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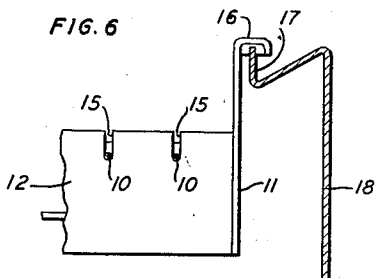
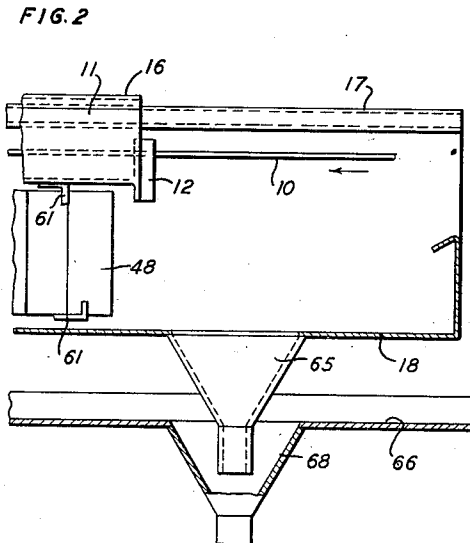
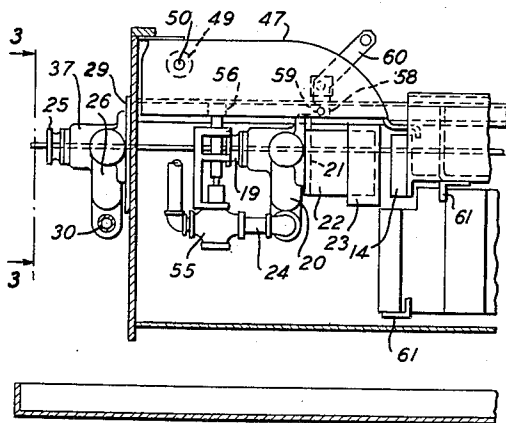
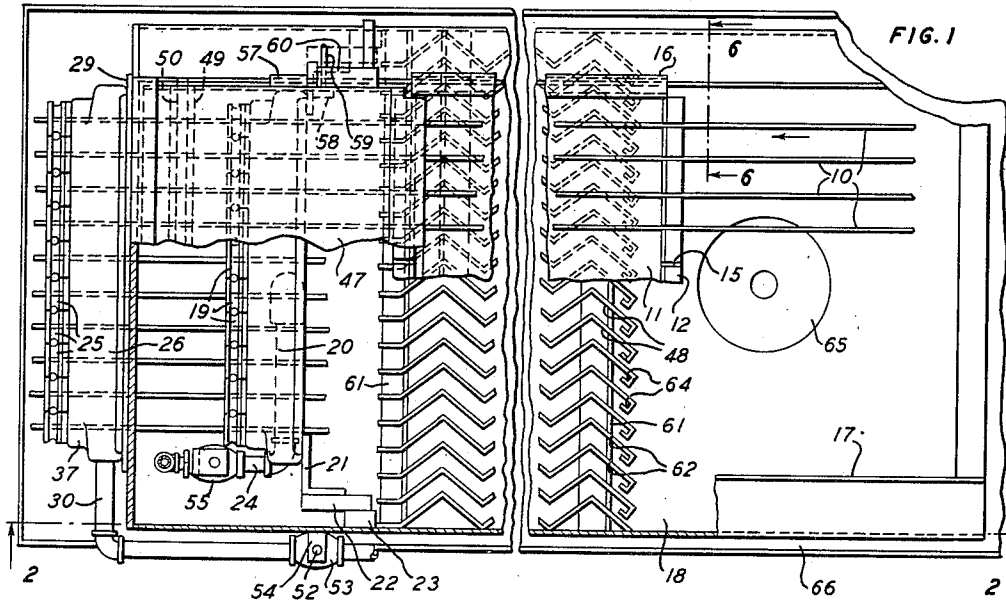
V. A. RAYBURN

