Feb. 16, 1965 W. E. BECKER 3,169,265

COMPOSITE RESILIENT POLISHING PAD AND METHOD FOR MAKING SAME

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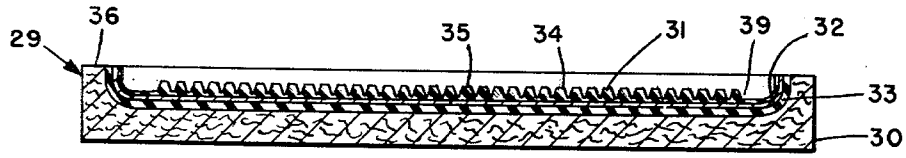


Fig. 1.

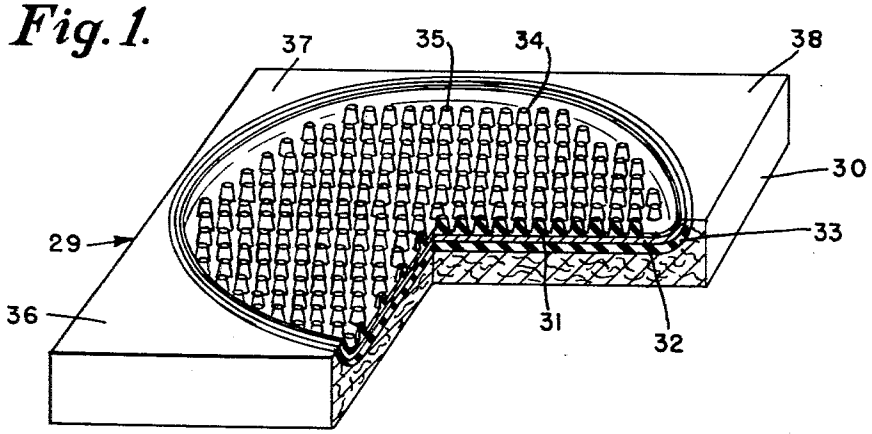


Fig. 2.

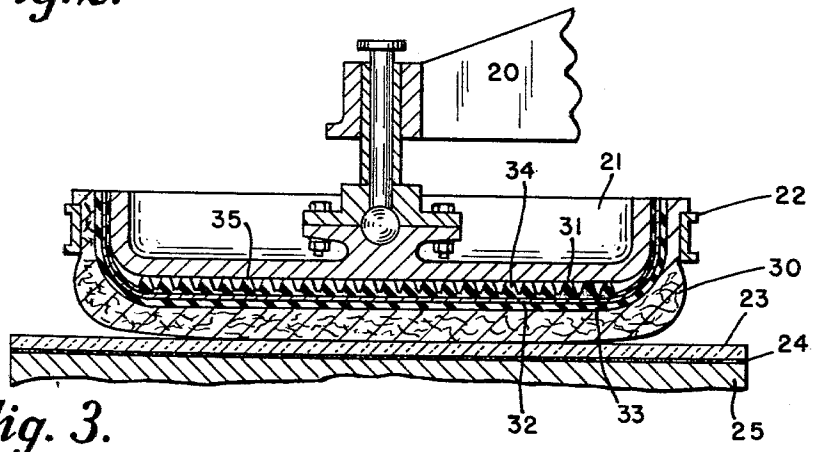


Fig. 3.

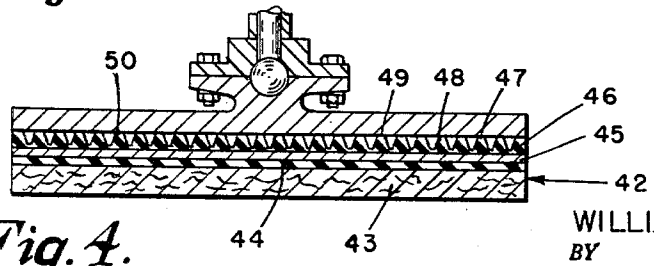


Fig. 4.

