Feb. 15, 1955 E. E. MURRAY 2,701,937

BLADE POLISHING MACHINE

Filed April 11, 1952 3 Sheets-Sheet 1

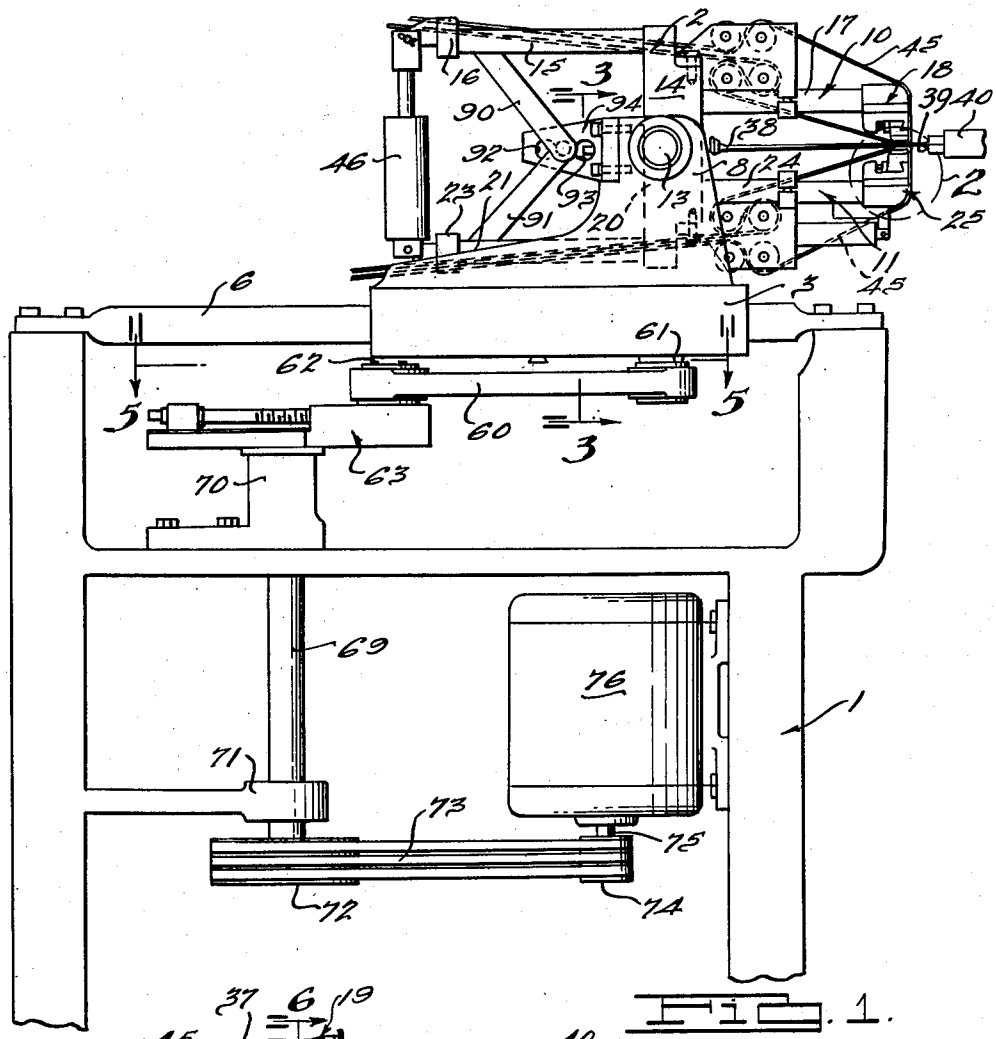


Fig. 1.

