Feb. 20, 1951 S. G. TILDEN 2,542,064

APPARATUS FOR MAKING MEANS TO ATTACH FRICTION MATERIAL TO BRAKE SHOES AND THE LIKE

Original Filed May 10, 1946

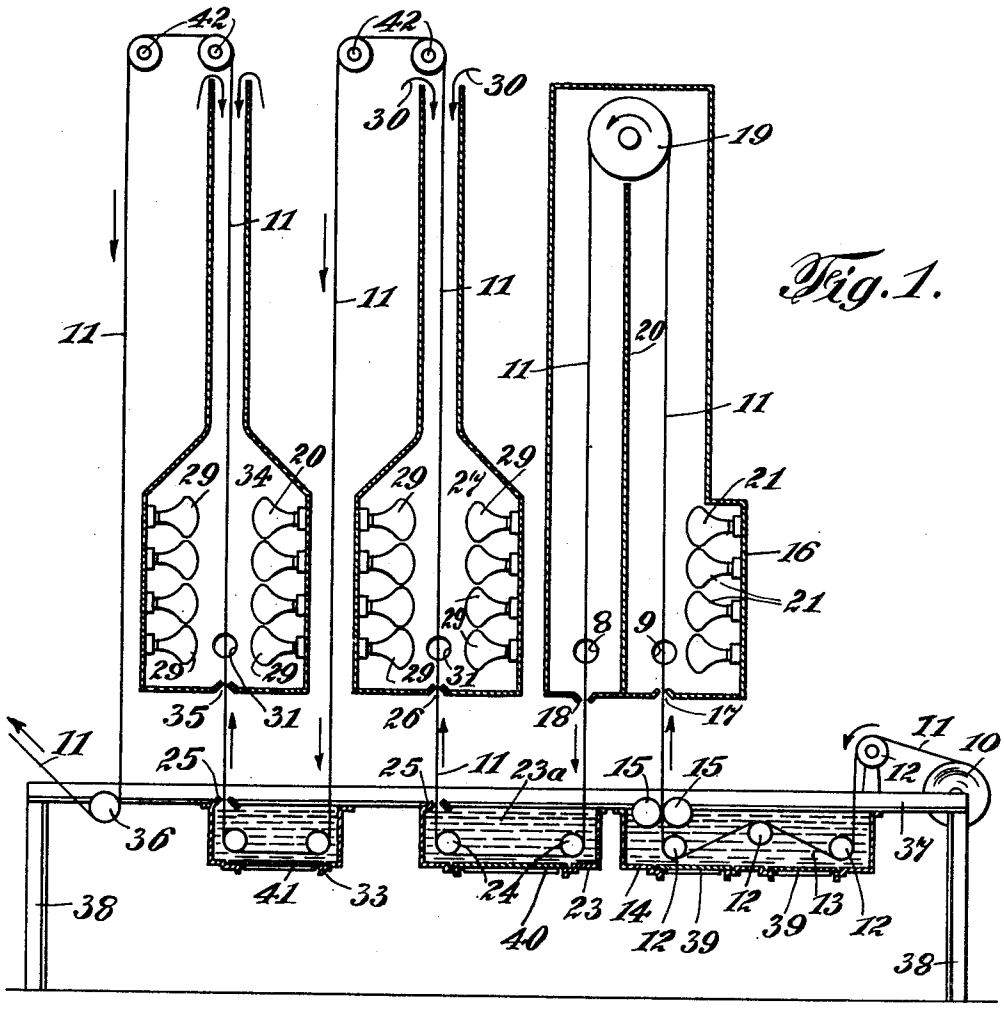
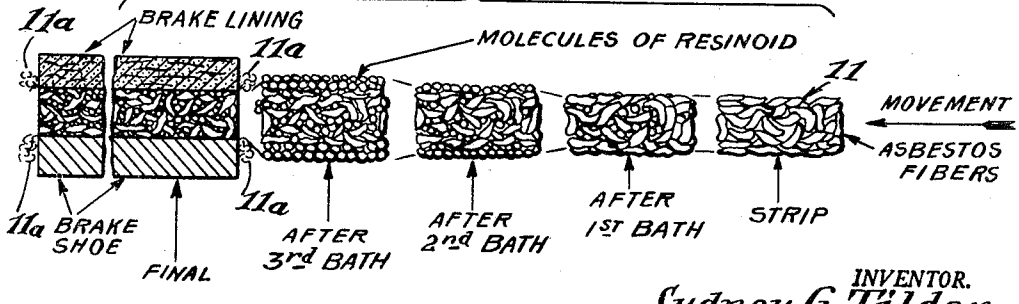


Fig. 1.

