

April 26, 1938.

G. SPAANBROEK

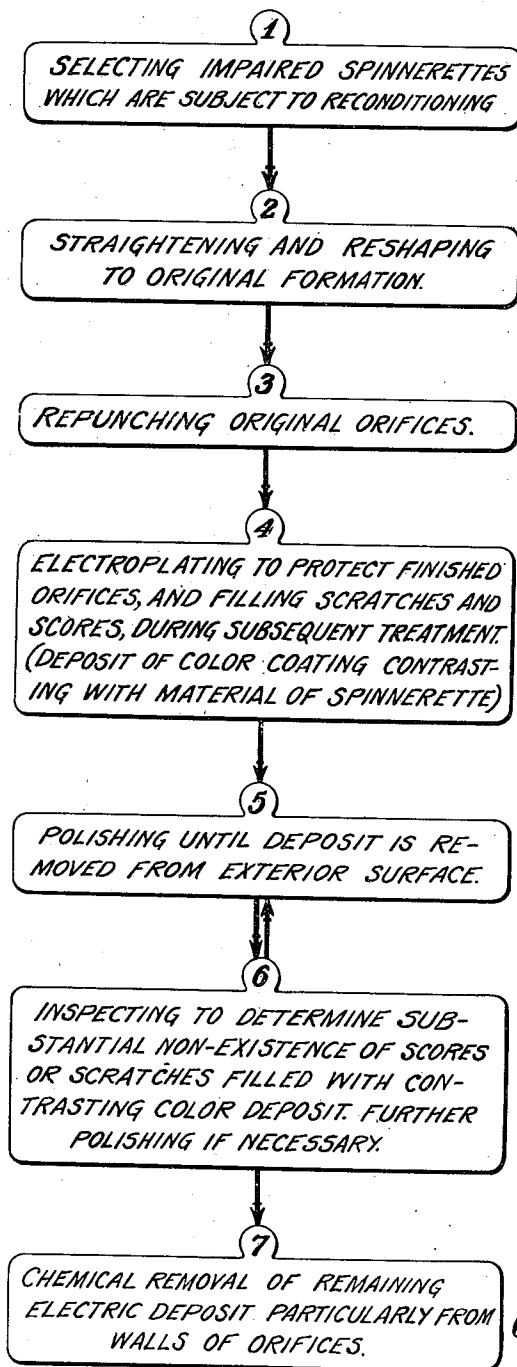
2,115,402

PROCESS FOR RECONDITIONING SPINNERETS

Filed June 11, 1936

4 Sheets-Sheet 1

Fig. 1.



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4 Sheets-Sheet 2

Fig. 2.

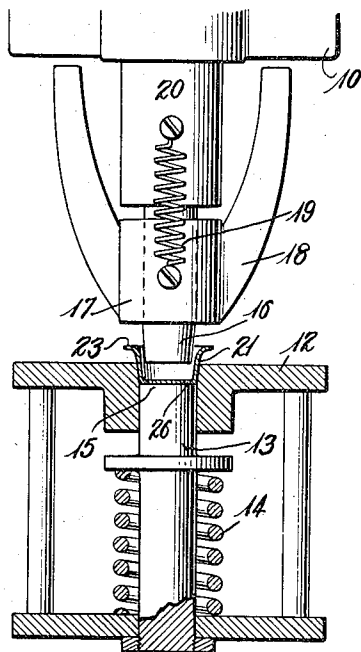
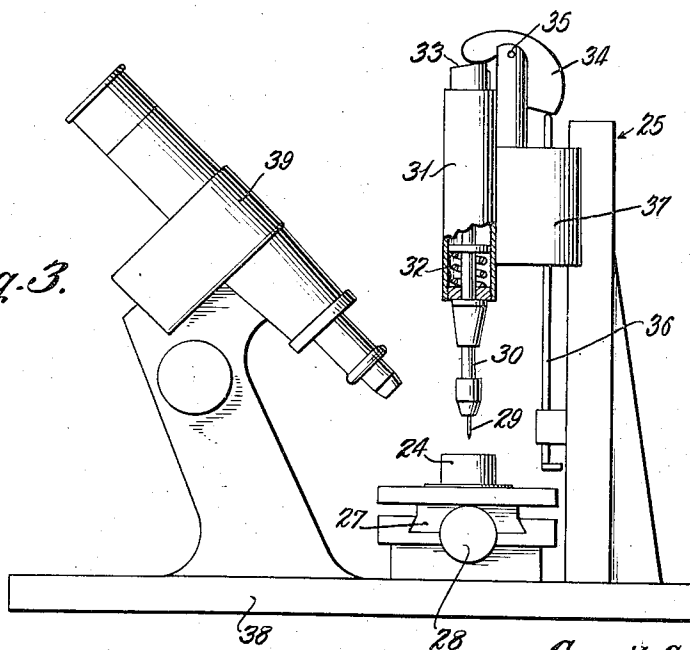


Fig. 3.



