential operation of a series of valves or like instrumentalities is of course well understood. Similarly, it has been deemed unnecessary to illustrate the means whereby oil or equivalent fluid under pressure is supplied to the cylinders for the several pistons which actuate the different instrumentalities, as described.

Once the operation of the machine as illustrated in said Figs. 6 to 9 inclusive is started, such operation will continue automatically until the supply of stranded brush material is exhausted. Such operation will be entirely automatic and finished brushes may be turned out at the rate of from thirty to sixty per minute. Moreover, such brushes, whether of the flat or helical form, will not only have the brush material secured between the stem wires with a degree of firmness not heretofore obtainable, where, as in the conventional method for making twisted stem brushes, previously cut short lengths of stranded brush material are utilized, but the placement of the material will be accurately controlled so that no further trimming of the finished brush is required.

While the stem wires between which the brush material is secured are preferably formed as shown by doubling a single wire at an intermediate point, it will be understood that the two wires required for the purpose may be otherwise provided, so long as such wires are suitably secured together so as to provide an area or space within

which the layer of brush material may be confined. Thus instead of being bent or folded at point 2 the stem wires 1, illustrated in Figs. 3 and 4, may comprise separate wires "tacked" together at the point in question, as at 53 in Fig. 10, by brazing or welding. The stem portions extending beyond the other side of the layer of brush material may likewise be welded together as at 54 and 55 instead of being secured together by twisting. Where it is not important that the end of the stem be rounded (as by doubling) or that it terminate closely adjacent the layer of brush material, the two component wires may merely be twisted together as at 56 (Fig. 11). Indeed, this may also be done when a single wire is doubled to form the two stem wires, the ends of such wires being joined as by twisting at 57 (Fig. 12) while the doubled portion is twisted to form a stem 58 terminating in a handle loop 59. Various other modifications will be apparent to those skilled in the art as being capable of manufacture by our new method.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any of the following claims or their equivalent be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In the manufacture of brushes of the twisted stem type, the steps which include doubling transversely of a layer of brush material, at spaced intervals therealong, a series of elongated stem forming members, whereby portions of the latter are brought into contact with opposite sides of such layer, the point of doubling being adjacent one edge of the latter, subjecting the layer contacting portions of said members to externally imposed transverse pressure, whereby such layer will be compacted and remain firmly held between such portions by the compressive action thereof, and then subsequently transversely severing such layer between successive members.

2. In the manufacture of brushes of the twisted stem type, the steps which include doubling transversely of a layer of brush material, at spaced intervals therealong, a series of elongated stem forming members, whereby portions of the latter are brought into contact with opposite sides of such layer, the point of doubling being adjacent one edge of the latter, subjecting the layer contacting portions of said members to externally imposed transverse pressure, whereby such layer will be compacted and remain firmly held between such portions by the compressive action thereof, twisting together the portions of said members lying beyond such layer to form a stem, and then subsequently transversely severing such layer between successive members.

3. In the manufacture of brushes of the twisted stem type, the steps which include doubling transversely of a layer of brush material, at spaced intervals therealong, a series of elongated stem forming members, whereby portions of the latter are brought into contact with opposite sides of such layer, the point of doubling being adjacent one edge of the latter, subjecting the layer contacting portion of said members to externally imposed transverse pressure, whereby such layer will be compacted and remain firmly held between such portions by the compressive action thereof, twisting together the portions of said members lying beyond such layer to form a stem,

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while the portions of said member in contact with such layer are still under pressure, and then transversely severing such layer between successive members.

4. In the manufacture of brushes of the twisted stem type, the steps which include doubling transversely of a layer of brush material, at spaced intervals therealong, a series of elongated stem forming members, whereby portions of the latter are brought into contact with opposite sides of such layer the point of doubling being adjacent one edge of the latter, subjecting the layer contacting portion of said members to externally imposed transverse pressure, whereby such layer will be compacted and remain firmly held between such portions by the compressive action thereof, twisting together the portions of said members lying beyond such layer to form a stem, while the portions of said member in contact with such layer are still under pressure, relieving such pressure, thereupon twisting together such last-mentioned portions to form a continuation of such stem, and then transversely severing such layer between successive members.

