Oct. 16, 1962 J. STEIN 3,058,870

METHOD OF DEBONDING A BRAKE LINING FROM A BRAKE SHOE

Filed Feb. 15, 1956 2 Sheets-Sheet 1

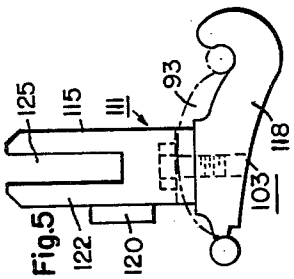


Fig.5

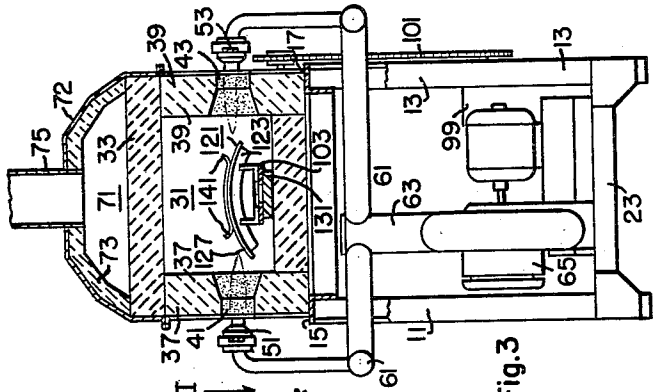


Fig.3

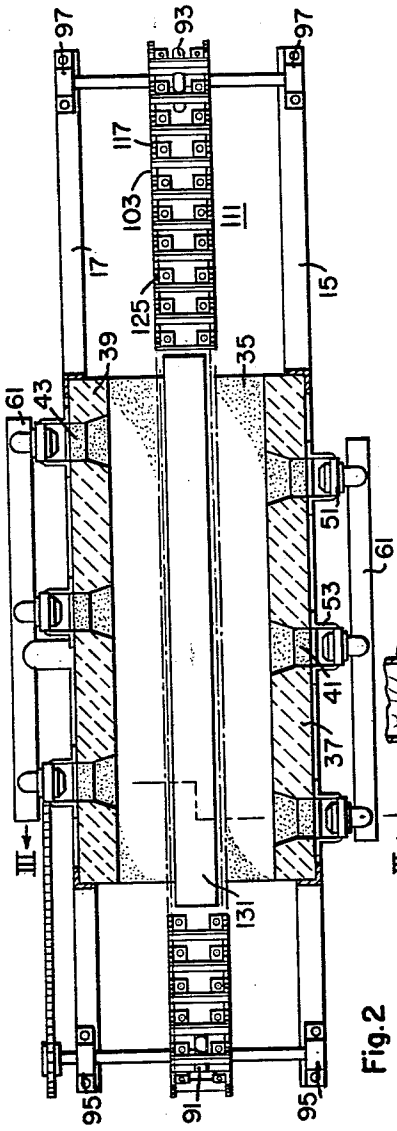


Fig.2