Fig. 2.



INVENTOR.
Sydney G. Tilden
BY
C. P. Goepel
his ATTORNEY

Patented Feb. 20, 1951 2,542,064

UNITED STATES PATENT OFFICE

2,542,064

APPARATUS FOR MAKING MEANS TO ATTACH FRICTION MATERIAL TO BRAKE SHOES AND THE LIKE

Sydney G. Tilden, Stewart Manor, N. Y., assignor to The Permafuse Corp., a corporation of New York

Original application May 10, 1946, Serial No. 668,662. Divided and this application November 3, 1947, Serial No. 783,703

3 Claims. (Cl. 91—55)

1

This invention relates to certain improvements in apparatus for making means to attach friction material to brake shoes, brake bands and clutch plates.

The invention contemplates the making of a bonding member in which a skeleton asbestos web or sheet or strip having its fibers purposely disposed indiscriminately, in contrast to laminations, is thoroughly impregnated with a resinoid solution, and subjected to infra-red rays to dry the exposed surface of the resinoid, and then subjecting this so prepared impregnated sheet to a molecular resinoid building up procedure on the parallel upper and lower surfaces to homogeneously increase the thickness of the sheet, and then drying the accretions, whereby upon the volatiles of the accretions evaporating, the finished sheet has a homogeneous colloidal texture in which all parts of the resinoid are thoroughly intermingled with each other in the skeleton like resinoid structure filling the interstices of the asbestos fiber distribution and the cellular structure thereof. The equalizing impregnation from face to face of the strip by the solution of resinoid between the indiscriminately disposed asbestos fibers, assures a resistance to tensile strain, and the integral homogeneous mass which is free from laminations and which has fibers transversely disposed to the length of the sheet assures a resistance to shear strain. The asbestos fibers being indiscriminately disposed, do not form any possible split line, as might be the case were the fibers arranged parallel with the faces. The improved bonding member is homogeneously solid, in distinction to a ply which is laminated and which may be split along pre-formed lines or planes.

The invention relates to an improved apparatus for making a bonding member to attach friction material to brake shoes and the like, in which a tank for an impregnating bath is provided, with a drying compartment above said tank, having a sheet inlet and a sheet outlet, drying means in said compartment, and means for continuously moving a sheet of fibers through the bath in the tank, and vertically through the sheet inlet, through the drying compartment, and through the outlet, and the invention consists in the combination of parts placed in the foregoing arrangement, consisting of an air inlet at one of the portions of the sheet within the compartment for supplying air to all sides of the sheet to be dried, an air outlet at the other end of the sheet within the compartment for discharging air from all sides of the sheet, the air inlet being contiguous

2

to the sheet inlet, and the air outlet being contiguous to the sheet outlet, and a second tank having a coating bath, means for continuously moving said sheet through the bath, a second compartment having a top open to the atmosphere and a closed bottom, a sheet inlet at its bottom, an air inlet adjacent the sheet inlet, said sheet moving vertically upwards from the sheet inlet to the open top, said second compartment having an upper portion of vertical parallel sides parallel with the sheet substantially adjacent the sheet, and an enlarged lower portion adapted to enclose heating means, the horizontal cross-sectional area of the upper portion being substantially less than the horizontal cross-sectional area of the lower portion. And the invention also includes the second compartment as described, without the first compartment combined therewith.

The invention will be further described, embodiments shown in the drawings, and the invention will be finally pointed out in the claims.

In the accompanying drawings,

Fig. 1 is a diagrammatic drawing of the tanks, and drying apparatus used in carrying out the improved method of making the improved binder; and

Fig. 2 is an enlarged diagrammatic view of the various stages in the making of the bonding member.

Similar characters of reference indicate corresponding parts throughout the various views.