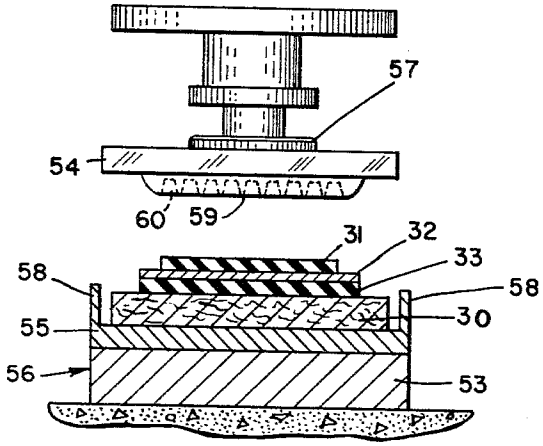
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Fig. 5.



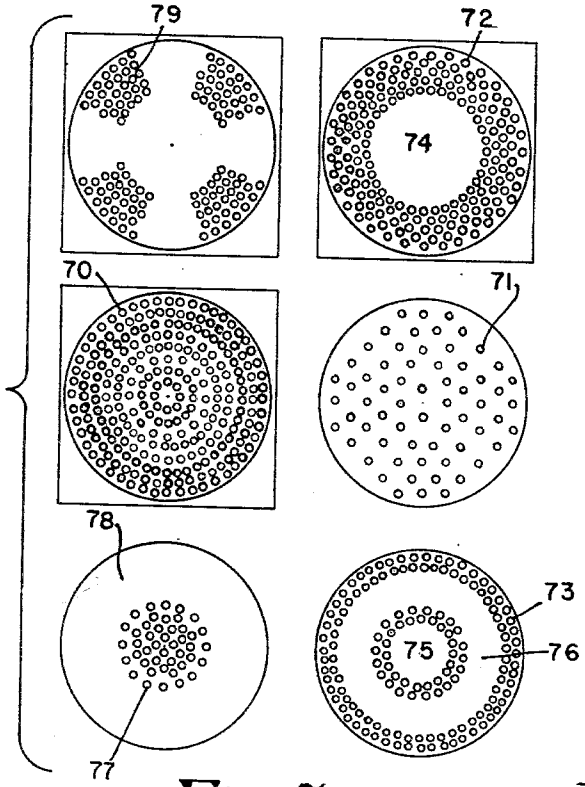


Fig. 7.

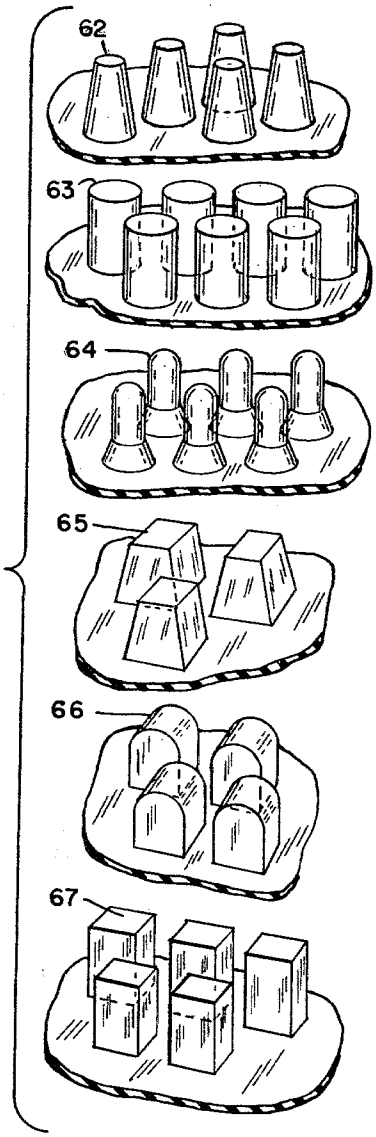


Fig. 6.

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COMPOSITE RESILIENT POLISHING PAD AND METHOD FOR MAKING SAME

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15 Claims. (Cl. 15—230.19)

This invention relates to an improved polishing member of the type used in polishing the surfaces of plate glass, marble and other large plane hard surfaces.

In the plate glass industry large sheets of glass, usually cut to convenient sizes, are both ground and polished using mechanical methods, which are quite similar. The unfinished plates are conveyed horizontally between rotatable grinding and polishing units, which are positioned parallel to the glass surfaces so that both faces of the glass are worked on simultaneously. The surfaces of the polishing units are faced with felt. Another method of grinding and polishing employs a system of flat bed conveyors, which hold and carry the precut glass sheets horizontally under the grinding and polishing units. The polishing units consist of a cluster of rotatable polishing blocks, which have been faced with felt.