2,364,752

APPARATUS FOR TREATING STRANDS

Filed April 10, 1942

2 Sheets-Sheet 1



INVENTOR
V. A. RAYBURN
BY *E. H. Rany*
ATTORNEY

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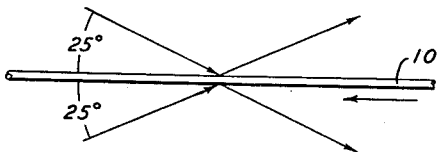
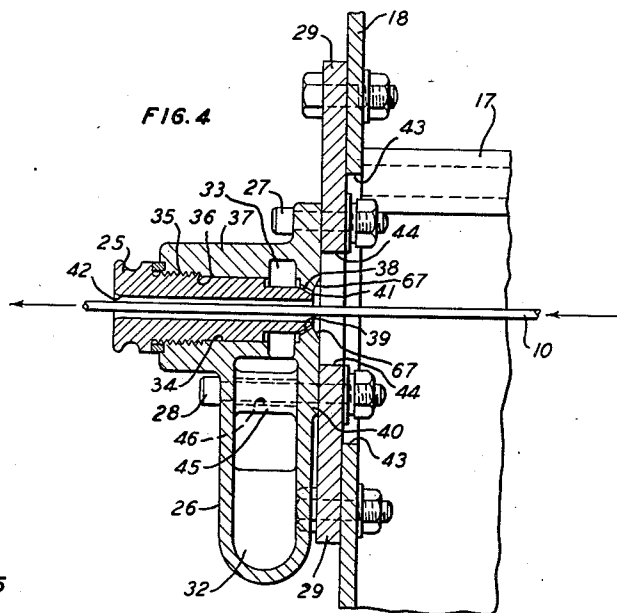
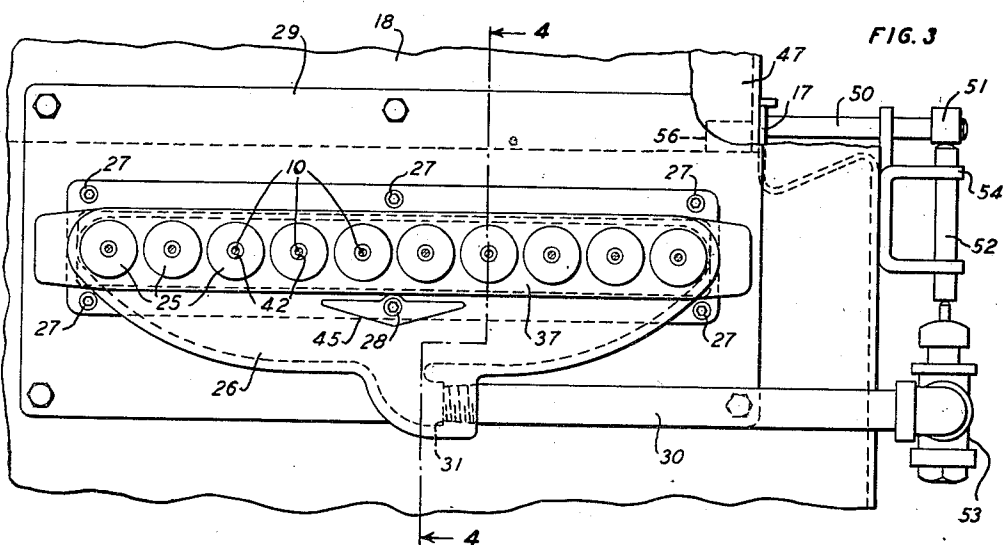
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INVENTOR
V. A. RAYBURN

BY

ATTORNEY

UNITED STATES PATENT OFFICE

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APPARATUS FOR TREATING STRANDS

Vincent A. Rayburn, Baltimore, Md., assignor to
Western Electric Company, Incorporated, New
York, N. Y., a corporation of New York

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7 Claims. (Cl. 34-75)

The invention relates to apparatus for treating strands and more particularly to apparatus for washing and drying strands.

The increased speed at which electrical conductors are now electroplated has necessitated faster and more efficient means of washing and drying electroplated conductors preparatory to storing them or performing further operations thereon.

Objects of this invention are to provide new and improved apparatus for treating strands and particularly to provide new and improved apparatus for washing and drying strands.

One type of apparatus embodying the invention comprises means for immersing a strand in a body of washing liquid, means for projecting a thin curtain of water about a point in the path of the strand, and means for projecting a thin curtain of steam about a point in the path of the washed strand. A plurality of wet plate eliminators are provided to condense the steam thereon, said steam being directed by appropriate means to the eliminators.