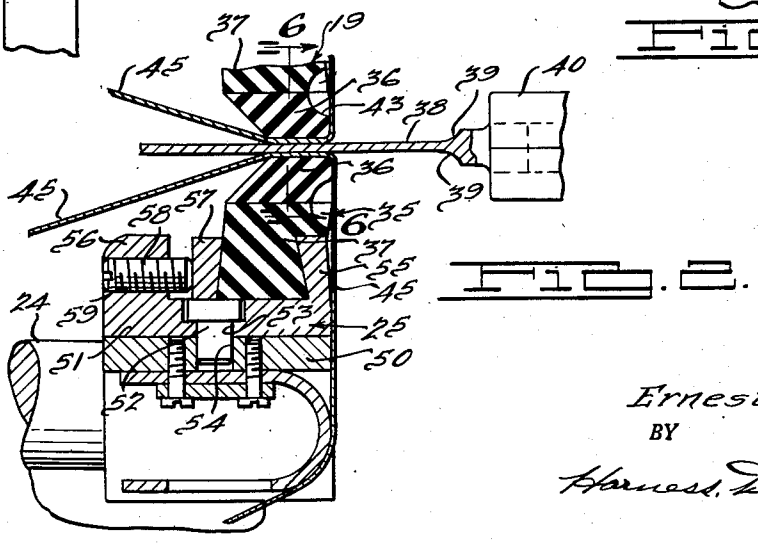


Fig. 2.

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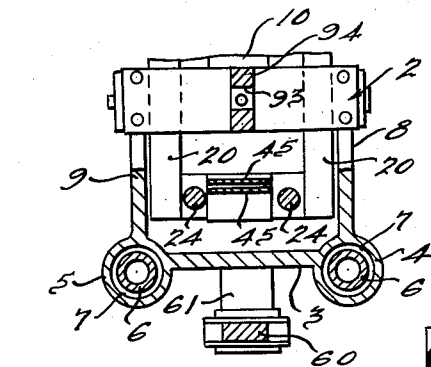


Fig. 3.

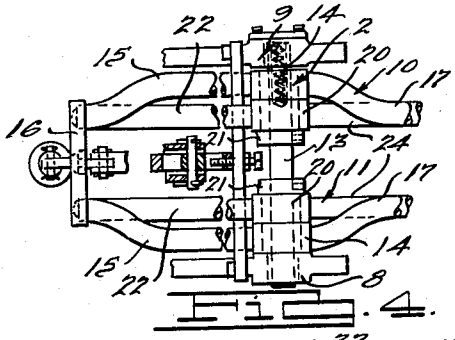


Fig. 4.

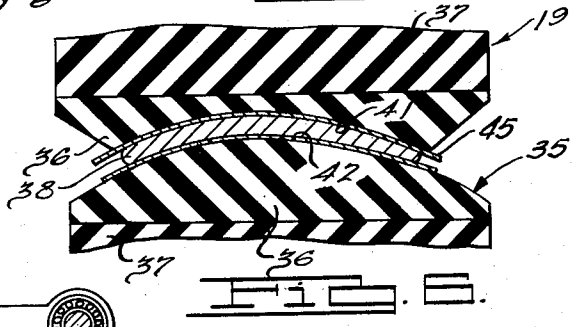


Fig. 5.

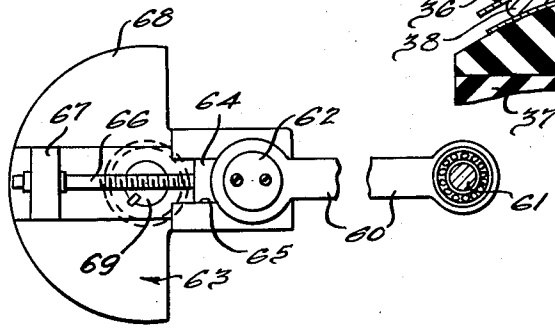


Fig. 6.