Referring to the drawings, Fig. 1, a roll 10 of an asbestos strip, enables the strip 11 to be fed over rolls 12, through a bath 13 of impregnating resinoid solution in tank 14. The bath 13 of the tank 14 has a level slightly below the centers of two calendering rolls 15, which are preferably used, and which press the asbestos fibers and impregnating material of the bath together. The centerline of the calendering rolls, when used is set just above the level of the resinoid solution so that the lower or bottom portion of each of the rolls is immersed in the solution and the excess solution which is squeezed out is free to run back along the strip into the bath with no opportunity to air harden or dry on the strip. The rolls, by continuous dipping in or rotation in the solution, are kept wet and thus do not stick to the strip.

The first drying compartment 16 has an entrance 17 for the strip 11, and an exit 18 for the same. The strip 11 passes over an intermediate roller 19 at the top. A partition 20 extends downwardly below the roller 19. On one side of this partition 20, a plurality of infra-red

drying lamps 21 are arranged to have the radiant heat of the same act to dry out the volatile solvents and, in the preferred form, to slightly advance the impregnated resinoid. Air is circulated through the compartment 16 entering through the intake port 9, becoming heated by the heat effects of the lamps 21 and of the surrounding metal parts of the compartment 16. The air passes up through the compartment at the right of the partition 20 and down at the left of the partition 20, and exhausts through the exhaust port 8, so that the strip 11 is subjected to the drying action of heated air throughout its entire trip through the drying compartment 16.

The strip 11 after leaving the exit 18 of the drying compartment 16 enters a second tank 23 having a bath of resinoid solution 23*a*, and the rollers 24 guide the strip 11 through the bath. Doctors 25 may be provided at the exit end of the strip from the bath 23*a* to control the thickness of the added material. The strip 11 then enters the entrance 26 of a second drying compartment 27, also having a plurality of infra-red drying lamps 29. Air entrance openings 30 are provided at the upper end of the compartment 27, and an air discharge 31 is provided at the lower part of the compartment 27. The infra-red lamps 29 are arranged on both sides of the strip 11, to accelerate the drying action, but not to advance the resinoid, while cool air entering from the top of the compartment 27, at 30, and passing along the strip 11, serves to harden and set the resinoid before the strip 11 passes over the top rolls 42. Referring more particularly to Fig. 1, it will be seen that the upper portion of the drying compartment 27 has a constant horizontal cross-sectional area formed by parallel vertical walls parallel with and adjacent to the sheet 11, and the lower portion has a greater horizontal cross-sectional area formed by parallel vertical walls inclosing the infra-red heating lamps 29, the upper portion of the compartment being open at the top to the atmosphere, and closed at the bottom save for the sheet inlet 26, with an air outlet opening in proximity thereto. The flow of air is in reverse direction to the direction of motion of the sheet, the air entering at the top and discharging at the bottom, while the sheet enters at the bottom and leaves at the top. This reverse direction of the air and sheet provides the optimum condition for heating the sheet in the lower portion containing the heating means and for cooling sheet 11 in the upper portion of the compartment, so that the sheet 11 leaving the open upper end has not only been dried by the air flow action referred to above but has been cooled as well. Since the air entering the open top at 30 is at atmospheric temperature the top sheet 11 leaving the open top 30, will be cooled to almost atmospheric temperature resulting in hardening and setting the resinoid and loss of tackiness, before the sheet 11 passes over the top rolls 42.

The time of immersion and temperature of the bath must be considered. As an example, an immersion time of 15 sec. in a bath 23*a* at 80° F. has given successful results. The temperature in the drying compartment 27 is maintained at about 100° F. and 2000 watts to 3000 watts if infra-red drying lights are used.

If desired, another tank 33 and compartment 34 having an entrance 35 may be added, operating in the same manner as the tank 23 and compartment 27, until the strip 11 in completed form finally passes over the discharge roller 36. The time and temperature is about the same as just stated.

The rollers 10 and 12 and the tanks 14, 23, and 33, as also the roller 36 are supported on the table 37 with standards 38. The guide rollers 42 and compartments 16, 27 and 34, are suitably supported (not shown) above the table 37. Electric strip heaters 39 on the impregnating tank 14, 40 on the tank 23, and 41 on the tank 33, are provided so that each of these solutions may be maintained at the optimum operating temperature.

