Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
The present invention relates to a method and apparatus of polishing end surfaces of rod-shaped members, which is suitable for polishing the respective end surfaces of a plurality of rod-shaped members at the same time, as per the preamble of claims 1 and 2. An example of such apparatus and method is disclosed by US 5 184 433 A.

For example, in the case where end surfaces of rod-shaped members such as ferrules with optical fibres are required to be finished into a desired shape by polishing the end surfaces, conventionally, as shown in Fig. 5, a large number of ferrules 102 with optical fibres are fixed to a periphery 101 of a regular polygonal holder 100 by suitable means while leaving a space between the ferrules, and a relative trochoid curvilinear motion is caused in the state that the respective tip ends of the ferrules 102 with optical fibres are pressed against a polishing disc 103 disposed opposite the holder 100, whereby the respective tip ends of the ferrules 102 with optical fibres are polished.

However, according to the conventional method as shown in Fig. 5, although end surfaces of a large number of rod-shaped members can be polished at the same time as shown in Fig. 6, only a specific portion near an outer circumference (indicated by oblique lines) of the polishing disc 103 is used, so that a large part of a polishing sheet is not used, thus the conventional method has a problem that an economical use of the polishing sheet cannot be attained.

US 5184433 discloses a method and apparatus of polishing the end of an optical fibre that produces relative lateral movement between the end of the fibre and an abrasive surface of the fibre in which the angle of attack of the relative movement is changed.

An object of the present invention is therefore to provide a method of polishing end surfaces of rod-shaped members in which the entire surface of a polishing sheet is uniformly used so that the lifetime of the polishing sheet can be elongated and running costs can be lowered.

According to a first aspect of the present invention, there is provided a method of polishing end surfaces of rod-shaped members as per claim 1.

According to a second aspect of the present invention, there is provided a polishing apparatus as per claim 2.

According to this method and apparatus, it is avoided that the regions on the polishing disc used by the respective rod-shaped members become quite identical to one another, so that almost all the surface of the polishing disc can be used.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying diagrammatic figures, in which:

Fig. 1 is a schematic structural view showing an example of a polishing apparatus for practising the method of the present invention;
Fig. 2 is a sectional view showing a polishing disc shown in Fig. 1;
Fig. 3 is an explanatory view for explaining an example of a method of mounting ferrules with optical fibres on a holder shown in Fig. 1;
Fig. 4 is a view showing loci drawn by the tip ends of the ferrules with optical fibres on the polishing disc in the case of the mounting method shown in Fig. 3;
Fig. 5 is a schematic structural view showing a conventional polishing apparatus;
Fig. 6 is a view for explaining the state of use of a polishing disc by the conventional polishing apparatus shown in Fig. 5.
optical fibres are positioned so that the respective distances L1, L2, ... between the ferrules and the centre point C of the holder 3 are made different from one another (see Fig. 3).

[0015] Thus, if the relative trochoid curvilinear motion is given between the polishing disc 2 and the holder 3 in the state that the respective tip ends of the ferrules 41 to 46 with optical fibres are pressed against the polishing sheet 23, there is generated a combined motion of rotating motion M1 with a centre axis of the polishing disc 2 as the centre and small circular motions M2 of the respective tip ends of the ferrules 41 to 46 with optical fibres. As a result, as shown in Fig. 4, on the polishing sheet 23 of the polishing disc 2, loci T1 to T6 drawn by the respective tip ends of the ferrules 41 to 46 with optical fibres do not overlap with one another, so that almost all the surface of the polishing sheet 23 can be used and the polishing sheet 23 can be extremely effectively used. Accordingly, the lifetime of the polishing sheet 23 can be greatly elongated as compared with the prior art, and the running costs can be greatly lowered.

[0016] In the above described example, there is exemplified the case in which a rectangular parallelepiped mounting block having a rectangular plane shape is used as the holder. However, it is apparent from the above description that the holder may be formed into any shape as long as a plurality of ferrules with optical fibres can be mounted thereon so that the distances between the respective ferrules and the centre of the polishing disc are different from one another. Accordingly, it is not necessarily required that the centre of the holder should coincide with the centre of the polishing disc. Further, in the example shown in Fig. 4, although the loci T1 to T6 do not overlap with one another, the method according to the present invention is not limited to this example, and the respective loci may partially overlap with one another as long as the distances between the respective rod-shaped members and the centre of the polishing disc are different from one another. Similarly, the rod shaped members could be arranged in groups having the same distance from the centre of the polishing disc with the distances of the respective groups being different such that although the loci of each group overlapped, the loci of different groups partially overlapped or did not overlap and almost all of the surface of the polishing sheet can be used.

[0017] According to the present invention, as described above, since the distances between the respective rod-shaped members and the centre of a polishing disc are made different from one another, it is possible to avoid that only a specific portion of the polishing disc is concentrically used. As a result, it is possible to use almost all the surface of the polishing disc, so that the lifetime of the polishing disc can be elongated and the running costs can be decreased.

[0018] The foregoing description has been given by way of example only.