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Fig. 4.

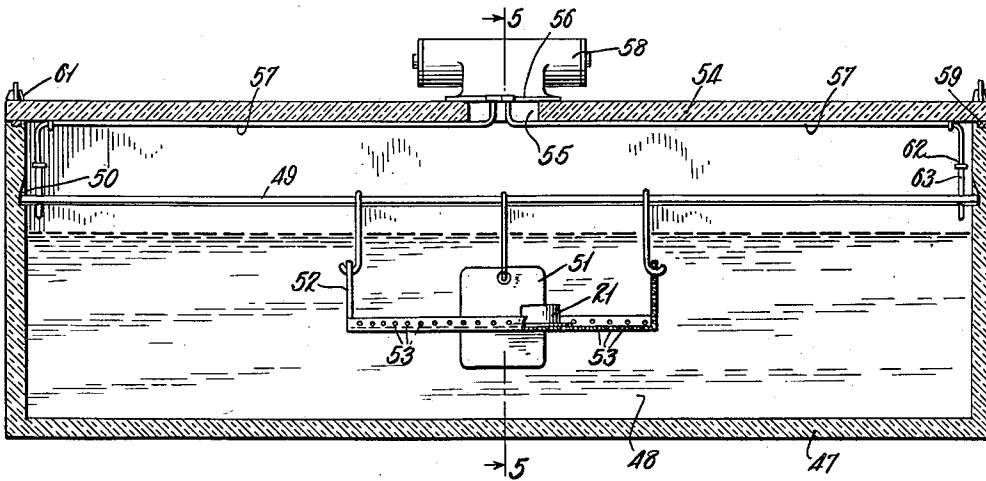


Fig. 5.

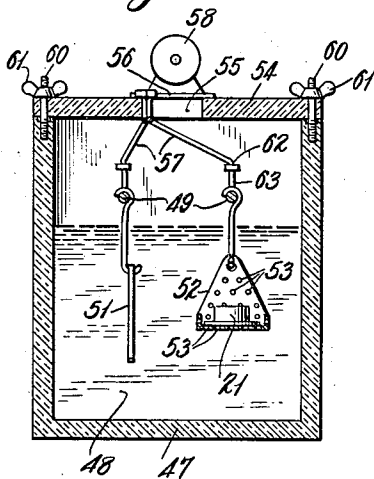


Fig. 8.

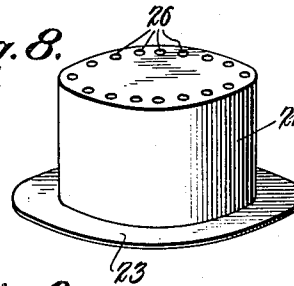


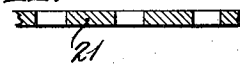
Fig. 9.



Fig. 10.



Fig. 11.



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Fig. 6.