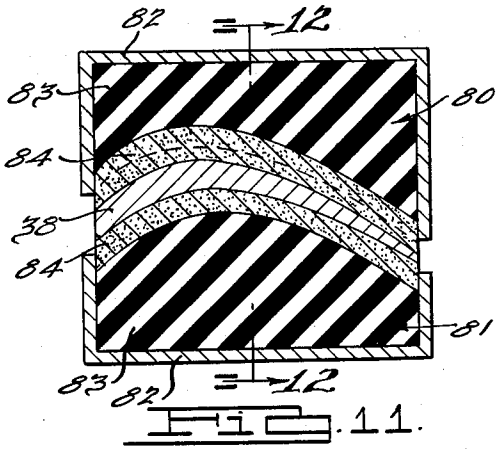


Fig. 11.

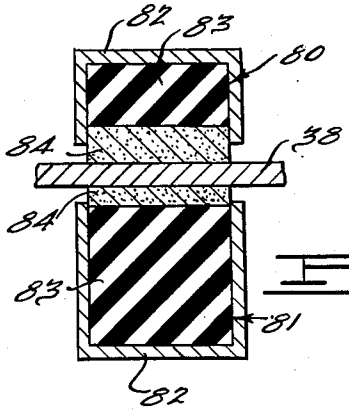


Fig. 12.

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BLADE POLISHING MACHINE

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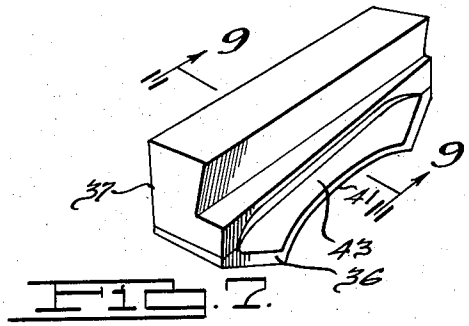


Fig. 7.

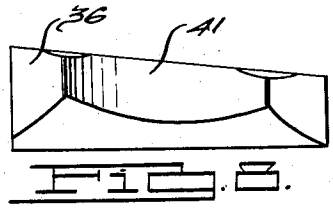
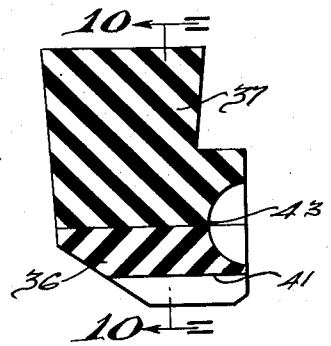


Fig. 8.

Fig. 9.



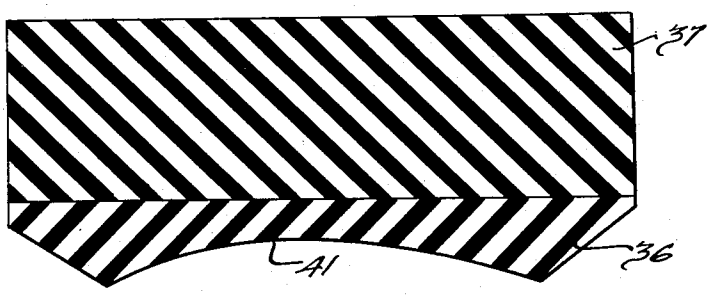


Fig. 10.

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2,701,937

Patented Feb. 15, 1955

2,701,937

BLADE POLISHING MACHINE

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Application April 11, 1952, Serial No. 281,835

8 Claims. (Cl. 51—59)

The present invention relates to polishing machines, and particularly relates to machines for simultaneously polishing both sides of impeller blades.

Impeller blades, and particularly such blades of the jet engine type, must be precisely finished, and heretofore this has been a slow process in which a part of the blade had to be finished by slow manual processes. With the machine of the present invention the entire portions of both sides of the blade that require polishing are finished simultaneously in a relatively short time. In the machining step, prior to the finish polishing step of the present invention, the grain of the cut runs transverse to the length of the blade. The polishing action of the present invention is such that the final grain runs longitudinally of the blade, which is an important factor in lengthening the life of the blade in use.

More specifically, the machine of the present invention involves means for simultaneously engaging both sides of the blade with polishing elements while the blade is held longitudinally stationary but permitted to rotate about its longitudinal axis, and reciprocating the polishing means along the length of the blade.