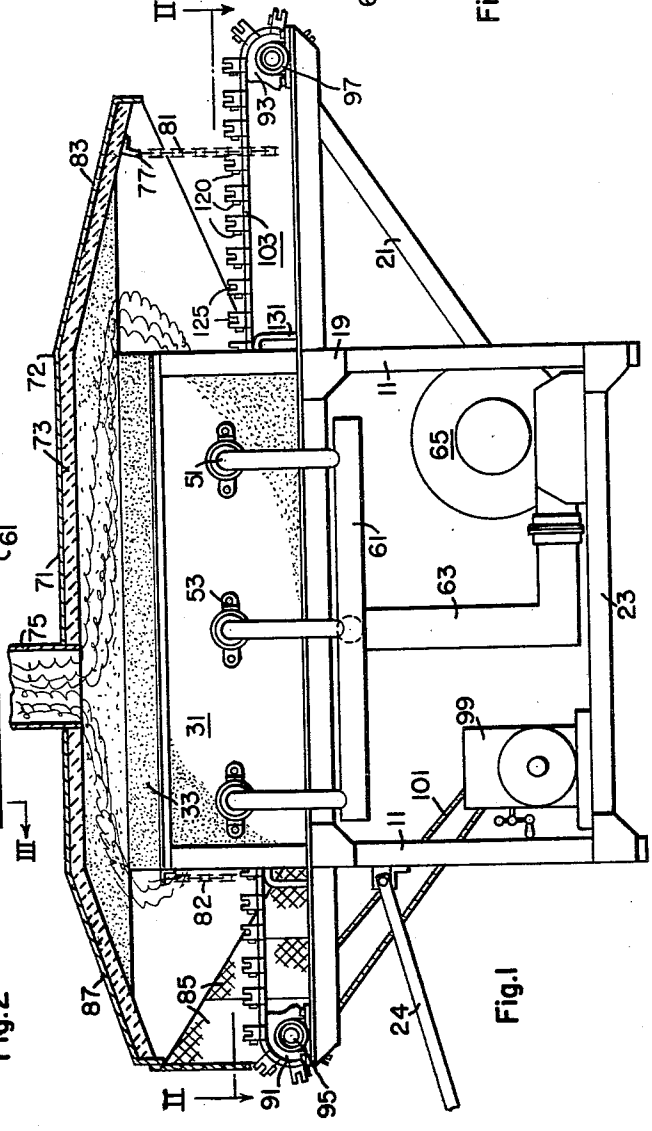


Fig.1

METHOD OF DEBONDING A BRAKE LINING FROM A BRAKE SHOE

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Fig.4a

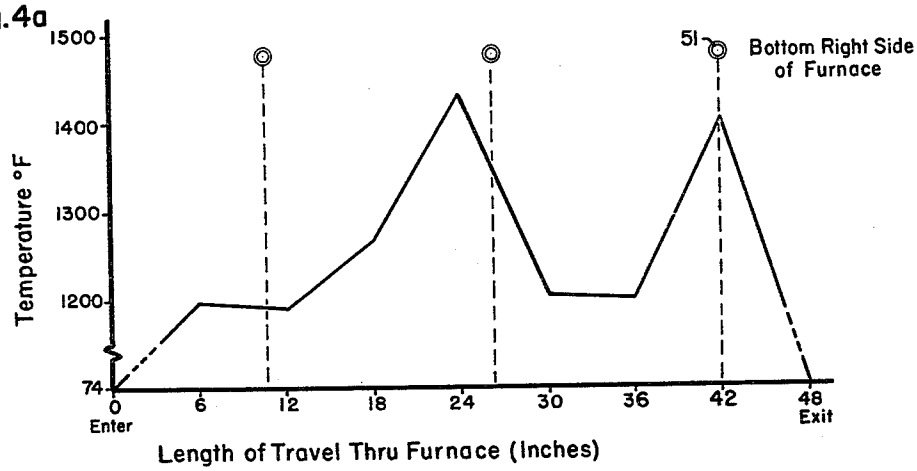


Fig.4b

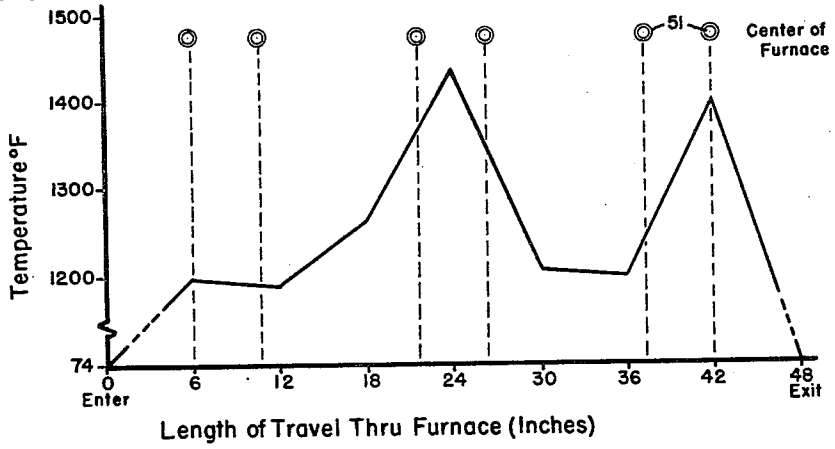
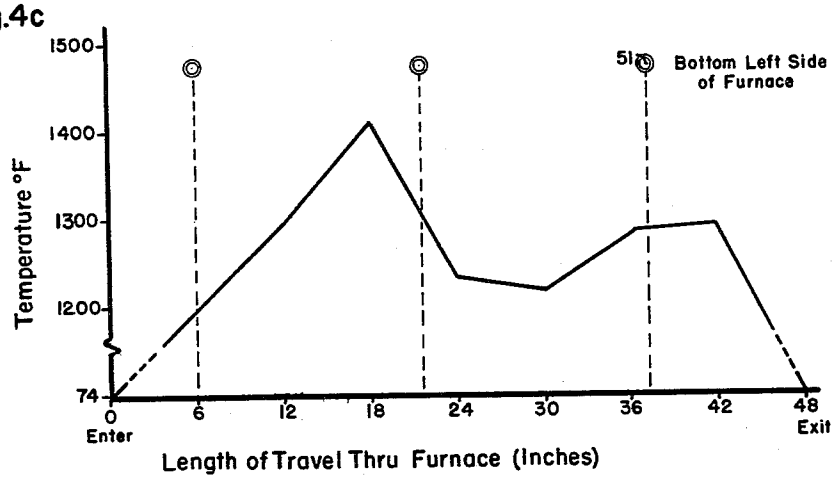


