Patented May 22, 1951

2,554,070

UNITED STATES PATENT OFFICE

2,554,070

METHOD OF FINISHING LENSES

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No Drawing. Application June 5, 1946, Serial No. 674,624

1 Claim. (Cl. 51—284)

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The principal objects of this invention are to provide a finishing compound which is capable of being used both for final grinding and for polishing the surfaces of lenses, particularly ophthalmic lenses, and to provide a method of finishing lenses employing such a finishing compound, whereby numerous operating economies are effected.

Other objects and advantages of the invention will become apparent from the following detailed description.

The long-established present practice of the optical industry in the manufacture of ophthalmic lenses, is to grind the lenses by means of tools called laps, usually made of cast iron. A series of grinding operations is performed on each lens, using successively finer abrasive material in each operation. The abrasive material is supplied in the form of abrasive grains suspended in a liquid vehicle which is usually water but may be oil or other suitable liquid suspending medium. This suspension of abrasive material is usually supplied to the work in a constant stream during the grinding operation, being re-circulated from a sump or the like into which it drains. The working surface of the lap becomes charged with abrasive grains which partially imbed themselves in the metal lap surface, whereby the lap becomes effective as a grinding tool.

It is customary to employ at least three and frequently four or five such grinding steps. For example, a relatively coarse abrasive grain, such as No. 80, may be used for the first or rough grinding step, succeeded perhaps by a somewhat finer grain such as No. 220, which is followed, either directly or after one or two grinding steps with still finer grain mixtures, by a final grinding with so-called "optical powder."

Optical powder (sometimes called "optical emery") is, as is well-known, a very fine abrasive material usually obtained by reclaiming abrasive material which has previously been used in a coarser lens grinding operation, the reclaiming being done by classifying the used abrasive material by a process involving washing and settling in water. Optical powder usually has as its base either silicon carbide abrasive grain or fused alumina abrasive grain, and may contain small particles of iron and glass resulting from the previous coarse grinding operations. Silicon carbide and fused alumina are not usually employed together in lens grinding because of their different characteristics, and optical powder therefore usually has as a base either one or the other. Instead of such reclaiming, some optical powders

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are made by employing fresh silicon carbide or fused alumina abrasive grain of comparable fineness. Natural abrasives, such as emery or corundum, could also be employed in place of the synthetic abrasives mentioned, but are comparatively seldom used in present practice. The particle size of the abrasive grains of optical powder is generally in the range of 10 to 15 microns.

It is customary to exercise meticulous care between each grinding step in cleaning the lens, the lap, and the grinding machine. Unless this is done, particles of the coarser abrasive from the preceding step will be present during the next finer grinding step, and will mar the results obtained.

After the final grinding with optical powder, and after another meticulous cleaning, it is customary to polish the lens. The abrasive material used during the polishing operation is much finer, having a particle size not substantially exceeding 5 microns, and is preferably softer than the abrasive materials used during the grinding operations. The abrasive materials commonly used for polishing are red rouge (iron oxide), cerium oxide and so-called white rouge (finely powdered silica), either alone or in admixture with each other or other constituents. Red rouge and white rouge commonly have particle sizes smaller than two microns, but, in the case of cerium oxide, considerably larger particles will polish effectively. Practically any metallic oxide, even alumina, has polishing properties if sufficiently finely divided, but the softer oxides give better results. I shall herein use the term polishing material as including any finely divided material suitable for polishing ophthalmic lenses and the like.

The polishing material is usually mixed with water, and may be applied to the work either by brushes or the like or in a constant stream flooding the work as is usually done in grinding. The polishing tool has a relatively soft surface, usually obtained by covering a cast iron lap with a non-abrasive polishing pad. This pad may be made of a soft textile material such as wool felt, or may be a coating of pitch, wax or resins applied to the lap working surface. The polishing material apparently does not function by reason of being imbedded in the surface of the polishing pad and pushed around by the pad, but apparently functions by being suspended in the water and forming a very thin film between the polishing pad and the lens being polished. This is believed to be true even in the case of the practice, which is sometimes followed, of incorpo-

rating the polishing material in the wax mixture, in which case a film of water containing only a small proportion of polishing material is introduced between the polishing tool and the lens.

It will be understood by those skilled in this art that in both grinding and polishing lenses, the tool and the lens are moved relatively to one another in a complicated and non-repetitious path, which path may be rotary or oscillatory or both, while the tool and the lens are pressed together under a regulated resilient pressure. Essentially the same type of machine, and very frequently the identical machine, is used both for grinding and polishing with, as stated above, careful cleaning between each of the various stages of treatment.

I have discovered that, by suitable choice of abrasive materials, the same abrasive compound may be used both for final grinding and for polishing. This permits these operations to be performed in the same machine with no cleaning in between, but merely the substitution of the polishing tool for the grinding tool or the covering of the grinding tool with a polishing pad. With the preferred forms of my finishing compound, the final grinding time and the polishing time required are strictly comparable to those required in present standard practice, resulting in a great saving of time in converting from the final grinding to the polishing operation, and resulting also, rather surprisingly, in a decided saving in the amount of abrasive material consumed during these final grinding and polishing operations. Essentially, my finishing compound consists of a mixture of optical powder and a lens polishing material such as above defined, preferably in the proportions of one part by weight of optical powder to two parts by weight of polishing material. As will be made clear hereinafter, other proportions may be employed in my finishing compound.