Resilient backing members engage opposite sides of the blade and each of such elements has a cross sectional configuration or is shaped so that the facing surface conforms substantially to the transverse configuration of the facing side of the blade to be polished. In one embodiment, each backing member is a composite one, with the outer or facing portion formed of a relatively soft rubber and the inner or backing portion formed of a relatively hard rubber. A flexible, coated abrasive strip is passed around the face of each backing member, with the abrading side in engagement with the adjacent side of the blade during the relative reciprocation of the blade and polishing means to finish the blade. The strip conforms to the facing side of the backing member and is so arranged that it may be moved along its length to present new abrading surfaces to the blade as the receding portions of the strip are worn down.

Another embodiment of a composite backing or polishing member has an outer element of hard rubber, either plain or having an impregnated bonded abrasive material therethrough, with a relatively soft inner rubber backing element. These elements, as in the embodiment described above, are bonded together and in this instance they are placed as a unit within a steel shell with the outer element projecting beyond the side of the shell so that it may float relative to the blade during the relative reciprocation. When the outer element is plain, a coated abrasive strip is disposed around it as in the embodiment described above.

The primary object of the present invention is to provide a polishing machine for quickly and properly finishing impeller blades by machine over the entire surfaces of those portions of the blade to be polished with the result that the grain on the final surface is longitudinal of the blade and the blade is finished to the precise dimensions required.

Other objects of the invention will become apparent from the following specification, the drawings relating thereto, and from the claims hereinafter set forth.

In the drawings in which like numerals are used to designate like parts in the several views throughout:

Figure 1 is a partial, side elevational view, of a polishing machine embodying features of the present invention;

Fig. 2 is an enlarged, cross sectional view of that portion of the machine shown within the circle 2 of Fig. 1;

Fig. 3 is a cross sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a partial, top plan view of the polishing head shown in Fig. 1;

Fig. 5 is a plan view taken substantially along the line 5—5 of Fig. 1;

Fig. 6 is a cross sectional view taken substantially along the line 6—6 of Fig. 2;

Fig. 7 is a perspective view of the composite backing member shown in Fig. 6;

Fig. 8 is a bottom plan view of the member shown in Fig. 7;

Fig. 9 is an enlarged, cross sectional view taken substantially along the line 9—9 of Fig. 7;

Fig. 10 is an enlarged, cross sectional view taken substantially along the line 10—10 of Fig. 9;

Fig. 11 is a cross sectional view similar to Fig. 6, showing the modified form of the present invention; and

Fig. 12 is a cross sectional view taken substantially along the line 12—12 of Fig. 11.

Referring to the drawings and referring particularly to Figs. 1 through 6 thereof, the polishing machine of the present invention is illustrated and comprises a base or table generally indicated at 1 having the polishing mechanism generally indicated at 2 mounted thereon.

The polishing mechanism 2 comprises a carriage 3 having a pair of transversely spaced and longitudinally extending cylindrical portions 4 and 5 which slidably receive therethrough supporting tubes 6. Suitable bearings 7 are interposed between the bores of the cylindrical portions 4 and 5 and the tubular support 6 for slidably supporting the carriage 3 thereon. The tubular members 6 are suitably fixed to the top of the base 1 in parallel relationship with respect to each other.

The carriage 3 is formed with integral, laterally spaced, upstanding brackets 8 and 9, respectively, for pivotally supporting the polishing heads thereon. An upper polishing head generally indicated at 10 and a lower polishing head generally indicated at 11 are pivotally supported on a transverse pivot shaft 13 which is supported in openings in the tops of brackets 8 and 9.

The upper polishing head 10 comprises upstanding mounting members 14 pivotally mounted on opposite ends of the shaft 13 inside of the brackets 8 and 9. A pair of rearwardly extending bars 15 are fixed to the rear sides of the members 14 adjacent the upper ends thereof and are interconnected adjacent their rear ends by means of a transverse plate 16 which is fixed thereto.