In both systems the polishing felt, which is customarily either round or square, may be secured to the metal polishing block, either by a mechanical locking device, or by cementing the felt in place with a suitable adhesive. It is the function of the polishing felt to efficiently hold the polishing particles in an ever-changing working position; to act as an immediate reservoir of polishing slurry, to gradually wear away constantly exposing a new felt-slurry surface to the glass and to act as a resilient member between the hard surface of the metal block and the solid glass surface.

As was disclosed in my Patent 3,013,366 of December 19, 1961, entitled Composite Polishing Member and Method for Making Same, a strong fabric has been adhesively united to the felt. This reinforcement has appreciably added to the total wear life of polishing felt and has allowed the felt to be worn completely through to the reinforcing fabric. It has been found that polishing felts having little or no remaining felt thickness also lack the natural resiliency of a felt with substantial remaining thickness and, therefore, will not function efficiently.

During the cooling phase of the manufacture of sheet and plate glass thermal stresses are established, which tend to distort the plane surfaces of the glass. It is one of the purposes of grinding and polishing to relieve these distortional stresses and to produce plane and parallel surfaces. Occasionally some slight distortions will remain through to the polishing phase. It is on these occasions that the resilient nature of the polishing felt is called on to reach down into the gentle and minute slope of the distortion and polish. Should the felt be too thin and lack resiliency, it will not have the ability to exert pressure uniformly over the entire glass surface, resulting in streaks and areas of unequal polish. Plate glass distortion can also be caused by uneven plaster on the bed, or uneven conveyor bed wear.

It is also well known that polishing felt, which has been exposed to the environmental conditions of the polishing action for extended periods of time tends to become hardened and over-impregnated with polishing slurry and other contaminates. As this conditions occurs, in addition to the gradual decrease in operating thickness of the felt, the polishing felt takes on a more rigid and non-resilient character. It is this hard plane surface of the polishing felt, which fails to exert uniform pressure as it passes over relatively broad stress depressions, resulting in a poorly polished surface.

The object of this invention is to provide an improved composite polishing felt, which will exhibit uniform resiliency characteristics throughout its entire operating life.

Another object of this invention is to provide a single composite polishing unit, wherein the felt polishing face is permanently united with and molded to a novel resilient backing.

Still another object of this invention is to provide a plate glass polishing felt, which has improved vertical polishing characteristics and which resists cyclic fatigue failure.

Another object of this invention is to provide a square polishing unit, having a preformed shallow recess in the rear face thereof to receive a circular polishing block and also having spaced protrusions in the rear face to serve as a uniform, resilient cushion between the planar polishing block and the polishing felt.

A further object of the invention is to provide a rapid, low cost means and method for exactly aligning the polishing unit to the polishing block, thereby insuring uniform operating characteristics.

Another object of the invention is to provide a polishing unit with an integral, soft rubber backing of novel design for exerting uniform resilience and pressure throughout its operating life, thereby insuring more consistent take-up and distribution of polishing slurry.

Another object of the invention is to provide an efficient method of fabricating in a single operation a unitary, composite plate glass polishing pad of square configuration, which has a permanently molded three-dimensional back including a circular block-receiving recess and a planar felt face.

Additional objects and advantages of the method of making the composite polishing felt of the invention and the improved polishing unit will be apparent from the claims and description of the drawing and from the drawing in which:

FIG. 1 is an elevation in section through the center of a composite polishing pad constructed in accordance with this invention.

FIG. 2 is a perspective view of a square composite polishing pad having a 90 degree segment removed, showing the laminated structure of the pad of this invention.

FIG. 3 is a fragmentary side elevation in section, showing a square composite polishing pad of this invention clamped by its corners to the polishing block.

FIG. 4 is a view similar to FIG. 3 showing a circular pad of the invention adhered to a polishing block.

FIG. 5 is a diagrammatic fragmentary side elevation showing the pressing, heating, molding and curing steps of the method of this invention to form a cushioned composite polishing member.

FIG. 6 is a perspective side view on an enlarged scale showing the preferred truncated, conical design for the protrusions on the rear face or cushion face, of the composite polishing pad and other possible designs.