Fig.4c



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3,058,870
METHOD OF DEBONDING A BRAKE LINING FROM A BRAKE SHOE

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This invention relates to the debonding or the removal of brake linings from brake shoes preparatory to the bonding of a new lining.

The lining is usually bonded to a brake shoes adhesively by a heat hardened organic binder. In debonding the shoe heat is applied so that the binder is decomposed and oxidized. Apparatus, in accordance with the teachings of the prior art, for debonding the brake linings from brake shoes, is typified by Batchelor Patent 2,711,775 and it appears desirable to use this patent at a starting point in explaining the invention disclosed herein.

In accordance with the Batchelor patent the shoe is mounted on a wheel and heated by radiant heat from a plurality of radiators extending along the flanges of the shoe. The wheel on which the shoe is mounted is held in one of its extreme positions for about twenty seconds while the heat is applied and then moved to the other extreme position while heat continues to be applied, the movement consuming another twenty seconds. Since approximately twenty seconds would be consumed in mounting and removing the shoe from the wheel, the total time for debonding a shoe is of the order of one minute.

After a shoe is debonded the metallic base remaining is subjected to cleaning in a shot blasting chamber and then it is coated with cement by dipping and a new lining is bonded to it. But while a shoe is in use on a vehicle it tends to come into contact with the grease on the wheel to which it is applied and with the braking fluid and thus has a substantial deposit of greasy and oily material on its surface. This material must be removed before the blasting and cementing operations are performed because it tends to render the shot in the shot-blasting chamber sticky and ineffective, and also because any greasy or oily deposit on the surface of the base tends to prevent the adhesion of the cement.

The prior art apparatus typified by Batchelor has the disadvantage that its debonding time is too long; sixty shoes per hour is inadequate to meet the demands of a modern relining plant. In addition, this prior art has the disadvantage that the shoes must be degreased before the blasting and cementing operation.

It is, accordingly, broadly an object of this invention to provide debonding apparatus and a debonding method, in the use and practice of which it shall be feasible to debond a brake shoe in a substantially shorter interval than the debonding time necessary in accordance with the teachings of the prior art.

Another object of this invention is to provide a method and apparatus for debonding a brake shoe, in the use and practice of which the base from which the lining is removed shall be thoroughly purged of any greasy or oily material.

A more specific object of this invention is to provide a novel conveyor furnace which while having other uses is particularly suitable for the debonding of a brake shoe in the practice of this invention.

Another specific object of this invention is to provide a novel conveyor chain.

In accordance with this invention, heat is concentrated on the opposite ends of the brake shoe to cause the lining to curl away at the ends from the base to which it is bonded. This results from the forces applied within the brake lining as it tends to expand when heated. While the heat is being concentrated on the ends of the shoe

and the lining is curling away from the base, the shoe is also heated throughout. This causes the binder to decompose and become plastic. The resulting pressure blasts the lining away from the base and the lining drops off. In the preferred practice of this invention, the heating of the base then continues until all of the greasy and oily material which has adhered to the surface of the base has been oxidized.