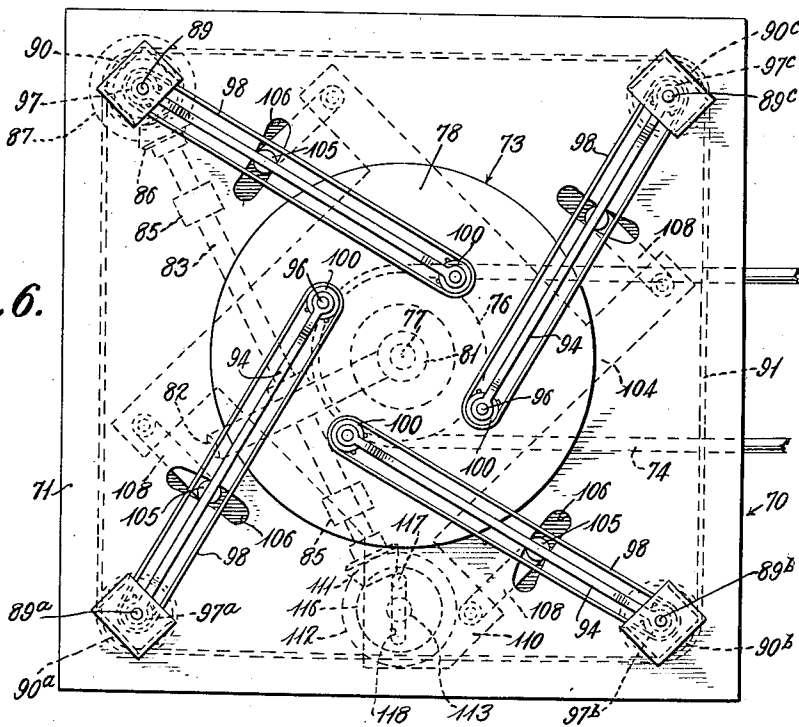
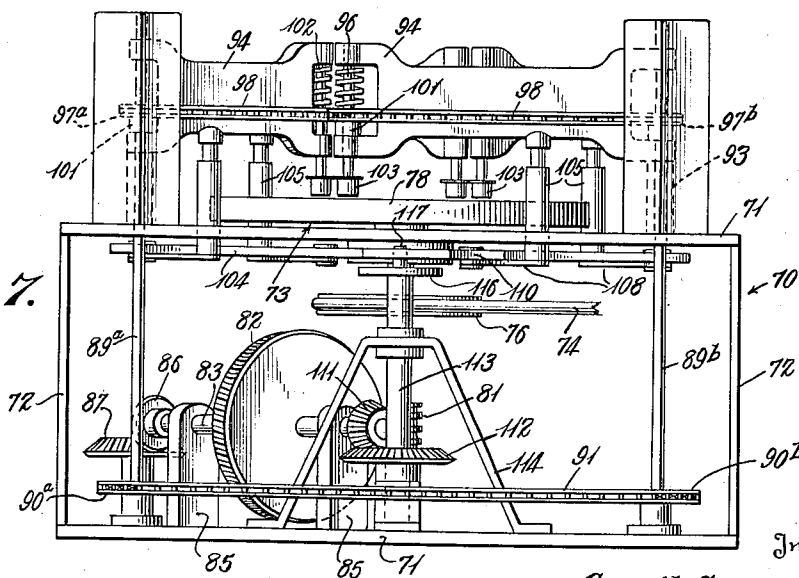


Fig. 7.



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UNITED STATES PATENT OFFICE

2,115,402

PROCESS FOR RECONDITIONING
SPINNERETS

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Application June 11, 1936, Serial No. 34,757

7 Claims. (Cl. 76-107)

This invention relates to spinnerets adapted for use in the manufacture of artificial silk, and more particularly to a process for reconditioning spinnerets which have become impaired by wear or damage.

A normal spinneret as employed in the artificial silk industry is in the form of a small cup-shaped die, the base plate of which is perforated with minute openings through which a cellulosic solution may be forced as individual fine streams. It is these thus formed fine streams which when subjected to conditions to cause coagulation of the solution comprise the multiplicity of filaments used in the formation of artificial silk yarn. Due to the severe conditions to which the spinnerets are normally subjected during spinning operations, they must be constructed of materials which will withstand long and hard usage with the necessity for the replacement thereof being maintained at a minimum. The spinnerets must also be resistant to the corrosive action of the various chemicals to which they are subjected during use.

For economical reasons attempts have been made to employ spinnerets manufactured of glass, hard rubber, bakelite and the like, but spinnerets formed of these materials were found to be impracticable due to the necessity for frequent replacement as a result of breakage, wear and other impairment. It is now generally agreed that for practical working conditions spinnerets formed of the rare metals or their alloys should be employed. An alloy of platinum and gold is one which is entirely satisfactory in the manufacture of spinnerets since a spinneret manufactured from such an alloy, although quite expensive, does not corrode and has considerable durability and wear resistance and therefore does not require frequent replacement during the manufacture of artificial silk.

Although the spinnerets formed of platinum and gold alloy are comparatively durable and may be maintained in use over prolonged periods of time, it is important to eliminate replacement with new spinnerets to as great an extent as possible. Even spinnerets manufactured from the metals which are acknowledged as the most suitable at times become unfit for use due to defects developed in prolonged use. The tremendous pressure required to force the viscous cellulosic solution through the minute openings in the base plates of respective spinnerets causes the base plates to become bent and otherwise distorted. Furthermore, incrustations formed around the edges of the orifices decrease the re-

pective diameters thereof and in many instances the orifices become completely closed. Closing of certain of the orifices results in the production of a thread which varies from the initially formed thread and it is therefore necessary to remove and replace such clogged or partially clogged spinnerets.