FIG. 7 is a diagrammatic top view on a smaller scale, showing six different designs of the molded juxtapositioned cushioning protrusions of this invention. Three square polishing felts and three round polishing felts are illustrated and it is not intended that any one design be confined to either square or round polishing pads.

As shown in FIG. 3 a polishing machine conventionally includes a plurality of large rotating polishing spindles, such as partially shown by **20** which carries the freely rotating polishing blocks **21** on each spider or spindle. There may be two to twelve such blocks passing over and pressing on the surface of the glass **23**. The sheet of glass is held in place with quick setting calcium sulfate **24**, or other material which exhibits both a soft character and a high co-efficient of friction. The glass is transported beneath the plurality of polishing blocks by a suitable table **25** on tracks, not shown.

Other polishing systems provide for the ground glass to pass between two opposed polishing blocks, which are faced with polishing pads. Pressure, motion, and polishing slurry are introduced to the two glass surfaces through the oppositely reacting polishing pads.

In both of the above systems it is important that the polishing pads maintain uniform resiliency characteristics throughout their entire operating life.

In this invention consistent resiliency in the polishing unit, or pad, is accomplished by permanently bonding to and molding into the back of a conventional polishing felt, such as disclosed in my said Patent No. 3,013,366, a resilient rubber cushion of novel design.

In FIG. 1 the composite polishing pad **29** is shown to include the felt polish pad **30** bonded to a reinforcing fabric **32** by means of a cured rubber sheeting **33**. Permanently bonded to the fabric **32** is a molded rubber three-dimensional cushioning layer or backing **31**. The felt layer **30**, which is preferably formed of felted cattle, wool and goat hair, is precut to fit the size of the polishing block **21** and may be square, oblong or round in shape. The thickness of the felted layer **30** may vary from ¾ inch to 3 inches depending upon the physical vertical limitations of the polishing machines.

The intermediate layer **33** of sheet rubber is formed by precutting to suitable dimensions and is coextensive with layers **30** and **32**. The layer **33** is relatively thin and is preferable between .03 and .06 in. thickness. The intermediate rubber layer **33** is continuous and impervious in order that it may serve as an impermeable moisture barrier between the slurry saturated lower felt layer **30** and the intermediate fabric layer **32** and the resilient cushion or backing **31**. The rubber layer **33** is partially cured and requires further heat curing to obtain complete vulcanization and stability.

The intermediate layer **32** is of strong fabric, which is precut and coextensive with the lower felt layer **30** and the rubber bonding layer **33**. Layer **32** may be canvas, woven metal cloth or the like, whose strands may be cotton, jute, wool, or man made fibers or combinations thereof. While a non-woven strong fabric with reinforcing resins may be used as layer **32**, a woven material has been found to be more resistant to the operational stresses.

The three-dimensional top backing layer **31** is composed of molded rubber similar in composition to layer **33**, but preferably of a somewhat less hardness in order to obtain best felt-like resiliency. A soft uncured rubber which will have an ultimate Durometer of about 50 is preferred for layer **31**.

Layer **31** is precut from semi-cured or uncured rubber sheet material and is permanently bonded to intermediate fabric layer **32**. The molded area is coextensive with the area of the polishing block **21** and forms a shallow recess **39**, ¼ to ⅜ inch of uniform depth for partially receiving block **21**. However because of the novel pattern of spaced protrusions **34**, layer **31** contacts the polishing block only at the plurality of raised blunt tips **35**. It is the resilient nature and relative low density of protrusions **34** which provide for a more aggressive and active polishing surface as the felt **30** naturally decreases in thickness due to wear.

In FIG. 2 the cushioning layer or backing **31** can be seen to be coextensive with the area of the polishing block and to be so molded as to fit snugly over the polishing block, thus permitting positive indexing of the entire polishing unit to the block. The height of the protrusions **34** may vary according to strength and resiliency required, but the tooth-like protrusions **34** generally have their blunt tips **35** located in a plane slightly lower than the plane of the tops of the four outside corners such as **36**, **37** and **38** of felt unit **30**.