In accordance with the preferred practice of this invention, the concentrated heating is effected by conveying the brake shoes through a tunnel or furnace into which flames from a plurality of nozzles project. The brake shoes are so positioned while being moved that the flames contact the opposite ends of the shoes thus producing the required concentrated heating of the ends. The nozzles on one side of the tunnel are staggered with respect to the nozzles on the other side. This staggering has several advantages. First it is advantageous as regards the operation of the furnace in that the flame emitted by one nozzle does not tend to blow out the flame of the nozzle opposite it. Further, because the nozzles are staggered, the heat is concentrated on the ends of the brake shoe alternately and this mode of heating has been found to be effective in producing the curling and the removal of the lining. It has also been found to be more effective in removing lining to concentrate a plurality of successive heat blasts in rapid succession against the ends of the brake shoe than to apply the heat shots more slowly but to both ends simultaneously.

The tunnel has a refractory lining which is heated by the flames from the nozzles to a high temperature and the radiation from which heats the shoes throughout while the concentrated heat is being applied on their ends. The heating throughout has the effect of causing the binder to decompose and explode and the lining to drop from the bases. In the practice of this invention, each shoe is so moved through the flames and is so heated that the lining drops away from the base before the shoe has reached the end of the tunnel. While the lining is being removed the greasy and oily materials are oxidized by the flames; thus when a base has reached the end of the tunnel it is completely degreased. The shoe then continues moving while it is subject to a cooling air draft for a predetermined interval allowing it to cool. After this interval the shoe drops into a trough. When the shoe is ready to drop into the trough it is sufficiently cooled so that it is not damaged by the shock of being dropped. The shoe is now ready for the shot blasting chamber.

In the practice of this invention, the shoes are moved continuously through the flames and it has been found that because of this movement the instantaneous temperature to which the brake shoes are subjected may be substantially higher than the temperature to which brake shoes may be subjected when they are maintained continuously in a heating region. Further, the lining is effectively removed from a brake shoe and the base is effectively purged of grease and oil by movement through the tunnel or furnace at a high rate and thus the rate of debonding shoes is high. In fact, in the practice of this invention, it has been found that, depending on the character of the brake shoe, from 500 to 700 shoes may be debonded per hour. The high rate of debonding and the high temperature are thus compounded factors in conferring advantage on the method according to this invention. The higher the rate the higher the temperature may be and the more effective the debonding and the oxidation and the higher the temperature the higher the rate.

The novel features considered characteristic of this invention are described generally above. The invention itself both as to its organization and its method of operation, together with additional objects and advantages there-

of, will be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which:

FIGURE 1 is a view partly in transverse section showing a preferred embodiment of this invention;

FIG. 2 is a view in section taken along II—II of FIG. 1;

FIG. 3 is a view in section taken along III—III of FIG. 2;

FIGS. 4*a*, 4*b* and 4*c* are graphs showing the temperature distribution in a furnace or tunnel in accordance with this invention; and

FIG. 5 is a fragmental view showing a chain used in the practice of this invention.

The apparatus shown in FIGS. 1, 2 and 3 includes a support comprising spaced pairs of vertical angle irons **11** and **13**. Across the top of each pair of irons **11** and **13** a long angle bar **15** and **17**, respectively, is secured by angle brackets **19**. The bars **15** and **17** extend a greater distance on one side than on the other and are braced by cross angle irons **21** on this side. A platform **23** is secured between the angle irons **11** and **13** near their lower ends. A trough **24** is pivotally supported from the angle irons **11** and **13** on one side.

A tunnel or open end furnace **31** having a top **33**, a base **35** and side walls **37** and **39** of refractory material is mounted on the bars **15** and **17**. A plurality of openings **41** and **43** are provided in the side walls **37** and **39**, respectively, the openings **41** in one wall **37** being staggered with respect to the openings in the other wall. Each opening **41**, **43** is flared inwardly. Opposite each opening (**41**, **43**) on the outside of the tunnel a nozzle **51** is mounted on a bracket **53**. While nozzles of many types may be utilized, in accordance with the preferred practice of this invention, the Sticktite flame retention nozzles sold by Maxon Premix Burner Company of Muncie, Indiana, is preferred. This nozzle is disclosed on pages 1201 and 1202 of the Maxon Bulletin 1200. The mouths of the nozzles **51** are so dimensioned and spaced relative to the openings **41** and **43** and the brackets **53** are so shaped that there is an air gap between the nozzles **51** and the boundaries of the openings **41**, **43**.