A pair of forwardly projecting rods 17 are fixed to the forward faces of the members 14 above the centerline of shaft 13 and have a transversely extending backing support means 18 mounted thereto. Such support 18 mounts an upper backing member 19 therein and the support means and the backing member 19 will be described in detail hereinafter.

The structure comprising the member 14 and the rods 15 and 17 may be formed of a single sheet metal stamping, if desired.

The lower polishing head comprises a pair of mounting members 20 which are pivotally mounted to the shaft 13 inside the mounting members 14 and end collars 21 are then secured on the shafts 13 to hold the members 14 and 20 in proper axial position on the shaft 13.

A pair of rearwardly extending rods 22 are fixed to the rear faces of the members 20 and extend rearwardly therefrom where they are interconnected by a transversely extending plate 23 which is disposed under the plate 16, the rods 15 and 22 being of the same effective length from the center of shaft 13.

A pair of forwardly extending rods 24 are fixed to the forward faces of members 20 and a transversely extending support 25, for supporting a backing member, is fixed to the forward ends of the rods 24.

The structure comprising the member 20 and the rods 22 and 24 may also be formed of a single sheet metal stamping, if desired.

A backing means 25, which is similar to the backing

member 18 except that it is inverted, is mounted on the forward ends of rods 24.

A lower backing member 35 which is similar and complementary to 19 is mounted within the holder or support 25. Each of such backing members 19 and 35 comprise an outer portion 36 formed of a relatively soft rubber of approximately 60 to 65 Shore durometer and an inner backing portion 37 formed of a rubber of a harder degree of hardness than the portion 36 and being of approximately 100 Shore durometer. The portion 36 is an integral part of the portion 19 and is intimately joined thereto by vulcanizing, for example.

The members 19 and 35 are adapted to either directly engage the opposite surfaces of a blade 38 to be polished or are adapted to back strips of a coated abrasive to hold such abrasive against the blade 38 during the polishing operation.

The machine of the present invention is particularly adapted for polishing impeller blades of the jet engine type, and it will be appreciated that such blades are transversely curved on both sides and are twisted longitudinally. The blade 38 to be polished may be held in a suitable holder or fixture 40 and is preferably held therein so that it may rotate about its longitudinal axis during the relative reciprocation of the blade with respect to the backing members. It will be noticed that the blade 38 terminates adjacent its end in curved portions 39, and it will be appreciated that such curved portions 39 must also be polished to the same preciseness as the remaining portions of the blade over its length. The machine of the present invention is designed so that such curved portions 39 will be polished by machine as well as the remaining portions of the blade.

As shown in Figs. 6 to 10, the outer portion 37 is formed, as indicated at 41 and 42, so that such facing surfaces of the outer portions 36 are complementary to the transverse contours of the blade 38.

The leading or forward edge of each portion 36 and 37 is formed at the juncture with a transverse recess 43 in the forward face and behind the leading edge so as to provide a resilient lip thereacross. As the backing members approach and bear against or over the curved portions 39 of the blade, the resilient lips will give, so that the contour of the blade in that curved portion may be properly followed and the polishing action will take place.

As mentioned above, strips 45 of coated abrasive are disposed on the heads 10 and 11 and are passed around the faces of backing portions 36 so that such abrasive strips are held against the blade 38 during the polishing operation. Such strips will conform to the contours of members 36 and in turn conform to the contours of the blade to be polished.

The abrasive strips are trained about suitable guide rollers and mechanism may be provided for automatically moving such strips so as to advance abrading surfaces as the strips wear. However, such supporting and feeding mechanism does not form a part of the present invention and for an understanding of the present invention is is merely necessary to understand that such strips are suitably mounted in the position shown.