In FIG. 3 a molded, cushion backed felt **30** with the rubber layers **31** and **33** and fabric layer **22** can be seen to be mechanically attached to the polishing block **21** by means of a metal retaining ring **22**. The entire unit is mounted through a free-turning and a self-aligning bearing to the larger, power-driven spider **20**. As a polishing felt **30** passes over the surface of the unpolished glass **23**, the interfacial friction between felt **30** and glass **23** causes an induced rotation of the polishing unit.

Frequently, there can be either a thermal distortion in the glass **23**, or an uneven laying of the plaster layer **24**, which is used to hold the plate glass **23** to the transporting bed **25**, or uneven wearing of the surface of the metal transporting bed **25**. All of these can cause areas where the pressure between the polishing felt **30** and the glass surface **23** is non-uniform. Normally, the natural resiliency of the felt **30** will be sufficient to compensate for the uneven surface of the glass **23** and will exert equal pressure over the entire felt surface **30**, regardless of the slight distortion of the glass surface **23**. As the thickness of the felt **30** wears, its "responsiveness to" the depressed areas of the distorted glass also decreases. This lack of natural resiliency of a worn felt **30**, however, is compensated for in my invention by the built-in cushion effect of the integral resilient rubber layer **31**. An advantage of this type of construction is that the polishing unit is a composite unit and is ready for use. No construction of a unit is required by the operator at the time of application to the block **21** and the polishing unit is completely disposable after a single use. No attention or inspection after use of the cushion is required, as is the case of a separate interlay unit. In addition, exact alignment of the cushioning layer **31** is assured at the time of application by the fact that the sqaure felt unit is precisely molded to the shape of the polishing block **21** and the layer **31** is part of the whole member.

In FIGURE 4 a composite polishing pad **42** is illustrated which is substantially identical with composite pad **29** except that it is of circular configuration rather than of square configuration and, while molded and compressed in the same manner, no shallow recess **39** is provided for partially receiving the block **21**. The felt layer **43**, impermeable intermediate cured rubber layer **44** and reinforcing intermediate fabric layer **45** are all similar to the corresponding layers **30**, **33** and **32** of laminated pad **29**. The backing sheet, or backing layer, **46** corresponds to cushioning backing layer **31**, and the blunt tips **47** of the pattern of protrusions **48**, are firmly secured to the front, planar face **49** of block **21** by a layer of suitable adhesive **50**.

In FIGURE 5 the single operation of laminating and molding the unit is illustrated. The felt layer **30**, an uncured rubber layer **33**, a strong reinforcing fabric layer **32**, all the foregoing coextensive in area, and an uncured rubber layer **31** coextensive and aligned with the metal mold **59** are all placed between the steam heated platens **54** and **55** of an hydraulic press **56**. In operation the ram **57** of the hydraulic press **56** is activated, closing the platens **54** and **55** to the metal stops **58**, whose gauge determines the finished thickness of the composite polishing unit. Best results are obtained by using a dwell time of 30 min., a pressure of 50 p.s.i. on the composite polishing unit and a platen temperature of 230° F. During the 30 minute dwell time the rubber layer **33** is heat-cured permanently bonding the felt layer **30** to the reinforcing fabric layer **32**. The mold layer **31** is permanently bonded through curing to the reinforcing fabric layer **32** and is molded into the shape of the metal die mold **59**. The outer face **59** of the die mold is designed to duplicate the shape of the specific polishing block for which the laminated unit is intended to form a shallow recess such as **39** in the cushionnig layer **31**. The inner cavities **60** of the mold **53** are designed to cause the rubber of layer **31** to flow into and be molded into the protrusions **34** having maximum resiliency and strength.

The uncured rubber layers **31** and **33** may be of the type commercially available as stock No. 50 of New Jersey Rubber Company of Taunton, Massachusetts.

Preferable thickness is .03 to .05 in. for the layer 33 and the thickness of the layer 31 will be dependent upon the cavity volume of metal die mold 37.

The reinforcing fabric layer 32 may be of the standard 12 oz. cotton duck type, which is commercially available and common in the cotton textile trade.

It is necessary to machine the die to have a cavity design, which will exactly duplicate the protrusion design. It is the function of the protrusions to provide maximum resiliency between the polishing block and the back of the felt. Further important considerations are the strength and fatigue resistance of the protrusions. The above factors must all be taken into consideration when the protrusion design is established.