The nozzles **51** are supplied with gas from a manifold **61** which is itself supplied through a tube **63**. Gas and air in a ratio of approximately 10 parts of air to 1 part of gas are transmitted through the tube **63** by a blower and mixer **65** mounted on plate **23**. This gas is ignited at the nozzles **51** and produces a broad flame at each nozzle which extends into the associated opening **41** or **43** in the wall of the tunnel and flares out into the tunnel. As the combustion gases in the flame are projected into the tunnel through the openings **41** and **43**, they carry with them air which flows around the mouths of the nozzles **51** into the openings in the tunnel and assures the complete combustion of any material oxidized in the tunnel.

A hood **71** is mounted on the top **33** of the tunnel and extends over and overlaps the open ends of the tunnel. The hood includes a sheet metal outer casing **72** within which a roof **73** of refractory material is secured. The casing **72** extends over the ends of the roof **73**. The roof **73** of the hood opens into a flue **75**. A wall of chains **81** extends from an angle bracket **77** secured to the roof **73** on one side and another wall of chains **82** extends from the end of the tunnel on the other side. An enclosure or curtain **85** of heat resistant board is supported by the extension **87** on the latter side. The flue **75** extends centrally in a transverse direction with reference to the hood **71** but is displaced longitudinally towards the side of the enclosure **85** with reference to the tunnel.

Between the ends of the angle bars **15** and **17** a pair of sprocket wheels **91** and **93** are mounted on suitable bearings **95** and **97**, respectively. One of these sprocket wheels **91** is driven from a variable speed drive **99** through a sprocket chain **101**. The other sprocket wheel **93** is an idler. The drive **99** is mounted on the plate **23**. A sprocket chain conveyor **103** is mounted in engagement with the sprocket wheels **91** and **93** extending through and under the tunnel between the bars **15** and **17** and is driven by sprocket wheel **91** and as it is so driven passes over the idler sprocket wheel **93** and advances through the tunnel in the direction from wheel **93** to wheel **91**.

On the chain a plurality of brake shoe holders **111** are mounted. Each of these holders consists of a pair of angle brackets **115** and **117** bolted to each chain link **118** and held together by a tie bar **120**. The sides **122** of the angle bars extending away from the link **118** are slotted. A brake shoe **121** may be mounted on each of the supports **111**, either with the web **123** extending through the slots **125** (as in FIG. 3) or with the flange **127** extending through the slots. In either case the brake shoe lies loosely in the slots **125** with its ends extending in both directions from the slot so that they project into the flames produced by the nozzles **51**.

Since the conveyor **103** may at times sag under the weight of the brake shoes **121**, a supporting bracket **131** is provided within the tunnel which extends under the conveyor and over which the conveyor and shoe supports may slide without damaging the lining on the floor of the tunnel.

In the use of the apparatus the flames are ignited in the nozzles **51** and after stable conditions are reached the conveyor **103** is started. The drive **99** is set so that the speed of the conveyor **103** is suitable for the shoe being delined. The operator then stands near the feed-in end of the tunnel and places the shoes **121** in the supports **111** as they pass by. The shoes are then moved into the tunnel and the ends of the shoes pass successively and alternately through the flames produced by the nozzles **51**. The brake lining is then curled as shown at **141**. The shoes are also heated throughout and eventually the lining drops from its base. Since the brake shoes **121** are held loosely in the holders **111**, there is no tendency to deform or distort the brake shoes by overheating, even if over-heating tended to occur. But in the practice of this invention the shoes are moved through the tunnel at so high a rate that there is no tendency to overheat. The lining usually drops away from the base of each shoe before the shoe reaches the delivery end of the tunnel. It has been found that depending on the speed of the conveyor **103**, the temperature in the tunnel, and the character of the shoe, the lining drops off at some point in the region between the second nozzle **51** on each side and the end of the tunnel. While the shoe is being conveyed through the tunnel, the greasy and oily materials on its surface are entirely oxidized. The heating and oxidation are supported by the air sucked into the tunnel at the nozzles **51** and also by the air draft through the ends of the tunnel. Because the feed-in end of the tunnel is relatively open and the delivery end is relatively closed there is a greater draft into the tunnel on the side into which the work moves than on the other side. The conveyor **103** extends a substantial distance beyond the exit end of the tunnel so that the shoes are cooled by the draft of air through the exit end before they reach the end of the conveyor. When the shoes reach the end of the conveyor they drop into trough **24**.