In the embodiment illustrated, the heads 10 and 11 are pivoted about shaft 13 in order to bring the backing members 19 and 35 and the abrasive strips 45 into proper engagement with the surfaces of the blade 38 or to move such heads away from each other in order to release the backing members from such engagement. Such pivotal movement of the upper and lower heads is accomplished by means of a piston and cylinder assembly 46. The lower end of the cylinder 46 is pivotally connected to a bracket mounted to the transverse member 23 of the lower head 11 and the upper end of the piston rod is pivotally connected to a bracket on the transverse member 16 of the upper head 10. Suitable means are provided for introducing and exhausting motive fluid in opposite ends of the cylinder in order to effect a reciprocation of the piston rod.

The supporting means 18 and 25 for the backing members 19 and 35, respectively, are similar to each other and are mounted adjacent the forward ends of heads 10 and 11, respectively. Such mounting means include a transversely extending plate 50 which is mounted on and secured to flats formed on the ends of the rods 17 and 24. A plate 51 is mounted on the plate 50 substantially centrally between the ends thereof for pivotal movement thereon by means of a pivot pin 52 which extends through an opening 53 in plate 51 and into an opening 54 in plate 50. The plate 51 is formed with an upstanding flange 55 at the front thereof and an upstanding flange 56 across the rear thereof. A clamping plate 57 disposed between the flanges 55 and 56 is urged toward the flange 55 by means of a set screw 58 which is threaded into a tapped opening 59 in the flange 56 and which abuts against the rear face of the clamping bar 57.

The facing edges of the clamping bar 57 and the flange 55 may be tapered and the corresponding edges of the backing members may be correspondingly tapered so that when the backing members are in the clamped position shown in Fig. 2 they will be locked or dove tailed against outward movement.

The pivotal mounting of the plate 55 permits pivoting of the backing member as the polishing heads are reciprocated relative to the blade so that the backing members may follow the contour of the blade during such reciprocation.

Reciprocation of the carriage 3 is effected by a crank mechanism, and, referring to Figs. 1, 3 and 5, such mechanism comprises a crank arm 60 which is pivotally connected to the carriage 3 by means of a pivot pin and bearing 61, and pivotally connected at its opposite end to a pivot pin and bearing assembly 62. The pivot pin 61 is mounted on an eccentric 63 and may be adjustably mounted thereon through a slide plate 64. Pin 62 is a part of the slide plate 64 for movement therewith and the plate 64 is mounted within guide slots 65 forming the eccentric 63. Adjusting screw 66 is connected to the slide plate and is mounted in a bracket 67 on the eccentric so that by adjusting the screw 66, the center of the pin 62 may be varied to adjust the throw of the crank arm 60 and thus adjust the movement of the carriage 3. The eccentric 63 includes a counterweight 68 which functions to provide a smooth rotative action as the carriage is reciprocated.

The eccentric 63 is connected to a rotating shaft 69 and the eccentric 63 is mounted to the standard 1 by means of a mounting bracket 70. The shaft 69 is also mounted in the bracket 70 adjacent the upper end thereof and is mounted in a steady bracket 71 adjacent the lower end thereof. A pulley 72 is fixed to the lower end of the shaft 69 and is connected through V-belts 73 with a pulley 74. The pulley 74 is mounted on motor shaft 75 of motor 76 which is mounted on the standard 1 as shown in Fig. 1. The pulleys 72 and 74 are of such relative sizes as to provide a speed reduction between the motor 76 and the shaft 69. If desired, a speed reducer could be employed.

It will be appreciated that upon actuation of motor 76, the shaft 69 is rotated to effect rotation of the eccentric 63 and the crank arm 60 to cause reciprocation of the carriage 3 together with the polishing heads mounted thereon.

In the embodiment so far described, the composite backing members 19 and 25 are formed as described above and are employed with the abrasive strips 45. As a modification of the above construction, the strips 45 may be dispensed with and the softer rubber portion 36 instead of being of plain rubber may have impregnated and bonded therein and uniformly disposed therethrough an abrasive material. In this event, the softer rubber having the abrasive therein directly engages the propeller blade and effects the polishing action without the strips 45.