The improved bonding member is formed from a sheet made from fibres of one kind of asbestos, namely, chrysotile surpentine, chemically known as a hydrous magnesium silicate containing approximately 43% magnesium oxide (MgO), 44% silicon dioxide (SiO_2), and 13% water. Such fibres are quite flexible and may be fibrilated and intertwined in beaters and then matted into sheets. The asbestos sheets are those in which the fibers are arranged transverse to the longitudinal line of the strip with irregular transverse and longitudinal interstices between the fibers which permit ready and rapid filling by the resinoid, and impregnation by the resinoid of the fibrous structure, particularly by the preferred water soluble resinoid, so that the fibres are impregnated by the resinoid and the interstices between the fibres filled by the resinoid. The individual asbestos fibers indiscriminately disposed are encircled, permeated and bonded together by the surrounding resinoid in a transverse and longitudinal homogeneous structure. This is important in order to assure the uniformity of the solid. Upon completely reacting the resinoid under the heat and pressure applied to the brake shoe, bonding member and brake lining, the fibres are strongly bonded together by the adhesive action of the resinoid, and the resinoid forms an integral structure from face to face of the sheet. It is a solid from face to face. Under such heating the bond is not greatly weakened because of the known heat resisting attributes and consequent incombustibility of the chrysotile. Comparative shear tests to destruction of this improved bonding member show bonds between brake lining and brake shoe of 400 to 500 lbs. per sq. in. and only very slight reduction of shear strength after subjection to a temperature of 500° F. for 30 min.

In Figure 2, the progressive stages in the production of the bonding member from its initial stage as an asbestos sheet to the final stage ready to be applied between a brake shoe and brake lining is shown. The asbestos sheet first shown has a sizing (not shown). Following the direction of the arrow, the impregnation bath adds the resinoid. The second bath adds accretions to the surfaces. The third bath, if used, adds further accretions. When pressure and heat are applied, to assemble the brake shoe, bonding member and brake lining, the excess resinoid is squeezed out, as indicated by the bubbles 11*a*, so that the intervening bonding member is a concentrated composite of resinoid and asbestos. Some of the accretions are forced into the asbestos interstices, under the molding action of heat and pressure; that is, it is not intended that all the accretions of resinoid on the surface of the bonding member are squeezed out, but rather that they are forced into the mass of resinoid and become part thereof. Under the heat and

pressure applied in its intended use, the resinoid particles become one mass.

A sheet of such asbestos fibres of a thickness between 0.007'' and 0.025'' which is commercially available in various grades has very little tensile or shear strength since the fibers have no fibrils or whiskers, such as cotton or wool fibers which intertwine and resist pulling apart. The heat resistance of asbestos presents advantages over cotton or wool. The interstitial spaces between the overlapping asbestos fibers in all directions, provide a network interstitial space through which the resinoid enters, to convert the low tensile and low shear strength of the sheet into a high tensile and high shear strength. By impregnating the spaces between the fibers with a phenol formaldehyde resinoid, the fibers become dispersed in the colloidal molecular resinoid, all parts of the fibers being surrounded. Any breaking of the fibers into smaller fragments in the presence of the enveloping resinoid, as by calendering rolls or restricted passages, causes the resinoid mass to enclose the smaller fragments. The entrained asbestos particles give strength to the dispersed medium, both in tensile and shear stress. In Fig. 2 of the drawings the resinoid particles have been shown diagrammatically by circles as representing the particles though to the sight the resinoid is a solid mass.

The bath solution is a solution of a phenol-formaldehyde resinoid containing 25% to 40% solids by weight to obtain a thorough impregnation as described, the time element and solution temperature being taken into consideration. As an example, an impregnation of about 45 sec. at a temperature of 80° F. has given good results.

The drying is carried out under infra-red drying lamps in the presence of an air stream warmed by the lamps and the intensity of heat is so controlled that the volatile solvents are evaporated and, in the preferred use, the resinoid is partially advanced so that the resinoid impregnation is not readily soluble in any additional resinoid solution when applied. By controlling the intensity of the heat of the drying lamps, the temperature of the air flow, and the speed at which the impregnated tape or strip passes the lamps, the degree of advancement of the resin may be controlled. As an example, 1125 watts of drying lamps (3–375 w. lamps), an inlet air temperature of 90° F., an outlet air temperature of 105° F., and a tape speed of 4 ft. per min., have given good results. It is desirable to advance the resinoid impregnation just enough to prevent too quick a solvent action of any further resinoid solution. If the resinoid impregnation is advanced too far, the strip becomes very brittle and is easily fractured in handling. If it is not advanced at all, the solvent action of any additional resinoid solution causes difficulties in drying.