Other features and advantages of the invention will become apparent from the following detailed description of a specific embodiment thereof when read in conjunction with the attached drawings, in which

Fig. 1 is a plan view of a washing and drying apparatus having portions thereof broken away to show more clearly certain portions of the apparatus;

Fig. 2 is a vertical section of the apparatus taken on line 2-2 of Fig. 1;

Fig. 3 is an enlarged fragmentary view of the apparatus as seen from the left in Figs. 1 and 2;

Fig. 4 is an enlarged fragmentary sectional view of a steam wiper forming part of the apparatus, taken on line 4-4 of Fig. 3;

Fig. 5 is a diagrammatic view illustrating the operation of the steam wiper shown in Fig. 4, and

Fig. 6 is an enlarged fragmentary sectional view taken on line 6-6 of Fig. 1.

The particular embodiment of the invention shown in the attached drawings comprises apparatus designed to wash and dry electroplated conductors shortly after they emerge from an electroplating bath. In this embodiment of the invention, conductors 10-10 are first cleaned and electroplated by means of suitable apparatus (not shown). After being electroplated, the conductors 10-10 are advanced by any suitable means (not shown) through a washing tank 11 (Figs. 1 and 2) having end plates 12 and 14 in

which are formed a plurality of weirs 15-15 (Fig. 6) to serve as passages for the conductors and outlets for the washing liquid efflux. A washing liquid, which in the present embodiment is water, is supplied to the tank 11 by any suitable means (not shown) at a rate sufficient to maintain the level of the washing liquid within the tank 11 slightly above the conductors passing therethrough. Thus, the conductors 10-10 are at all times completely covered by the washing liquid. The washing liquid overflows through the weirs 15-15 into a collecting tank or enclosure 18, thereby effecting a continual change of the washing liquid within the washing tank 11. The washing tank 11 is supported by means of horizontal flanges 16-16 (Fig. 6) extending from the sides thereof, which rest upon inwardly and upwardly bent portions 17-17 of the collecting tank 18.

While most of the impurities adhering to the conductors 10-10 are removed by means of the foregoing washing processes, still the water within the wash tank is not changed rapidly enough to prevent some dilution from previous electroplating or other treating solutions and to insure the immediate removal of all impurities dissolved by the washing liquid from the vicinity of the conductors. These impurities, and in addition, certain impurities which tend to adhere firmly to the conductors are removed mechanically by causing a portion of the fresh and undiluted washing liquid to impinge upon the conductors in the form of jets and effect a pressure rinse.

For this purpose, the conductors 10-10 are next subjected to a conical spray of water projected about them by expansion nozzles 19-19 positioned in a manifold 20. The manifold 20 is fixedly connected to both sides of the collecting tank 18 by means of L-shaped bars 21-21 and blocks 22-22 and 23-23. Water is supplied to the manifold 20 by a pipe 24. Since the particular arrangement of the expansion nozzles 19-19 within the manifold 20 is identical with that of the drying devices hereinafter described, the details of the construction of this washing device will be disclosed in the following description of the drying device.

The drying device comprises a plurality of expansion nozzles or tubular cores 25-25 positioned within a manifold or chamber 26 which is attached by means of bolts 27-27 and 28 (Figs. 3 and 4) to a mounting plate 29 bolted to the end of the collecting tank 18. A drying gas, which in this particular embodiment of the invention is

steam, is supplied to the manifold 26 through a pipe 30, which engages an inlet 31 (Fig. 3) formed on the bottom of the manifold 26. Within the manifold 26 are inter-connected cavities 32 and 33 respectively (Fig. 4), to conduct the drying gas or steam to the nozzles 25—25. Each of the nozzles 25—25 has screw threads 35—35 (Fig. 4) cut in a portion of their peripheries, which engage screw threads 36—36 cut in a plurality of passages 34—34 formed in an elongated projection 37 extending outwardly from the manifold 26. By suitably adjusting the nozzles 25—25 within the projection 37, beveled ends 38—38 of nozzles 25—25 coact with beveled openings 39—39 formed in a wall 40 of the manifold 26 to provide narrow, conical orifices 41—41. Longitudinal bores 42—42 are cut through the nozzles 25—25 concentrically with the conical orifices 41—41 and are axially aligned with apertures 43 and 44 formed in the ends of the collecting tank 18 and mounting plate 29, respectively, so that a strand to be treated may pass freely therethrough. A baffle 45, cast integrally within the cavity 32 of the manifold 26 and having an aperture 46 (Fig. 4) provided to permit the bolt 28 to pass therethrough, performs the dual function of a stay and a baffle. The baffle 45 is shaped (Fig. 3) so that it deflects the steam entering through the inlet 31 in such a manner as to equalize the pressure of the steam throughout the cavity 33 and thereby equalize the force of the jets of steam projected through the conical orifices 41—41.