Prior to this invention it has been the practice to return the impaired spinnerets to the factory for remelting and reconstruction while large numbers of newly formed spinnerets are maintained at the point of manufacture of the artificial silk for replacement. Even in a relatively small artificial silk plant many thousands of spinning points are operated at one time. A spinneret is in use at each spinning point and many thousands of additional spinnerets must be kept in stock for replacement. It is therefore apparent that the maintenance of many thousands of spinnerets formed of precious metal alloys constitutes a material investment.

The past practice involving the reconstruction of impaired spinnerets was thought to be necessary because of the fragile character of the spinnerets and the fact that the openings therein are so minute. Reconstruction was considered essential in order that the spinnerets have the exact precision required in the production of high grade artificial silk.

This invention has as an object the provision of a process by which spinnerets may be reconditioned without the necessity for melting and reconstruction of the same.

Additionally this invention has as an object the reconditioning of spinnerets in which the minute openings thereof are maintained at substantially their original diameters and the formation of burrs surrounding the openings is eliminated. This invention also contemplates the step in the process of reconditioning spinnerets which accurately designates when defects in the spinneret, which are not normally determinable, have been eliminated.

Other objects and advantages of this invention will be apparent from the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 illustrates a flow sheet designating the various steps of the process of this invention for reconditioning spinnerets;

Figure 2 illustrates a schematic view of a press for reshaping impaired or damaged spinnerets;

Figure 3 is a view of a machine for repunching, cleaning and truing the openings in spinnerets

after the reshaping of the same in the press of Figure 2;

Figure 4 is a schematic view of an electroplating assembly in which the spinnerets are electroplated subsequent to the operations performed with the mechanisms illustrated in Figures 2 and 3;

Figure 5 is a cross-sectional view taken on lines 5-5 of Figure 4;

Figure 6 is a top plan view of a spinneret face-polishing mechanism;

Figure 7 is a side elevational view of the polishing machine shown in Figure 6;

Figure 8 is a perspective view of a typical spinneret;

Figure 9 is a diagrammatic view on an enlarged scale indicating the structure presented by plating the base of the spinneret;

Figure 10 is a corresponding view showing the appearance upon completion of the polishing operation; and

Figure 11 is a corresponding view showing the appearance upon completion of the process.

In referring to the drawings in detail, reference first will be had to the flow sheet of Figure 1. As indicated, the spinnerets to be reconditioned must be selected since if the openings therein have become enlarged or badly damaged, they are not readily subject to reconditioning. The impaired spinnerets primarily intended to be reconditioned in accordance with this process are those which have been bent or distorted, those in which some of the openings have been closed by incrustations, and/or those spinnerets which have surface defects in the form of scratches and the like. The impaired spinnerets selected for reconditioning are now subjected to the second operation during which they are straightened or reshaped so that the spinnerets are formed into their original contour.

The reshaped spinnerets are next subjected to the third operation which involves the repunching of the original openings to remove incrustations and to cause the openings each to be of substantially its original diameter. After the spinnerets have been repunched they are subjected to an electro-plating operation in which a deposit, preferably of a color contrasting to the material from which they are formed, is deposited over their outer surfaces and within all minute openings thereof. The metal deposited upon the walls of the minute openings should extend along said walls for a substantial distance, at least to the extent of covering the opening walls adjacent the exterior surface of the base. The plated spinnerets are then subjected to a grinding and polishing operation in which the outer surface of the base is polished until the electro-deposit is removed. The polished spinnerets are then inspected and if it is found that scratched or scored spaces still exist on the surface, such being readily visible because of the existence of the electro-deposit of different color within the scratched or scored spaces, the spinnerets are further polished. When, upon inspection, they are found to be substantially free of any of the electro-deposit on the exterior surface, the spinnerets are placed in an acid bath, thereby chemically effecting the removal of the electro-deposit from within the openings. The latter operation results in the existence of a sharp, smooth edge surrounding the openings at the exterior surface of the spinnerets. The purpose of utilizing each of the steps referred to

will be more fully discussed as these steps are hereinafter discussed in detail.

Selection of spinnerets for reconditioning

During the course of operation of numerous spinning points it becomes essential from time to time to replace certain of the spinnerets due to impairment as a result of scratching, bending and the plugging of the openings thereof by incrustations. These spinnerets are carefully collected and examined to determine whether the openings are unduly enlarged and whether the spinnerets are impaired otherwise than by scratches, plugged openings and general distortion. The spinnerets which are generally distorted, scratched and/or have plugged openings are then collected and conveyed to the location of the reshaping press.