On thinner asbestos paper strips of between 0.007'' and 0.015'' thickness, the use of calendering rolls is not essential, since thorough impregnation by simply passing the strip through the resinoid solution bath is possible. In this case, the use of a doctor consisting of rubber or steel wiping blades is sufficient to remove the excess resinoid from the surface as the strip is withdrawn from the bath.

In the bath, when the resinoid is in solution, molecular separation and particle suspension exists. When the volatiles are evaporated, the resinoid particles adhere to each other, forming a colloidal mass with the asbestos fibers dispersed therein. The advanced resinoid at the surface of this colloidal mass thus forms a partial impedance to the dissolving of the mass by the solvent of the additional resinoid applied thereto, while the volatile solvents still remain unevaporated, but nevertheless there is an accretion of the added molecules to the molecules of the first impregnation whereby homogenity is obtained, upon the evaporation of the volatiles supplied by the subsequent resinoid. Furthermore, the drying by infra-red rays aided by air circulation of the added resinoid from the second bath, follows so closely upon application of the added resinoid that the volatile solvents do not have time to act on any part of the thickness except the surface thereof, since before they can penetrate too deeply, the solvents are evaporated and the accretion takes place.

If desired this subsequent process of adding to the thickness of the strip may be repeated, depending on the desired thickness of the strip. A plurality of thin applications rather than one thick coat has several advantages. It permits faster drying of the volatile solvents without advancement of the resinoid, since less heat is required to dry each of the thin applications. It permits the use of less viscous applications, and thus more ready drying. It provides an accretion of the molecular or colloidal resinoid, since the solvent dissolves the surface of the previously applied resinoid and enables a homogeneous merging, without stratification, upon the evaporation of the volatile solvent. Every bath application repeats the accretion process. When the desired thickness has been obtained, the bonding member is ready for use.

The speed of vertical movement of the strip out of both of the resinoid baths is related to the gravity drip or flow off of the excess resinoid and the temperature and viscosity of the bath solution must be controlled and co-ordinated with the vertical speed of the strip out of each of the baths to secure an even surface and eliminate "lace curtains." In other words, as the strip is withdrawn from the bath, the excess resinoid must run down the surfaces of the strip and back into the bath faster than the strip is withdrawn.

The height of the drying compartment and the length of the strip therein being dried also requires consideration, since if the height is too great, the strip will break under its own weight, and if the compartment is too short, the drying must be too intensified.

It is preferred to modify the impregnating solution by the addition, or the substitution, of an aqueous solution of a phenol-formaldehyde resinoid. The smaller molecular size of the water soluble resinoid permits faster and more complete impregnation of the asbestos fibres, and brings about the solubility of the size or glue used in the manufacture of the asbestos sheet. A solution containing four parts by volume of alcohol soluble resinoid containing 25% to 40% solids by weight, and one part by volume of water soluble resinoid containing 70% solids by weight, and one part by volume of denatured ethyl alcohol has given excellent impregnation having the wetting and saturating action necessary and the proper viscosity.

In certain cases, the addition of a plasticizer to the impregnating resinoid bath, or to the accretion bath, or to both, is preferred. The presence of such a plasticizer permits advancing the resinoid without the extreme brittleness some-

times obtained. The addition of 20% tricresyl phosphate (ortho free), 20% dibutyl phthalate, or 5% castor oil, all by weight, has given satisfaction. When a plasticizer is added, the action described is substantially the same, save that the presence of the plasticizer reduces the tendency to brittleness after all volatiles have been evaporated.