Claims

1. A method of polishing end surfaces of rod-shaped members (41-46) comprising:

- mounting a plurality of the rod-shaped members on a holder (3); and
- causing a relative trochoid curvilinear motion between the holder (3) and a polishing disc (2) disposed opposite the holder (3) while respective tip ends of the rod-shaped members (41-46) are pressed against the polishing disc (2) so that the respective tip ends of the rod-shaped members are polished, characterised in that:

  - distances between a centre of the holder (3) and the respective rod-shaped members (41-46) are made different from one another; and (2) said relative trochoid curvilinear motion is caused by rotating the disc (2) and imparting a constant orbital motion to the center of the holder.

2. A polishing apparatus comprising:

- a holder (3) for mounting a plurality of rod-shaped members (41-46); and
- a polishing disc (2) disposed opposite the holder (3) and adapted for trochoid curvilinear motion relative to the holder (3) while respective tip ends of the rod-shaped members (41-46) are pressed against the polishing disc (2) for polishing the respective tip ends of the rod-shaped members, characterised in that:

  - the holder (3) is adapted for mounting the rod-shaped members (41-46) such that distances between a centre of the holder (3) and the respective rod-shaped members (41-46) are different from one another; and
  - the polishing disc (2) is adapted to be rotated and the center of the holder (3) is adapted to be moved with a constant orbital motion for causing said relative trochoid curvilinear motion.

Patentansprüche

1. Verfahren zum Polieren der Stirnflächen von stabförmigen Elementen (41-46), das umfaßt:

- Montieren mehrerer stabförmiger Elemente an einem Halter (3); und
- Bewirken einer relativen, trochoid-krummlini-
gen Bewegung zwischen dem Halter (3) und einer Polierscheibe (2), die gegenüberliegend dem Halter (3) angeordnet ist, während die entsprechenden Spitzen der stabförmigen Elemente (41-46) gegen die Polierscheibe (2) gedrückt werden, so daß die jeweiligen Spitzen der stabförmigen Elemente poliert werden; dadurch gekennzeichnet, daß die Abstände zwischen einer Mitte des Halters (3) und den jeweiligen stabförmigen Elementen (41-46) verschieden sind; und die relative, trochoid-krummlinige Bewegung hervorgerufen wird durch Drehen der Scheibe (2) und Beaufschlagen der Mitte des Halters mit einer konstanten kreisförmigen Bewegung.

2. Poliervorrichtung, die umfaßt:

einen Halter (3) zum Montieren mehrerer stabförmiger Elemente (41-46); und eine Polierscheibe (2), die dem Halter (3) gegenüberliegend angeordnet ist und konfiguriert ist für eine trochoid-krummlinige Bewegung relativ zum Halter (3), während die jeweiligen Spitzen der stabförmigen Elemente (41-46) gegen die Polierscheibe (2) gedrückt werden, um die jeweiligen Spitzen der stabförmigen Elemente zu polieren; dadurch gekennzeichnet, daß:

der Halter (3) dafür konfiguriert ist, die stabförmigen Elemente (41-46) so zu montieren, daß die Abstände zwischen einer Mitte des Halters (3) und den jeweiligen stabförmigen Elementen (41-46) voneinander verschieden sind; und die Polierscheibe (2) dafür konfiguriert ist daß sie gedreht wird, und die Mitte des Halters (3) dafür konfiguriert ist, daß sie mit einer konstanten kreisförmigen Bewegung bewegt wird, um die relative, trochoid-krummlinige Bewegung hervorzurufen.

Revendications

1. Procédé de polissage de surfaces d'extrémité d'éléments sous forme de tige (41 à 46) comprenant les étapes consistant à :

monter une pluralité d'éléments sous forme de tige sur un dispositif de maintien (3) ; et induire un mouvement curviligne trochoidal relatif entre le dispositif de maintien (3) et un disque de polissage (2) disposé opposé au dispositif de maintien (3) tandis que les extrémités de bout respectives des éléments sous forme de tige (41 à 46) sont pressées contre le disque de polissage (2) de sorte que les extrémités de bout respectives des éléments sous forme de tige sont polies, caractérisé en ce que :

les distances entre un centre du dispositif de maintien (3) et les éléments sous forme de tige respectifs (41 à 46) sont rendus différentes les unes des autres ; et ledit mouvement curviligne trochoidal relatif est induit en faisant tourner le disque (2) et en communiquant un mouvement orbital constant au centre du dispositif de maintien.

2. Appareil de polissage comprenant :

un dispositif de maintien (3) pour monter une pluralité d'éléments sous forme de tige (41 à 46) ; et un disque de polissage (2) disposé opposé au dispositif de maintien (3) et conçu pour un mouvement curviligne trochoidal relatif par rapport au dispositif de maintien (3) alors que les extrémités de bout respectives des éléments sous forme de tige (41 à 46) sont pressées contre le disque de polissage (2) pour polir les extrémités de bout respectives des éléments sous forme de tige, caractérisé en ce que :

le dispositif de maintien (3) est conçu pour monter les éléments sous forme de tige (41 à 46) de sorte que les distances entre un centre du dispositif de maintien (3) et les éléments sous forme de tige (41 à 46) respectifs sont différentes les unes des autres ; et le disque de polissage (2) est conçu pour être mis en rotation et le centre du dispositif de maintien (3) est conçu pour être déplacé selon un déplacement orbital constant pour induire ledit mouvement curviligne trochoidal relatif.
FIG. 5  PRIOR ART