As shown in FIGURE 6 the preferred shape of the protrusions, especially in the mechanically attached square pads such as illustrated at 29, is truncated conical with the height one and one half times the base diameter. For example, the type shown at 62 in FIGURE 6 have a one quarter inch base, a three eighths inch height and a preferred density of the blunt tips of three eighths inch staggered centers. The protrusions may, however, be cylindrical, as at 63, combined conical, rounded and cylindrical, as at 64, truncated pyramidal, as at 65, rounded as at 66 or cubical as at 67 as shown in descending order in FIGURE 6. It will be understood that sufficient space is provided around each individual protrusion 34 so that it may be omnidirectionally deformed and so that each protrusion has its own inherent resiliency and cushioning effect independent of the adjacent protrusions. For those plate glass polishing units which are adhesively bonded to the polishing block, it has been found best to use a protrusion design which provides blunt tips 35 of maximum area, such as the cubical or cylindrical types of FIGURE 5.

FIGURE 7 shows six of some of the many patterns of the protrusions, which are possible with my invention. The number, concentration and pattern of the protrusion are dependent upon the actual size of the individual tips and the load that each tip will carry.

Pattern design is also dependent upon the location and type of distortion that is to be found in the glass surface, upon the operating position along the length of the polishing line, upon the amount of unsupported travel over the lengthwise edge of the glass surface, upon the type of attachment used, whether adhesive or mechanical, and upon the operating characteristics of the felt itself.

The overall uniform distribution patterns of protrusions shown at 70 and 71 are preferred for the reason that generally uniform, consistent, resiliency and exertion of pressure is desired over the entire polishing block. However, as indicated, the annular patterns 72 and 73 may be desirable to provide central circular areas 74 and 75 or annular areas 76 which are free of protrusions. Similarly where central wear is likely, a circular pattern 77, surrounded by an annular area 78, free of protrusions may prove useful. Protrusions in the pattern of an interrupted annulus as at 79 have been found to be desirable.

The low density and independent resiliency of the multiplicity of individual protrusions, and the fact that the protrusions extend outwardly from the rear face of the backing toward the front, or adjacent face of the block are of great importance in this invention. It has been found that waffle designs, grid designs, concentric rib designs and the like are too inflexible to approximate the resiliency of the felt of the pad. Similarly inflated tubular cushions, air cell type cushions and the like are subject to blow-outs and to variations in resiliency due to change in temperature of entrapped air. The front face of the backing layer disclosed herein is firmly anchored to the polishing felt means and it is the resilient toothed rear face of the backing which engages the block and provides a supplement to natural felt resiliency.

Thus the composite polishing pad of this invention comprises polishing felt means including a thick felt layer operating as a polishing tool and a reinforcing fabric layer

supplying physical stamina plus a rear-toothed rubber cushion which supplies added resiliency and action.

I claim:

1. In combination with a glass polishing block having a front fame, a composite, unitary polishing pad, detachably mounted on said front face, said pad comprising:

a resilient backing having a front face and a rear face, said rear face having a low density pattern of integral, outwardly extending, individual, resilient, substantially identical tooth-like protrusions each spaced from the other and deformable omnidirectionally and all having tips engaging, and uniformly spacing said backing from, the said front face of said block and,

polishing felt means, including a thick pad of polishing felt fibers backed by, and bonded to, a layer of strong reinforcing fabric, said fabric being bonded to the front face of said resilient backing to form said composite polishing pad.

2. A polishing pad as specified in claim 1 wherein said protrusions are truncated cones, each having a height approximately equal to one and one half times the diameter of its base and said pattern is co-extensive in area with a substantial portion of the area of the front face of said block.

3. A polishing pad as specified in claim 1 wherein said resilient backing is of soft rubber about durometer 50, said protrusions are truncated cones and the tips of said cones are spaced apart a predetermined uniform distance approximately equal to the height thereof from centre to centre.

4. A polishing pad as specified in claim 1 wherein said pattern of protrusions substantially uniformly covers an area coextensive with the area of the front face of said block for providing uniform resiliency thereover.

5. A polishing pad as specified in claim 1 wherein said pattern of protrusions includes at least one area covered by said low density protrusions and at least one area free of said protrusions for controlling the pressure transmitted by said backing.