Reshaping the spinneret

The selected spinnerets are reshaped on the press illustrated in Figure 2 which press is formed with a supporting frame 10 which contains a fixed female die member 12. The female die member is formed with a vertical bore accommodating a vertically slidable plunger 13. Plunger 13 is resiliently supported by coil spring 14, and its upper end 15 acts as a base plate for female die 12. Male die member 16 is suspended above said female die and is adapted for coaxial downward movement therein effected by means of a foot pedal or other suitable pressure-applying device (not shown). Fast on male die 16 is a sheath 17 having upwardly extending arms 18 for operative connection with said pressure-applying device, the male die 16 being suspended by means of retractile spring 19 from guide column 20.

The spinneret 21 to be straightened is placed within the female die member 12 in position to rest upon the upper end 15 of plunger 13. Spring 14 offers sufficient resistance to the downward force of male die 16 to allow proper reshaping of the spinneret. Upon each downward movement of male die 16, annular flange 23 of spinneret 21 engages the upper edge of the female die so as to be flattened thereon and straightened by compression between the female die and the lower surface of sheath 17.

From the foregoing it will be observed that the face of the spinneret is straightened so as to be perfectly reformed between the cooperating surfaces of male die 16 and plunger 13, upon operation of the arms 18 to cause downward movement of the sheath 17. Said downward movement in the normal course of operation, is substantially continuous, its first result being the straightening of the face of the spinneret. Continued movement results in depressing the plunger 13 against tension of spring 14 to reshape the flanges 23 and walls of the spinneret by fixed pressure between the upper surface of female die member 12 and the lower surface of sheath 17. While it is contemplated that normal operation as described will produce accurate reshaping as a consequence of a single continuous operation, it will be understood that because the female die member forms a closely-fitting nest for the spinneret, successive operations may be safely imposed upon the same spinneret if necessary in order to bring about a completely satisfactory reshaping operation. Upon proper reshaping of the spinneret, the male die 16 is permitted to be retracted into the die column 20 whereby the die member 16 clears die member 12 to permit re-

removal of the reshaped spinneret. After visual inspection to determine the quality of reshaping, the spinneret is conveyed to the repunching device.

Repunching the orifices of the spinnerets

The reshaped spinneret 21 is placed upon an anvil 24 of a punching device shown in Figure 3. Anvil 24 corresponds in conformation with the spinneret in order to permit holding the spinneret stationary except that its height is less in order to allow ample clearance between the top of anvil and the face of the spinneret for dressing or repunching orifices 26 therein. By rotating a turn table 27 supporting the anvil 24 by means of a hand wheel 28, punching needle 29 may be accurately axially aligned with the spinneret orifices. Punching needle 29 is mounted within plunger 30 and is adapted for vertical movement therewith. Plunger 30 is suspended in a housing 31 and maintained normally in its uppermost position by means of a spring 32 within said housing. In its uppermost position upper end 33 of plunger 30 is in contact with lever 34 which rotates on fixed pin 35. The lever 34, in turn, is actuated by means of a shaft 36 which may be pushed upwardly by any suitable means (not shown). Housing 31 is maintained on a vertical support 37 fixed to the bed 38 of the punching device.

In order to provide exact inspection for determining proper alignment of the punching needle 29 with the spinneret orifices to be redressed, a low-power binocular microscope 39 is mounted on the bed 38 and disposed for convenient focusing with reference to the point of application of the punching needle.

In the operation of the repunching device it will be obvious that by inverting the spinneret over the anvil the face of the spinneret will be positioned in a plane perpendicular to the axis of the punching needle. By rotating the anvil, the orifices of the spinneret may be brought successively in axial alignment with the punching needle and, after focusing, dressed by successive operations of the control shaft 36. All incrustations having been removed thereby, and all of the orifices having received requisite redressing by the punching device and thereby restored to their original filament-forming capacity, the spinneret is removed from the anvil and provided with a metallic inspection coating.

Electroplating

Having been reshaped and the orifices rebored to exactitude, the essential smoothness of the outer surface of the spinneret and the sharpness of the edges of the orifice's walls are restored by polishing. However, in order to limit the polishing effect to the outer surface and to protect the walls of the orifices, the outer surface of the spinneret is provided with a plating of suitable metal. A desirable characteristic of the electrodeposit is that it must possess a color which will contrast with the color of the spinneret in order to be readily visually distinguishable therefrom.