The flames from the nozzles **51** not only shock heat or concentrate the heat on the ends of the brake shoes **121** but also by radiation and convection heat the refractory materials in the sides **37** and **39**, roof **33** and base **35** of the tunnel and the radiation from this refractory material provides additional continuous heat for the shoes. In addition, the draft of air passing in through the chain **81** and out through the chain **82** tends to produce a draft of the combustion gases into and through the hood **71** and up through the flue **75** or stack **75**. By the cooperation of the air-draft flowing into the hood through the shield and the flames within the tunnel which are caused to flow into the hood the hydrocarbons which are produced in the tunnel are entirely oxidized and there is

substantially no smoke emitted from the flue. Thus the apparatus can be used in communities which have smoke control laws or ordinances. The refractory roof **73** is also heated to a high temperature and helps to oxidize any residual hydrocarbons which may flow into the hood.

In apparatus, in accordance with this invention which has been constructed and found to operate satisfactorily, the tunnel is 48 inches long, 12 inches high and 15 inches wide (inside dimensions) and there are six nozzles, three on each side. The spacing between successive nozzles on each side is 16 inches. The end nozzle on one side is spaced 10 inches from the entrance end of the tunnel and the end nozzle on the opposite side is spaced 6 inches from the entrance side of the tunnel. The shoes are conveyed substantially through the longitudinal center of the tunnel. With these nozzles burning commercial heating gas in the operation of the apparatus, the temperature distribution along the tunnel is shown in graphs *a*, *b*, and *c* of FIG. 4. In each of the graphs of FIG. 4, temperature is plotted vertically and the position from the entrance end of the tunnel in inches is plotted horizontally. The temperature is in degrees Fahrenheit.

Graph 4*a* shows the distribution along the center of the tunnel in the region of the nozzles. Graphs 4*b* and 4*c* show the distribution near the bottom of the tunnel on both sides. The words "left" and "right" are used with reference to an observer facing the feed-in end of the tunnel. It is seen that the temperature distribution is highly irregular and it is this irregular distribution which tends to produce the curling effect which is important in the removal of the lining from the shoe.

With the apparatus above described 500 to 700 shoes may be debonded per hour. Assuming 600 shoes per hour as a fair average, it is seen that each shoe moves through the tunnel in 1/600 of an hour or in 6 seconds. The speed of each shoe is then 8 inches per second and at these speeds the shoes are not damaged in the high-temperature regions of the tunnel.

While a specific embodiment of this invention has been disclosed herein, many modifications thereof are feasible. This invention, therefore, is not to be restricted except insofar as is necessitated by the spirit of the prior art.

I claim as my invention:

The method of debonding a brake lining from a brake shoe to which said lining has been adhesively bonded by means of an interposed heat hardened organic binder, which comprises passing both ends of said brake shoe which are generally transverse to the long dimension of said shoe through discrete regions of intense heat, to concentrate heat on the ends of said brake shoe sufficiently to raise said ends to a temperature such as to cause the ends of said lining to curl away from the metallic base of said shoe, each of said ends being passed through a plurality of discrete regions of intense heat in succession, whereby heat is concentrated on each of said ends for time intervals separated by intervening intervals, said ends being respectively passed through said regions alternately whereby heat is concentrated on each of said ends during the intervening intervals for the other ends, and while both said ends are being passed through said regions heating the shoe continuously throughout so that after said shoe has been so heated for a predetermined overall interval said lining is automatically disengaged from said metallic base.

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