6. A polishing pad as specified in claim 1 wherein said pattern of protrusions is in the form of an interrupted annular area, the central portion thereof being free of said protrusions.

7. In combination with a glass polishing block having a polishing felt thereon, a sheet of resilient rubber-like material interposed between said block and felt, said resilient sheet having the face thereof adjacent said felt firmly united thereto and having a multiplicity of integral, individual, resilient, substantially identical tooth-like protrusions uniformly spaced apart in a predetermined pattern on the face thereof adjacent said block, each said protrusion extending outwardly from said face, having its tip in contact with the face of said block and being deformable independently of adjacent protrusions for equalizing polishing pressure as said felt wears down.

8. A combination as specified in claim 7 wherein said polishing felt is compacted in the central portion thereof said central compacted portion forming a recess for partially receiving said block and wherein the protrusions on said sheet are substantially equal in height to the depth of said recess.

9. A composite polishing pad for a polishing block of a plate glass polishing machine and the like, said pad having successive layers comprising a relatively thick felt, a thin impermeable cured rubber bonding sheet, a reinforcing woven fabric and a resilient cured rubber backing having a plurality of individual, identical, outwardly extending protrusions thereon, said felt, rubber sheet, woven fabric, and resilient backing being adhesively united into a composite integral polishing member by means of said cured rubber.

10. An improved plate glass polishing member, for use with a polishing block comprising a felt polishing pad firmly adhered to and united with a fabric lamination,

the fibres in said felt being compacted centrally thereof to form a recess in the rear, non-working face thereof and said fabric lamination being centrally shaped to conform to the configuration of said recess; and a molded rubber backing, said rubber backing having a front face adhered to said fabric lamination and having a rear face centrally shaped to conform to the configuration of said recess to receive the front face of the polishing block and said rear face of said backing having a three-dimensional resilient, deformable patterned surface thereon, consisting of a multiplicity of integral, outwardly extending tooth-like, independently deformable protrusions having spaced apart terminal tips in contact with the front face of said block.

11. A square plate glass polishing felt for attachment to the round polishing block of a polishing machine, said square felt forming an integral polishing unit including a thick pad of felt fibers, a thin intermediate layer of bonding rubber, an intermediate layer of strong reinforcing fabric and a resilient rubber backing, said backing having a round pattern, coextensive in area with the face of said polishing block, having a multiplicity of individual, integral, resilient teeth extending outwardly therefrom for engaging the face of said polishing block.

12. A round plate glass polishing felt for adhesive attachment to the polishing block of a plate glass polishing machine, said felt being coextensive with the face of said polishing block and combined into an integral polishing unit, said unit including a thick pad of felt fibers, a thin intermediate layer of bonding rubber, an intermediate layer of strong reinforcing fabric and a resilient rubber backing having a multiplicity of individual, integral, resilient teeth extending outwardly therefrom.

13. A composite, laminated and unitary polishing member, comprising a lower layer of felt fibers, a middle layer of rubber and fabric reinforcement and a top layer of soft rubber, said top layer having a preformed recess for receiving a polishing block and uniformly spaced, integral resilient teeth in said recess for engaging the face of said polishing block.

14. The method of producing a unitary composite polishing member with an integral resilient backing for glass polishing machines, which comprises the steps of forming a lower layer of unpressed felt; an intermediate layer of thin impermeable, semi-cured sheet rubber; an intermediate layer of strong flexible fabric and an upper layer of thin, semi-cured sheet rubber and then simultaneously compressing said layers together, forcing said rubber layers into closer contact with said felt and fabric, molding the rubber of the upper layer into a pattern of outwardly extending, individual, identical spaced protrusions and heat vulcanizing said rubber at about 230° F. for about 30 minutes duration.

15. A composite pad for mounting on the face of a rigid support, said pad comprising:

a resilient backing of cured rubber having a front face and a rear face, said rear face having an integral, relatively low density pattern of individual, independent, resilient, substantially, identical tooth-like protrusions, each deformable omnidirectionally and each having a relatively blunt tip of substantial area in engagement with the face of said rigid support and spacing said backing from said support;

a strong, relatively thin, woven fabric lamination embedded in said backing, and

a relatively thick layer of felt fibers adhered to the front face of said backing.

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