5. In mechanism for making brushes, means for advancing by successive steps a continuous layer of brush material, means adapted to apply to opposite sides of such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members, a pair of opposed dies located to engage such members at a subsequent point of rest of such layer and compress the latter between said members means operative to secure such members together permanently to grip such brush material therebetween, and means operative to sever such layer at a point spaced from such stem members after such stem members have thus been pressed against such layer by said dies.

6. In mechanism for making brushes of the twisted stem type, means for advancing by successive steps a layer of brush material, means adapted to apply to opposite sides of such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members, a pair of opposed dies located to engage said members at a subsequent point of rest of such layer and compress the latter between said members, and means adapted to engage the ends of said members and twist the same together, said twisting means being controlled to operate while said dies are closed.

7. In mechanism for making brushes of the twisted stem type, means for advancing by successive steps a layer of brush material, means adapted to apply to opposite sides of such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members, a pair of opposed dies located to engage said members at a subsequent point of rest of such layer and compress the latter between said members, and means adapted to engage the ends of said members and twist the same together, said twisting means being controlled to operate initially while said dies are closed and thereupon to continue operation after said dies have opened.

8. In mechanism for making brushes of the twisted stem type, means for advancing by successive steps a layer of brush material, means adapted to apply to such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members, a pair of opposed dies located to engage said members at a subsequent point of rest of such layer and compress the latter between said members, shearing

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means adapted to sever such layer transversely at a point intermediate of the stem forming members thus applied, and means adapted to engage the ends of said members and twist the same together, said twisting means being controlled to operate initially while said dies are closed and thereupon to continue operation after such layer has been severed and said dies have opened.

9. In mechanism for making brushes of the twisted stem type, the combination with means for advancing by successive steps a layer of brush material, of means adapted to apply to such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members said means including a pin located adjacent one edge of such layer, and a pair of forming dies reciprocable past said pin across such layer, whereby a length of such elongated member may be doubled over said pin to contact opposite sides of such layer.

10. In mechanism for making brushes of the twisted stem type, the combination with means for advancing by successive steps a layer of brush material, of means adapted to apply to such layer, at one point of rest in its path of movement, a pair of opposed, elongated stem forming members, said means including a pin located adjacent one edge of such layer, a pair of forming dies reciprocable past said pin across such layer, whereby a length of such elongated member may be doubled over said pin to contact opposite sides of such layer, and a stop between said dies adapted to retain such doubled member in place upon retraction of said dies.

11. In the manufacture of brushes of the twisted wire stem type, the steps which include applying at spaced intervals to a layer of the stranded brush material, pairs of opposed, elongated members, one on each side of such layer, twisting the portions of each such pairs of members lying beyond such layer, subjecting such layer to pressure between said members before and during such twisting operation, whereby successive sections of such layer are clamped between said members and then severing such layer between successive pairs of said members.

12. In the manufacture of brushes of the twisted stem type, the steps which include applying in succession at spaced intervals to a layer of stranded brush material, pairs of opposed elongated members, one on each side of such layer, applying pressure to such paired elements thus placed so as to leave such layer laterally compressed and clamped therebetween, preliminarily to twisting the latter to secure the respective severed portions of said layer therebetween and then severing such layer between successive pairs of said members.

13. In the manufacture of brushes, the steps which include doubling transversely of a layer of brush material, at spaced intervals therealong, a series of elongated stem-forming members, whereby portions of the latter are brought into contact with opposite sides of such layer, subjecting the layer contacting portions of such members to externally imposed transverse pressure effective closely to compact such layer therebetween, securing such members tightly about such material to hold such material in substantially such closely compacted relationship, and severing such layer between successive members thus secured to such layer.

14. In the manufacture of brushes, the steps which include applying at spaced intervals to a layer of brush material pairs of opposed elongated

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members, one on each side of such layer, subjecting the layer contacting portions of such members to externally imposed transverse pressure effective closely to compact such layer therebetween, securing such members to hold such material in substantially such closely compacted relationship, and severing such layer between successive pairs of said members thus secured to such layer.

15. In brush making mechanism, means operative to advance a continuous layer of brush material, means operative to advance a continuous length of wire adjacent such layer, means operative to cut off sections of such wire, means operative to double such sections about such layer transversely thereof at spaced intervals therealong, externally imposed pressure means operative to compact such brush material between the portions of such sections embracing the same, means operative to secure such portions together tightly about such material to retain such material substantially thus compacted, and means operative to sever such layer between successive sections of wire thus applied.