Referring to Figures 4 and 5, an electroplating apparatus is diagrammatically shown. The apparatus includes a tank or container 47, the walls and bottom of which are of any suitable insulating material such as glass, bakelite and the like. A suitable electrolyte 48, such as copper-sulphate solution, which may be used very satisfactorily in connection with a spinneret made of an alloy of platinum and gold, is placed therein. Should

the electroplating of a gold spinneret be carried out in accordance with this invention, an electrolyte such as nickel-sulphate solution may be used. The purpose of the specific selection of an electrolyte will be hereinafter more fully discussed.

The apparatus includes a pair of parallel supporting bars 49 of conductive material which extend from end to end of the tank, resting in suitable recesses 50 formed therein. One of the bars 49 supports a copper plate 51 which is suspended in the electrolyte and acts as the anode. The other bar 49 supports a horizontal perforated copper tray 52 on which the spinneret, or a group thereof, is positioned, the spinneret acting as a cathode. It will be understood that perforations 53 of the tray are closely spaced in order to provide free communication for the electrolyte to all surfaces of the spinneret. The tank 47 has a cover plate 54 having a central aperture 55 provided with a hermetically sealed cap 56 through which electrical connections 57 for the bars 49 are led to any source of power (not shown). The cap 56 also includes a vacuum pump 58 driven by any source of power (not shown) which in operation exhausts the air from the container and thereby withdraws the gas bubbles from out of the minute orifices in the spinnerets. The vacuum is preferably applied at regular intervals; for instance, during the initial stages of electroplating the air is exhausted for a short time and thereafter atmospheric pressure is restored. This permits the free circulation and penetration of the electrolyte through said orifices in order to effect a deposition of copper entirely through the interior of the openings and allow the edges thereof and the face of the spinnerets to be substantially covered.

The plating action is allowed to go on for a sufficient length of time to cover all of the worn or abraded portions of the spinnerets. The cover plate 54 closely engages the walls of the tank 47 and is adapted to be hermetically sealed thereto by means of a gasket 59 and spaced bolts 60 carrying adjustable thumb screws 61. The connections 57 carried by the cover plate 54 engage holes 62 of terminals 63 in electrical communication with the support bars 49 when the cover plate 54 of the tank is in position.

Upon completion of the electroplating operation the electrolyte current is cut off and the cover plate removed to permit extraction of the spinnerets. Proper plating will be found to provide the face of the spinnerets and the walls of the orifices thereof with a continuous plating coating presenting the appearance indicated in Figure 9.

Polishing

Having been reshaped to remove dents, bends and warpings and electroplated in order to protect the walls of the redressed orifices and to provide the inspection coating, the spinnerets are polished in order to eliminate residual flaws and scratches and to otherwise restore the faces thereof. An apparatus for polishing the spinnerets is shown in Figures 6 and 7 and includes a rigid framework 70 having spaced upper and lower beds 71-71' interconnected by side supports 72. The apparatus polishes the spinnerets by rotating them individually, presenting them to a rapidly rotating polishing element 73 and simultaneously oscillating the spinnerets transversely of the surface of the rotating polishing element. Said apparatus is driven from any suitable source of

power (not shown) through a belt 74 which drives a pulley 76 fast to a central shaft 77 suitably journaled in upper and lower beds 71. Above upper bed 71 polishing element 73 is secured to the upper end of shaft 77. Polishing element 73 consists of a circular plate 78 covered with any suitable durable polishing fabric such as Canton flannel fixed to the exterior right side out, and dressed with a suitable polishing medium such as chrome-oxide suspended in tallow. It will be understood that when pulley 76 is rotated circular plate 78 will be driven at the same rate.

Rotation of the spinnerets is obtained through worm 81 on shaft 77 in driving engagement with worm wheel 82 fast to horizontal shaft 83. The shaft 83 is carried by suitable bearings 85 fixed on the lower bed 71. At one end, shaft 83 is provided with bevel gear 86 meshing with bevel gear 87 secured to rotatable vertical shaft 89 on which is fixed sprocket wheel 90. At spaced points about the polishing element 73 rotatable vertical shafts 89a, 89b, and 89c are disposed, journaled in suitable bearings in the beds 71. Adjacent the lower end said shafts are provided with sprocket wheels 90a, 90b, and 90c respectively, which are interconnected by continuous chain 91 whereby, it will be observed rotation of bevel gear 87 causes shafts 89a, 89b, and 89c to be driven from sprocket wheel 90.