Another embodiment of the invention is illustrated in Figs. 11 and 12. In this embodiment, backing members generally indicated at 80 and 81 are employed which correspond to the backing members 19 and 26. The backing members 80 and 81 are similar to each other except that the engaging surfaces are reversely faced to correspond to the adjacent sides of the blade 38. The backing members 80 and 81 comprise an outer metal shell 82 within which a relatively soft rubber member 83 of, for example, 30 Shore durometer is disposed. A relatively harder rubber element 84 of, for example, 90–100 Shore durometer is fixed to the outer face of the backing member 83, the members 84 and 83 having adjoining faces formed with transverse contours substantially the same as the facing side of the blade 38. The exposed face of the element 84 also has a transverse shape substantially that of the facing side of the blade 38.

The backing elements 84 project beyond the edges of the shell 82 as shown in Figs. 11 and 12.

The relatively softer rubber **83** provides, in effect, a floating mount for the harder rubber elements **84**. The elements **84** are preferably formed with an impregnated bonded abrasive material uniformly disposed therethrough. The blade is thus directly engaged by the elements **84** and as the polishing head is reciprocated relative to the blade with the casings **82**, mounted in the polishing heads in a manner similar to that described above, the two elements **84** will be held against the blade by their resilient backing elements **83** but the harder rubber parts may give against the action of the softer backing members so that the contours of the blade will be followed during reciprocation.

In the embodiments described above, the upper and lower polishing heads are pivoted about the pivot shaft **13** through the action of the piston and cylinder assembly **46** to move and clamp the backing members against the opposite sides of the blade or to move the backing members away from engagement with the blade. Struts **90** and **91** are pivotally connected at their outer ends to the rear ends of the upper and lower heads and the inner ends are pivotally connected to a pin which is adapted to be moved into the spaced openings **92** and **93** of the fixed bracket **94** in order to hold the backing members in the positions desired. Suitable timing mechanism may be provided so that the backing members are moved apart for the insertion of the blade, then moved to clamping position during the reciprocation of the carriage for polishing the blade.

Formal changes may be made in the specific embodiments of the invention described without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and having one of the transverse edges thereof shaped to provide a resilient lip thereacross, said outer portion being formed of a rubber of one hardness, and an inner portion backing said first portion and integral therewith and formed of a rubber of a harder degree of hardness.

2. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and having one of the transverse faces thereof provided with a relief thereacross and shaped to provide a resilient lip thereacross, said outer portion being formed of a rubber of one hardness, and an inner portion backing said first portion and integral therewith and formed of a rubber of a harder degree of hardness.

3. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of one hardness impregnated with a bonded abrasive mineral and an inner portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness.

4. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the

blade to be polished and being formed of a rubber of one hardness impregnated with a bonded abrasive mineral and an inner portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness, a casing supporting said portions, and the construction of said portions being such that said outer portion may bodily move with respect to the casing against the resilient support of the inner backing portion.

5. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of a hardness of approximately 95–100 Shore durometer impregnated with a bonded abrasive mineral and an inner portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness of approximately 30 Shore durometer, a casing supporting said portions, and the construction of said portions being such that said outer portion may bodily move with respect to the casing against the resilient support of the inner backing portion.

6. In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of one hardness and an inner portion backing said first portion and integral therewith and formed of a rubber of a harder degree of hardness, and a strip of coated abrasive mounted on said carriage and disposed around and against the face of the outer portion of each backing member.

7. A backing member for use on a blade polishing machine comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of one hardness impregnated with a bonded abrasive mineral and another portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness, a casing supporting said portions, and the construction of said portions being such that said outer portion may bodily move with respect to the casing against the resilient support of the inner backing portion.

8. A backing member for use on a blade polishing machine comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of a hardness of approximately 95–100 Shore durometer impregnated with a bonded abrasive mineral and another portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness of approximately 30 Shore durometer, a casing supporting said portions, and the construction of said portions being such that said outer portion may bodily move with respect to the casing against the resilient support of the inner backing portion.

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