Advantages follow from the action of the heat and pressure applied to the brake lining and brake shoe with the bonding member therebetween since the bonding member has a longitudinal and transverse homogeneous body of thermosetting resinoid from surface to surface, part of which resinoid, by such heat and pressure, enters the somewhat porous surface of the brake lining contiguous to the bonding member and makes the brake lining unitary with the bonding member while the other side of the bonding member has its resinoid adhere to the rough surface of the brake shoe. Thus, transverse columns of resinoid which are formed from surface to surface of the bonding member between the asbestos fibers, extend from the brake lining to the brake shoe, without any intermediary layer. It is these innumerable integral columns of thermosetting resinoid built between the asbestos fibers, which give strength to the bonding member.

The improved bonding member is preferably of a translucent character, almost transparent to the extent of being able to read printed matter beneath, and is self contained and ready to apply. It is believed that this is the first bonding member having the characteristics herein set forth.

The matter herein described and not claimed forms the basis of other applications, this application being a divisional application of the application filed by me on May 10, 1946, under Serial No. 668,662.

I have described several forms of my invention, but obviously various changes may be made in the details disclosed without departing from the spirit of the invention as set out in the following claims.

I claim:

1. In an apparatus for making a bonding member to attach friction material to brake shoes, having a tank for an impregnating bath, a drying compartment above the same and exterior thereto having a top and a bottom, a sheet inlet and outlet, drying means in said compartment, and means for continuously moving a sheet of fibres through the bath, and vertically through the sheet inlet, through the drying compartment under the influence of said heating means, and through the outlet, the combination of an air inlet at one of the portions of the sheet within the compartment for supplying air to all sides of the sheet to be dried, and an air outlet at the other end of the sheet within the compartment for discharging air from all sides of the sheet, the air inlet being contiguous to the sheet inlet, and the air outlet being contiguous to the sheet outlet, said sheet inlet and outlet being at the bottom of the compartment, a partition within the compartment extending from its bottom to near its top, and a guide roller for the sheet between the top and upper end of the partition to reverse the direction of the movement of the sheet within the compartment from vertically upward to vertically downward, whereby air circulation over the entire sheet within the compartment is obtained and follows the movement of the sheet throughout its length within the compartment.

2. In an apparatus for making a bonding member to attach friction material to brake shoes, having a tank for an impregnating bath, a drying compartment above the same and exterior thereto having a sheet inlet and outlet, drying means in said compartment, and means for continuously moving a sheet of fibres through the bath, and vertically through the sheet inlet, through the drying compartment under the influence of said heating means, and through the outlet, the combination of an air inlet at one of the portions of the sheet within the compartment for supplying air to all sides of the sheet to be dried, an air outlet at the other end of the sheet within the compartment for discharging air from all sides of the sheet, the air inlet being contiguous to the sheet inlet, and the air outlet being contiguous to the sheet outlet, and a second tank having a coating bath, means of continuously moving said sheet through the bath, a second compartment having a top open to the atmosphere and a closed bottom, a sheet inlet at its bottom, an air outlet adjacent the sheet inlet, said sheet moving vertically upwards from the sheet inlet to the open top, said second compartment having an upper portion of vertical parallel sides parallel with the sheet substantially adjacent the sheet, and an enlarged lower portion adapted to enclose heating means, the horizontal cross-sectional area of the upper portion being substantially less than the horizontal cross-sectional area of the lower portion.

3. In an apparatus for making a bonding member to attach friction material to brake shoes, composed of a continuous sheet of asbestos fibres impregnated and coated with a thermosetting resinoid, the combination of means for impregnating an asbestos sheet with a thermosetting resinoid solution, means for coating said impregnated sheet, and means for drying said coated sheet, including a compartment having a top open to the atmosphere and a closed bottom, a sheet inlet at its bottom, an air outlet adjacent the sheet inlet, said sheet moving vertically upwards from the sheet inlet to the open top, said compartment having an upper portion of vertical parallel sides parallel with the sheet substantially adjacent the sheet, and an enlarged lower portion adapted to enclose heating means, the horizontal cross-sectional area of the upper portion being substantially less than the horizontal cross-sectional area of the lower portion.

SYDNEY G. TILDEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,786,416	Martindell	Dec. 23, 1930
1,816,409	Steele	July 28, 1931
2,303,368	Keuffel et al.	Dec. 1, 1942
2,389,459	Remark et al.	Nov. 20, 1945
2,394,040	Callinan	Feb. 5, 1946
2,444,262	Knight et al.	June 29, 1948