Above the upper bed 71 the spaced vertical shafts 89, 89a, 89b, and 89c are each provided with a spaced collar 92 for mounting a horizontal housing or arm 94 which extends toward the axis of the polishing element 73. Horizontal arms 94 are bifurcated at each end and bored freely to accommodate at one end the vertical rotating shaft 89 and at the other a spinneret shaft 96. Sprocket wheels 97, 97a, 97b, and 97c keyed to the shafts 89, 89a, 89b, and 89c are interconnected by chains 98 with sprockets 100 keyed to the spinneret shafts 96. Sprockets 97 and 100 have spacing hubs 101 which maintain them in horizontal alignment during polishing, the sprockets 100 being normally urged to alignment by expansion springs 102 retained thereon. Spinneret holders 103 are secured to the lower end of the shafts 96. It will be observed that if the polishing plate 73 is rotated at any rate of speed the spinneret holders 103 will be driven at a corresponding but lower rate of speed through worm 81, wheel 82, shaft 83, bevel gears 86 and 87, vertical shaft 89, sprocket chain 91, sprocket wheel 97, sprocket chain 98 and spinneret shafts 96.

In order to insure optimum polishing conditions and to utilize substantially the entire surface of polishing element 73, it is proposed to cause the spinneret holders to traverse a constantly changing path with respect thereto, and this is accomplished by continuously oscillating horizontal arms 94 to carry the spinneret holders in an arcuate path between the axis and periphery of the polishing element. Mechanism for accomplishing this movement includes a horizontal spider 104 freely oscillatable about the main shaft 77 as an axis immediately beneath upper bed 71. Pivotal vertical rods 105 engage the under side of horizontal arms 94 and extend through arcuate slots 106 formed in the upper bed 71. The projecting end of each therebeneath is fitted with a pivotally connecting link 108, the opposite end of which is pivotally connected to the under side of spider arm 110. The relationship of the oscillating elements described is such that when the spider is rocked about the shaft 77 the arms 94

connected thereto by means of rods 105 and links 108 will be oscillated across the polishing element 73, the extent of said oscillation being limited by arcuate slots 106.

Rocking of the spider 104 is accomplished through power derived from the belt 74 and central shaft 77, applied through the horizontal shaft 83 which carries a bevel gear 111 keyed thereto on the end opposite bevel gear 86. The bevel gear 111 engages bevel gear 112 keyed to vertical shaft 113 supported for rotation in fixed bearing 114. Secured on its upper extremity the shaft 113 is provided with disk 116 having a projecting pin 117 eccentrically disposed with respect to the shaft 113. The pin 117 rides from end to end of straight slot 118 cut in the spider 104. It will be observed that continuous rotation of the shaft 113 as driven from the shaft 77 causes rotation of disk 116 to rock the spider through movement of pin 117 in opposite directions along slot 118.

Preferably the gear 112 is larger than the gear 87 in order that there might be obtained unbalanced equilibrium of the cooperating parts described, such coaction producing, for example, driving of the polishing disk at a speed of approximately 2,000 R. P. M. while the spinneret holders are rotated at about 100 R. P. M. and oscillated approximately 40 times per minute.

In lieu of driving the gear 112 from the shaft 83, the shaft may be connected to drive only the gear 87, it being feasible to drive the gear 112 directly from the main shaft 77 by connecting a suitably geared shaft between the worm 81 and the gear 112. When this modified construction is adopted, it will also enable the obtaining of different speed ratios between the cooperating parts as described above in order to maintain even distribution of wear on the polishing element. Suitable arrangements of gears and shafting, and belts and pulleys may be substituted for the chain and sprocket drive described.

Operation of these mechanisms has been found to insure that all portions of the face of the spinnerets carried on the holders 103 are subjected to the uniform action of the polishing agent so that at the end of the polishing operation the face of the spinneret will have been treated evenly.

It is, of course, intended that the apparatus might be operated at different relative speeds of the various movements in the practice of the invention and that the specific speeds and gearing ratio indicated above are not essential to the successful practice of the invention.

The polishing action performed on the spinnerets progressively removes the plating so that the quality of the surface may be conveniently inspected, the contrast of color between the plating and the spinneret indicating whether scratches, depressions, or other irregularities remain on the face thereof. When a complete surface of spinneret material is observed the polishing is complete and the spinnerets may be removed from the polisher.