16. In brush making mechanism, means operative to advance a continuous layer of brush material, means operative to apply elongated stem-forming members to opposite sides of such layer at spaced intervals therealong, externally imposed pressure means operative to compress such brush material between such members, means operative to secure such members tightly about such material to retain such material substantially thus compacted, and means operative to sever such layer between successive pairs of such members thus secured to such layer.

17. In brush making mechanism, means operative to advance a continuous generally flat layer of brush material, means operative to apply a pair of opposed elongated retaining members to opposite flat sides of such layer at one station in the travel of the latter, pressure means operative to engage such members in the region of such layer and compress such layer transversely therebetween, means operative to secure such members together to retain such material thus compressed, and means adapted to sever such layer of brush material between successive pairs of such members thus secured to such layer.

18. In brush making mechanism, means operative to advance a continuous generally flat layer of brush material, means operative to apply a pair of opposed elongated retaining members to opposite flat sides of such layer at one station in the travel of the latter, pressure means operative to engage such members in the region of layer and compress such layer transversely therebetween, twisting means operative to twist portions of such members extending beyond such layer together to retain such material therebetween while maintaining such externally imposed pressure thereon, said twisting means being also adapted to twist the portions of such members gripping such layer of brush material therebetween after release of such externally imposed pressure, and means adapted to sever such layer of brush material intermediate successive pairs of such members prior to twisting of the material gripping portions of the latter.

19. In brush making mechanism, means operative to advance a continuous generally flat layer of brush material, means operative to apply a pair of opposed elongated retaining members to opposite flat sides of such layer at one station in the travel of the latter, pressure means operative to engage such members across the entire lateral

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extent of such layer and compress such layer therebetween, means operative to secure such members to retain such material in locally compressed condition, and means adapted to sever such layer of brush material intermediate successive pairs of such members.

20. In brush making mechanism, means operative to advance a continuous layer of brush material, means operative to apply a pair of opposed elongated retaining members to opposite sides of such layer, pressure means operative to engage such members in the region of such layer and compress such layer therebetween, twisting means operative to twist portions of such members extending beyond such layer together to retain such material securely therebetween while maintaining such externally imposed pressure on such layer, and means adapted to sever such layer of brush material between successive pairs of such members.

21. In brush manufacture, the steps of advancing a continuous layer of brush material drawn from a supply thereof in the form of a relatively narrow elongated flat body, doubling an elongated stem-forming member transversely of such layer at a first station to engage such layer between straight parallel portions thereof, the point of such doubling being closely adjacent one edge of such layer and such member extending beyond the other edge of such layer, subjecting such layer-engaging portions of such member to heavy externally imposed pressure to compact such layer therebetween, securing together the portions of such doubled member thus extending beyond such layer while maintaining pressure on such layer-engaging portions, releasing such pressure, severing such layer at a following station in the advance thereof at a point thereon following such stem member thus affixed thereto and after another such stem member has been thus doubled about such layer at such first station, and thereafter twisting together such straight parallel portions of such stem member having the severed portion of such layer gripped therebetween.

22. In brush manufacture, the steps of advancing a continuous layer of brush material drawn from a supply thereof in the form of a relatively narrow elongated flat body, doubling an elongated stem-forming member transversely of such layer to engage such layer between straight parallel portions thereof, the point of such doubling being closely adjacent one edge of such layer and such member extending beyond the other edge of such layer, subjecting such layer-engaging portions of such member to heavy external pressure to compact such layer therebetween, securing together the portions of such doubled member extending beyond such layer while maintaining pressure on such layer-engaging portions, releasing such pressure, further advancing such layer, and thereafter transversely severing such layer at a point intermediate such member and a following member affixed to such layer in like manner.

23. In mechanism for making brushes of the twisted stem type, means operative to advance by successive steps a continuous layer of brush material, means operative to apply transversely to such layer, at one point of rest in its path of advance, a pair of opposed elongated stem-forming members, a pair of opposed dies located at a subsequent point of rest of such layer and operative to engage such members to compress such layer therebetween, twisting means operative to engage the end portions of such members and twist

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the same together, and shearing means operative to sever such layer transversely at a point spaced from such stem members subsequent to such twisting operation.

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