Each of the conical orifices 41—41 projects a thin, rapidly moving, conical curtain of gas about a point in the path of the approaching strand to be treated, so that the hot gas curtain impinges the approaching strand at an angle of approximately 25° with respect to the axis of the strand. The gas which is thus projected about and against the strand mechanically removes the major portion of the film of water adhering to the strand. The angle at which the gas strikes the strand is somewhat critical in order to obtain the maximum efficiency of the device. Should the gas be directed toward the approaching strand at an angle materially less than 25° thereto, a large amount of feathering or lateral dispersion of the projected gas occurs, which greatly decreases the mechanical force of the gas impinging upon the strand. Since any gas which feathers out and disperses before it contacts the strand only incidentally aids in heating the strand, the drying effect due to the heating of the strand by the hot gas is also greatly diminished. Should the gas be projected at an angle materially greater than 25°, there is a marked tendency for the projected gas to "blow back," through the nozzle bore, that is, to follow parallel along the treated strand in a direction opposite to that of its projection. When such a blow-back occurs, the projected gas exerts no mechanical force to remove the liquid adhering to the moving strand. Even when no blow-backs occur, the gas projected at an angle materially greater than 25° exerts a proportionately greater force perpendicularly against the strand than longitudinally against the liquid adhering to it, thereby reducing the wiping effect of the rapidly moving gas curtain. The mechanical cleaning or wiping effect of the gas projected by nozzles 25—25 is intensified by concentrating the entire volume of gas in a thin, annular curtain about a single point in the path of a strand to be treated, as shown in Fig. 5. Not only does this manner of projecting the drying gas concentrate the total mechanical force of the projected

gas upon a limited section of the strand, but it also prevents building up back pressure or forming an intimate gas film about the strand, as is the case when the drying gas is directed an appreciable length along the path of the strand.

When the projected gas is confined for an appreciable distance parallel to the path of a strand, the gas loses some of its momentum and tends to form a layer which is moving at a slower speed than that of the projected gas. This slower moving layer of gas lies in the path of subsequently projected, faster moving gas and therefore tends to slow up the subsequently projected gas. This tendency of a previously projected mass of gas to act under such circumstances to retard the movement of a subsequently projected mass of gas is called "back pressure."

The projection of the drying gas along an appreciable length of the strand causes a closely adjacent film of cold air to be sucked in at relatively low velocity through the nozzle bore and into the drying gas stream. The drying gas which expends the larger part of its energy longitudinally along the strand, must, with the small remaining perpendicular energy component, cut through and remove this film before it can impart a definite "wipe" or convey heat to the strand. Thus the force of the projected gas is reduced by back pressure and is counteracted by the film of indrawn air around the strand.

By projecting the gas about a limited area of the surface of the strand to be treated, no back pressure is produced because the projected gas is deflected sharply from the strand surface and immediately disperses. No closely adherent film of gas forms about the strand because the longitudinal movement of the projected gas along the strand is not sufficient to cause any substantial quantity of cold air to be drawn through the nozzle bore to form such a film.

Neither irregularities in the diameter of the strand nor misalignment of the strand in the nozzle bore prevents the conical curtain of gas from exerting its full drying force against the strand. Because the nozzles 25—25 direct the drying gas toward the strand from all points around the strand, all of the strand will be treated independently of its position within the area into which gas is projected.

By positioning the orifice 41—41 at the forward tip of the expansion nozzle 25—25 and sharply relieving the frontal face of the manifold 26, as indicated at 67 (Fig. 4), the gas projected therefrom expands rapidly, thereby suddenly reducing the pressure of the escaping, projected gas. This sudden reduction of pressure momentarily superheats the ambient gas about the strand increasing its moisture capacity sharply and causing the intimate moisture film remaining on the strand to flash into vapor and be carried away by the projected gas stream, thus leaving the strand dry.