A composition according to this invention with which I have had particular success consists of the following, in parts by weight:

	Parts
Shuron 16–B Optical Powder	1
White Rouge	2

The finishing compound is mixed with water to form a suspension having a Baumé gravity of from 30 to 40. This suspension is equally effective when fed to the work by brush as when used in a continuous re-circulating stream, but, for convenience. I prefer the latter. The usual cast iron lap is used in grinding. I have found that the use of a felt pad gives better results in polishing, producing a higher lustre than can be obtained with pitch, wax or resin polishing pads, but the latter may be successfully employed where an especially high lustre is not required.

My finishing compound as described above will final grind lens surfaces from the condition in which they are left after using No. 220 abrasive grain in accordance with present standard practice. After the final grinding is completed, it is merely necessary to dry the lap, apply the felt pad, and proceed with the polishing operation. The grinding and polishing times required are substantially the same as those now required for the separate use of optical powder for final grinding and of white rouge for polishing. The cleaning time formerly required is saved, or, where different machines are employed for final grinding and for polishing, as is frequently now done, the time of cleaning and transferring the lens is saved. The same machine, the same operator, the same abrasive compound and the same set-up may be employed in performing final grinding and polishing in accordance with my method in what is practically one continuous operation. With automatic abrasive feeds, the same bowl or sump, and the same pump and circulating appliances may be used interchangeably and continuously for both final grinding and polishing. Moreover, as stated above, less abrasive material is required with my method than with the present practice, resulting in a substantial saving in this regard also.

I have found that as many as 20 lens surfaces may be final ground and polished using the same re-circulated suspension of my compound, before any perceptible lengthening of the grinding time is required to produce a satisfactory fine ground surface. Although the required grinding time thereafter becomes somewhat longer, the polishing time is not affected. I have therefore found it feasible to enrich or fortify the suspension after such use on 20 lenses, by adding a small additional quantity of optical powder. A satisfactory fortifying may be obtained by adding one-fourth as much Shuron 16–B optical powder to the suspension as it originally contained. Apparently, a certain proportion of the original optical powder is broken down during the grinding operations to such an extent that it becomes less effective for grinding but does not interfere with polishing, and may even be helpful in that operation. This fortifying should not be continued indefinitely, and, under ordinary shop conditions, it will probably be found preferable to discard the suspension entirely when its grinding efficiency has become perceptibly diminished, and substitute a fresh suspension.

I have developed a theory as to the operation of my finishing compound, which is presented herewith without limiting myself to it as being a correct explanation of what occurs. My theory is that during the grinding operation, the optical powder charges the cast iron working surface of the lap and acts in the usual manner to grind the lens surface. During this grinding operation, the white rouge or other polishing material remains in suspension in the water and forms a very thin film which does not interfere with the action of the coarser abrasive particles of the optical powder. During the polishing operation with a felt polishing pad, the coarser grains sink into the yielding felt, and hence are rendered ineffective, while the film of polishing material remains in place to perform its function. As the felt pad moves over the surface of the lens, the abrasive particles are continuously displaced from the felt and rejoin the main circulating stream. Those particles of abrasive grain which remain imbedded in the felt are of course lost to the re-circulating stream, and may account for some of the loss of optical powder during the repeated operations on a plurality of lenses. The reason that pitch, wax or resin polishing pads are not as satisfactory for use with my finishing compound as felt, is probably that, being harder, the abrasive particles imbedded in the pitch or like surface provide too vigorous action during the polishing operation, and thus prevent obtaining a high lustre.

As pointed out above, any other conventional or suitable polishing material, such as red rouge or cerium oxide, may be substituted for the white rouge. However, I prefer the latter because it is less expensive than cerium oxide and is less ob-

jectionable than red rouge from the standpoint of the operator.

In lieu of the proportions of optical powder and white rouge given above, other proportions may be employed. I have found a mixture of equal parts by weight to be entirely suitable. A mixture of 3 parts of optical powder and 1 part of white rouge by weight gives a high final grinding efficiency, but increases the time required to secure a desirable polish. On the whole, this mixture is not as good as one of 3 parts of white rouge and 1 part of optical powder, which gives a comparable final grinding time and a shorter polishing time than the reverse proportions. Although all of these various mixtures are usable, I prefer the proportion of two parts of white rouge to one part of optical powder first given, as this gives both a short final grinding time and a short polishing time.

I prefer to include in my finishing compound a small proportion of talc or chalk, say 5% of the total weight. This acts as a filler and a carrier for the other ingredients, being itself non-abrasive. I prefer also to add a trace of coloring material to give the mixture an attractive appearance, both in its dry form and when used as a suspension in water. If desired, the color of the suspension may readily be made to match fairly closely the color of the machines in which it is to be used, so as to give a neat appearance to the machine at all times.

Although I have thus described my invention in its preferred form, as required by the patent statutes, I desire to be limited only by the scope of the appended claim.

I claim:

The method of final grinding and polishing ophthalmic lenses and the like, which comprises

subjecting the lens to the grinding action of a lap tool having a metal working surface in the presence of an abrasive compound consisting essentially of optical powder consisting essentially of an abrasive material of the group consisting of silicon carbide, fused alumina, emery, corundum and mixtures thereof, having a particle size of approximately 10 to 15 microns, and a lens-polishing material of the group consisting of red iron oxide, cerium oxide, silica and mixtures thereof, having a particle size not substantially exceeding 5 microns, interrupting said grinding operation and applying felt over the lap working surface, and subjecting said lens to the polishing action of said felt in the presence of the same abrasive compound.

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