Reference to Figures 9, 10 and 11 illustrates the character of the spinneret with reference to polishing. Figure 9 illustrates the spinneret with a plated coating over the face, said plated coating extending inwardly along the walls of the orifices whereby to shield the repunched orifices from deformation during polishing. Complete polishing results in the construction illustrated in Figure 10, by reference to which it will be noted that the plating is entirely removed from the polished surface of the spinneret while the

residual deposit of plating material remains along walls of the orifices, the accuracy and sharpness thereof having been maintained.

Removing electrolytic deposits

5 Upon the completion of the polishing operation, the remaining electrolytic deposits may be easily removed by dipping the spinneret in a nitric acid or other suitable bath. Brief sub-
10 jection of the polished spinneret to the bath results in stripping the last vestige of electrolytic deposit therefrom to present the appearance as indicated in Figure 11. Therein it will be noted
15 that the face of the spinneret has been restored exactly to its original condition, the face being free of deformations and the orifices having their original character for the efficient extrusion of filament.

Operation

20 In practicing my improved process for reconditioning spinnerets, the impaired spinneret is first placed upon the press and straightened by means of the die pressing machine. The spinneret is then positioned on the anvil of the re-
25 punching device and the minute orifices are cleaned and/or rebores by means of the needle mechanism. In the event the orifices are slightly enlarged the possibility exists that small raised places will be formed around the edges of the
30 openings. The next step consists in electroplating the spinneret to thereby cover these said raised portions and also cover the dents and scratches on the face of the spinneret while at the same time protecting all portions thereof.
35 The selection of the electrolyte depends upon the material of which the spinneret is manufactured and should be of such a nature that the metal deposited is of different coloration from the material of the spinneret itself. In this manner
40 the next step of polishing is rendered more suitable, as the damaged places to be removed will become instantaneously apparent, as the electrolytic deposit in the damaged portions will continue to be visible until they have been removed.
45 During the polishing operation the deposited metal will act as a protective medium for the edges of the orifices and prevent the said edges from becoming broken or in any way marred. As the final step the polished spinneret is dipped
50 in nitric acid to remove the copper deposit from all parts thereof. The spinneret is then ready for reincorporation in the spinning system.

No claim is made in this application to the detailed process and apparatus for electroplating
55 the spinnerets described herein, as that subject matter is claimed in my co-pending application Serial Number 141,806, filed May 10, 1937. The spinneret polishing apparatus is claimed in another copending application Serial Number
60 141,807, also filed on May 10, 1937.

What I claim is:

1. A method of reconditioning spinnerets which comprises the steps of selecting a spinneret which has become impaired through usage,

straightening the spinneret, repunching the orifices therein, subjecting the spinneret to the action of an electrolyte of such character as to coat the same with a distinguishing metal, uniformly polishing all parts of the coated face of
5 the spinneret without injuring the edges of the orifices and removing the electrolytic deposits from the orifices of the spinneret.

2. A method of reconditioning spinnerets which have become impaired through usage, comprising straightening the spinneret to restore its original configuration, repunching its orifices to remove encrustations and redress the walls and edges thereof, electroplating a metal of distinguishing coloration thereon to provide an inspection coating for the spinneret to bring out
15 obscure defects therein and also to provide a protective coating for the walls and edges of the orifices, and polishing the spinneret until the defects in the face thereof are completely removed.

3. A method of reconditioning spinnerets which comprises the steps of electroplating thereon an inspection and protective coating of distinguishing coloration to bring out obscure defects, and polishing the spinneret to remove said defects while maintaining the edges surrounding the orifices of the spinneret intact as a result of said coating.

4. A method of reconditioning defective spinnerets which comprises the steps of electroplating thereon an inspection coating of different coloration from the material of the spinneret to bring out obscure defects, polishing the spinneret to remove said defects without injuring the orifices thereof and dissolving out the remaining coating.

5. A method of reconditioning spinnerets which comprises the steps of selecting a spinneret which has become impaired through usage, electroplating thereon a metallic coating of different coloration from the material of the spinneret in order to bring out visually defects therein, polishing the spinneret to remove the defects, and subjecting the polished spinneret to a stripping bath to remove the residual deposit of plating.

6. A method of reconditioning spinnerets which comprises the steps of straightening a spinneret which has become impaired through
50 usage, repunching its orifices, immersing the spinneret in an electroplating bath and coating the same with an inspection coating to bring out defects and protect the orifices, and polishing the plated surface to remove said defects.

7. A method of reconditioning spinnerets which includes the steps of repunching the orifices of an impaired spinneret, electroplating thereon an inspection coating to bring out defects and protect the orifices, polishing the plated surface to remove said defects, and subjecting the polished spinneret to a stripping bath to remove the residual deposit.

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