From the foregoing description, it is evident that the effect of the drying means upon the strand is threefold; first, the mechanical removal of the water film from the strand by the force of the curtain of gas projected about the strand; second, the evaporation of the water by the heat imparted to the strand by the gas projected thereabout; and third, the evaporation of the remaining, closely adherent water film from the strand by the gas pressure reduction about the strand resulting from the immediate and rapid expansion of the gas upon its being ejected from the nozzle through which the strand is passing.

A conical curtain of water is projected about the strands by the nozzles 19—19 in a manner similar to that described with respect to the curtains of steam produced by the nozzles 25—25. This rapidly moving curtain of water removes all of the impurities from the strand which are not removed by the washing liquid in the wash tank 11. The water, like the steam from the nozzles 25—25, is projected about a single point of the path of a strand to be treated, so that the mechanical force of the water is concentrated and, consequently, reaches its maximum effectiveness. Any fluid, whether a liquid or gas, may be projected by the nozzles 19—19 or 25—25 to perform a number of different functions.

A cover 47 is provided to enclose the washing and drying nozzles and to direct the water and steam projected about the strands through a plurality of eliminator plates 48—48 (Figs. 1 and 2) disposed in the collecting tank 18. The cover 47 is provided with a hinge which comprises a tube 49 welded to opposite sides of the cover 47 and riveted to a hinge pin 50 positioned within the tube 49 and extending through the sides of the cover 47. This construction makes the cover hinge steam-tight. The hinge pin 50 is pivoted at both ends in the upwardly bent portions 17—17 of the collecting tank 18. A pawl 51 (Fig. 3) is attached to the extremity of the hinge pin 50 which extends beyond the flange 17. A plunger 52 of a spring closing valve 53, which controls the supply of steam to the manifold 26, is positioned so that the lowering of the cover 47 will cause the pawl 51 to engage the plunger 52 and open the valve 53. A yoke 54 welded to the side of the tank 18 guides the plunger 52. A similar valve 55 controls the water supplied to the washing device and is similarly operated by a lug 56 (Fig. 3) welded to the side of the cover 47 adjacent to the valve 55.

When the cover 47 is in the closed position as seen in Fig. 2, a stop 57 (Fig. 1) welded to the side of the cover 47 rests upon the upwardly bent portion 17. With the cover in this position, both of the valves 53 and 55 are open so that water and steam are projected about the strands. The cover is secured in the closed position by a latch 58 which catches on a pin 59 (Fig. 2). When a latch handle 60 (Fig. 1) is moved upwardly, the latch 58 is drawn free of the pin 59 and the cover may be lifted. Immediately upon lifting the cover 47, the valves 53 and 55 close and the water and steam are shut off, so that there is no danger of injury to the operator of the machine from the hot steam.

The eliminator plates 48—48 have a corrugated shape, as shown in Fig. 1, and are fixedly positioned in the lower portion of the collecting tank 19 by means of angle bars 61—61 having slots 62—62 (Fig. 2) formed therein to retain the eliminator plates. The angle bars 61—61 are connected to the sides of the collecting tank 18 and are disposed at the top and bottom of the eliminator plates 48—48 in order to firmly position them. The cold water projected about the conductors 10—10 by the nozzles 19—19 passes into the lower portion of the collecting tank 18 and wets the eliminator plates 48—48. As the steam passes through the angled eliminator plates, it strikes the wet cold surfaces of the plates, gives up its heat, and condenses on the plates. Any moisture which reaches the foremost end of the eliminator plates 48—48 is retained by the hook-shaped ends 64—64 (Fig. 1) thereof. The cold water and the condensed

steam are collected at the bottom of the collecting tank and are drained therefrom by means of a funnel-shaped outlet 65 (Fig. 2).

The eliminator plates 48—48 prevent the steam from enveloping the entire apparatus so as to interfere with the operation thereof, while at the same time they condense the steam fast enough to prevent back pressure from building up about the nozzles. The building up of back pressure would prevent the formation of a low pressure atmosphere about the conductors, as above described, and thus would decrease the drying effect of the steam nozzles 25—25.

As shown in Fig. 2, a drip pan 66 having a drain 68 may be located beneath the collecting tank 18 to keep the floor free from water.

