



Robot polishing device

Robot Polishing machine



Patent title Large mirror polishing device capable of polishing curved surface

Inventor Korea Astronomy and Space Science Institute
/ Han Jeong-yeol, Nam Wook-won, Kim Young-soo, Na Ja-kyung, Kim Ji-heon

Patent application No. KR 10-2016-01418154(2016.10.28)/10-1893795(2018.08.27) **Authority status** Registered

Technicality

Technology overview

A robot polishing device is a device capable of simultaneously polishing large optical surfaces with free-curved surfaces. The device is a unique polishing tool using robots, magnetic fields, and remote control technologies so as to solve the problems of much consumption of prices, schedules, and manpower required due to the huge size of existing polishing equipment. The technology is economical and innovative in that when polishing large optical surfaces, a tool with the size of 1/5 to 1/10 the size of an optical surface can polish large or multiple optical surfaces compared to conventional polishing devices which are at least 3 to 5 times larger than the size of the optical surface.

Development background and problem to be solved

- Aspherical lenses having steep curvatures should be polished by using a very small tool. When polishing large curved, aspherical, or free-form mirrors other than general mirrors, it is difficult to control a polishing tool compared to flat mirrors.
- Therefore, there is a need for a polishing technology for improving the convenience of polishing large mirrors and shortening an operation time.

Excellence and discrimination of technology

Excellence of technology

- A technology which is small with the size of 1/5 to 1/10 the size of an optical surface but an polish large or multiple optical surfaces at once when polishing a large optical surface
- A technology in which a polishing device can perform polishing while moving on an optimal polishing path and moving on a mirror with a grinding head
- Convenience is improved as a polishing device autonomously tilts at a certain angle and polishes curved, aspherical, and free-form mirrors.
- Even an optical surface, such as a spherical or aspherical surface, having a large curvature change value can be polished and ground easily.
- A plurality of polishing robots move independently in respectively assigned areas at the same time, and it is possible to perform avoid moving at the same time of mirror polishing.

Discrimination of technology

- The volume of a polishing device is remarkably reduced by developing and applying a unique polishing tool control scheme using a polishing robot, a remote control, a magnetic field, and the like.
- Large-diameter optical surface polishing can be performed with multiple robots, and thus it is possible to greatly reduce a processing time.
- Manpower required for polishing is reduced due to an automatic control.



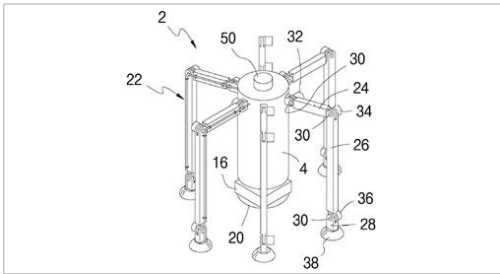
Robot polishing device

Robot Polishing machine

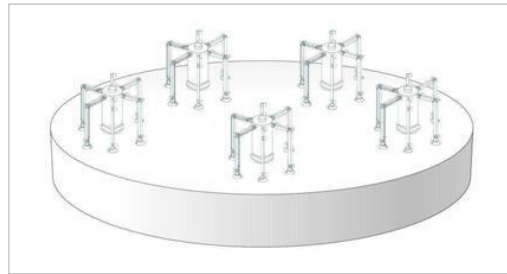
Implementation method

According to the present invention,

- included are a main body, a polishing head, a drive unit, a control unit (including an input unit, a memory unit, a command unit, and a communication unit), and a tilt adjustment unit.
- The robot foot of the drive unit is fixed on a mirror with a fixing force of a sucker unit, and the surface of an aspherical mirror is polished through the polishing head.
- The tilt is controlled while adjusting the magnetic force of the tilt adjustment unit, and movement is made while a vacuum suction force is released.



Picture 1 Schematic diagram of a mobile robot polishing device



Picture 2 Polishing schematic diagram of a mobile robot polishing device

Degree of technology completion (TRL)

Degree of technology completion: TRL2 (technology concept setting stage)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

Utilization

Utilization field and applied product

Utilization field

- Optical surface polishing
- Mirror surface autonomous movement



Picture 1 Optical surface polishing device

* Data: https://www.researchgate.net/figure/The-18m-capacity-swing-arm-NC-polishing-machine-left-developed-at-the-Optical_fig6_253479446

Applied product

- Optical polishing device
- Mirror surface autonomous movement robot



Picture 2 Mirror surface autonomous movement robot

* Data: <https://www.turbosquid.com/ko/3d-models/legged-robotic-lunar-rover-3d-model-1317983>



Robot polishing device

Robot Polishing machine

Technology trend

- Due to a rise of global environmental problems, new industries such as wind power and solar power are growing, and accordingly, the need for machine tools and processing tools is increasing. Recently, the demand for high-efficiency and complex optical properties is increasing mainly with display optical components. Also, the demand for optical components in the form of large-area microfabricated products is rapidly increasing.
- In addition, as the light-related industry increases, the demand for large-diameter optical lenses such as aspherical optical mirrors for high-resolution satellite cameras, ground-use large astronomical telescopes, telescopes for tracking satellites, and exposure devices for semiconductors and flat panel displays is expected to increase.
- Large optical lens processing technology are possessed by some advanced countries such as the United States, Russia, and France. In Korea, Hwacheon Machine Tool, Hyundai Wia, Doosan Infracore, and Yuga Enterprise are researching and developing precision polishing technologies.

Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	KR 10-2019-0160276 (2019.12.05) / 10-1893795 (2018.08.27)	Large mirror polishing device capable of polishing curved surface
KOR	KR 10-2016-0141812 (2016.10.28) / 10-1871782 (2018.06.21)	Large mirror polishing system using multiple polishing robots
KOR	KR 10-2013-0035273 (2013.04.01) / 10-1482842 (2015.01.08)	Polishing device

Market prospect

Target market size and prospect

The global market size for precision and micromachinery is expected to grow from about USD 170 billion in 2016 to about USD 245 billion in 2021, growing at a CAGR of 7.6%.

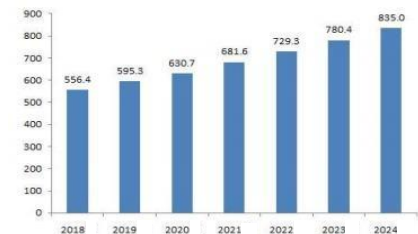
In the market, the market size of precision machining systems including polishing/grinding machines is expected to grow from about USD 92 billion in 2016 to about USD 125 billion in 2021 at a CAGR of 6.3%.

In addition, the optical system market is expected to increase in demand for satellite-mounted optical systems along with the expansion of commercial artificial satellites in the future.

Division	Unit: million dollar						
	'16	'17	'18	'19	'20	'21	CAGR
Precision processing system	91,933	97,752	103,940	110,520	117,480	124,881	6.3%
Micro/macro production system	78,000	91,200	94,300	101,200	109,100	119,901	9.9%
Total	169,933	188,952	198,240	211,720	226,580	244,782	7.6%

Table Global precision and micro machine market size

<Data: SME Technology Roadmap (2018-2020)_Precision Micro Machinery>



Picture Global mining industry market size

<Data: Global Photonics Market (2018.12)>

Technology transfer query

DH 두호특허법인 / (주)두호기술경영
DooHo IP Law Firm / DooHo Tech. & Mgt. Inc.

Patent attorney Kyuhyeong LIM
Contact 070-4333-8021
Email khlim@doohopat.co.kr

Technology transfer process