It is understood that various departures may be made from the specific embodiment of the invention disclosed in the drawings and described in the foregoing specification without departing from the spirit of invention. For example, any type of washing liquid or any type of drying gas suitable for the purposes of this invention may be used. The device may be used wherever it is desirable to wash and dry strands, and is not limited to washing and drying electrical conductors. Other changes will be apparent to those skilled in the art.

What is claimed is:

1. In an apparatus for treating a strand, a chamber having an inlet and outlet for a continuously moving moist strand, an expansion nozzle mounted in the chamber and surrounding the path of the strand, and means for supplying a hot drying gas under pressure to the chamber, a wall of the chamber and a portion of the expansion nozzle coacting to form a passageway for directing a conical curtain of the gas toward and about the strand in a direction opposite to that of the movement of the strand, said wall of the chamber being sharply relieved adjacent to the forward tip of the expansion nozzle, whereby a thin curtain of the gas is projected about and against a small portion of the strand surface.

2. In an apparatus for treating a moist strand, an enclosure having in combination therewith a nozzle for projecting a thin, conical curtain of steam about a point in the path of a strand, means for advancing a strand through said enclosure and the nozzle, means for supplying steam to the nozzle, a plurality of wet plate eliminators adjacent to the nozzle, and means for directing the steam which has been projected about the strand through the eliminators to condense the steam and thereby create a low pressure area near the nozzle.

3. An apparatus for treating a moist metallic strand, which comprises a chamber having a conical opening in one wall thereof and an aligned tubular opening in the opposite wall thereof, a tubular member adjustably positioned in said tubular opening and having a conical end portion positioned to coact with said conical opening to form an annular, conical passageway, means for advancing such a strand through the center of said passageway, and means for supplying steam under pressure to said chamber, whereby a thin, conical curtain of the steam is projected through said passageway toward a point on the axis of a strand passing therethrough and impinges upon a small, band-shaped area on the surface of the strand, the projected steam being free to expand immediately after it traverses the passageway.

4. In an apparatus for treating a strand, a chamber having an inlet and an outlet to permit the strand to pass therethrough, an expansion nozzle positioned within the chamber and having an axial bore designed to permit the passage therethrough of a strand, means for advancing a strand through the axial bore, and means for supplying steam to the chamber, said chamber inlet and expansion nozzle coacting to form a thin sheet-like passage gradually converging from an annular opening of a large diameter adjacent to the interior of the chamber to an annular opening of a small diameter at the exterior of the chamber for expelling a thin, converging sheet of steam with high velocity against a small peripheral area of a strand advanced through the axial bore.

5. In an apparatus for treating a strand, a chamber having an inlet and an outlet to permit a continuously moving strand to pass therethrough, said inlet being frustroconical in shape with the larger portion thereof positioned at the interior of a wall of the chamber and the smaller portion thereof positioned at the exterior of the wall, means for supplying steam to the chamber, and a tubular expansion nozzle positioned within the chamber and having a frustroconical surface formed on an end thereof disposed adjacent to the chamber inlet in complementary relationship thereto, whereby the frustroconical surface and the frustroconical inlet form a converging sheet-like passage therebetween for directing a converging sheet of steam toward and about a point in the path of the strand and in a direction opposite to and at an angle of about 25° with respect to the path of movement of the strand.

6. In an apparatus for treating a moist strand, a thick-walled shell having an inlet and an outlet formed in opposite walls thereof, which inlet is frustroconical in shape and tapers from a large opening at the inner side of the wall in which it is formed to a relatively small opening at the outer side of that wall, a tubular core having an outwardly tapered frustroconical surface formed on an end thereof complementary to the frustroconical inlet and positioned in alignment with the inlet and the outlet and with the frustroconical surface fitting into the frustroconical inlet, whereby a thin sheet-like passage is formed between the inlet and the frustroconical surface, and means for supplying steam under pressure to the interior of the shell to force a thin converging sheet of the steam through the passage.

7. In an apparatus for treating a strand, means for advancing a moist strand, an expansion nozzle surrounding and spaced from the path of the moving strand, means for positioning the nozzle with respect to the strand, means for supplying steam under pressure to the positioning means and an outlet for the steam formed by the nozzle and the nozzle positioning means conjointly in such a manner as to project a conical sheet of gas inwardly against a small area of the strand, said nozzle positioning means being sharply relieved adjacent to the forward tip of the expansion nozzle so as to cause the gas to expand immediately upon its being projected through the outlet.

VINCENT A. RAYBURN.