

PETITION TO ACCEPT UNINTENTIONALLY DELAYED PAYMENT OF MAINTENANCE FEE IN AN EXPIRED PATENT (37 CFR 1.378(b))				
Patent Number	Issue Date	Application Number	Filing Date	Docket Number (if applicable)
7266055	04-Sep-2007	10849190	20-May-2004	
CAUTION: Maintenance fee (and surcharge, if any) payment must correctly identify: (1) the patent number and (2) the application number of the actual U.S. application leading to issuance of that patent to ensure the fee(s) is/are associated with the correct patent. 37 CFR 1.366(c) and (d).				
Applicants claims the following fee status:				
☐ Small Entity				
☐ Micro Entity				
☒ Regular Undiscounted				
Applicants selects the following :				
☐ 3 1/2		☐ 7 1/2		☒ 11 1/2
PETITION FEE The petition fee required by 37 CFR 1.17(m) (Fee Code 1558/2558) must be paid as a condition of accepting unintentionally delayed payment of the maintenance fee.				
MAINTENANCE FEE (37 CFR 1.20(e)-(g)) The appropriate maintenance fee must be submitted with this petition.				
STATEMENT The delay in payment of the maintenance fee for this patent was unintentional. Petitioner is reminded that a delay resulting from a deliberately chosen course of action or a change in circumstance is not an unintentional delay. Petitioner is further reminded that a person seeking reinstatement of an expired patent should not make a statement that the delay in payment of the maintenance fee was unintentional unless the entire delay was unintentional, including the period from discovery that the maintenance fee was not timely paid until payment of the maintenance fee. For example, a statement that the delay in payment of the maintenance fee was unintentional would not be proper when the patentee becomes aware of an unintentional failure to timely pay the maintenance fee and then intentionally delays filing a petition for reinstatement of the patent under 37 CFR 1.378. See MPEP 2590. NOTE: Where the petition under 37 CFR 1.378 is filed more than two years after the date the patent expired for nonpayment of the maintenance fee, the United States Patent and Trademark Office requires an additional explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional. This requirement is in addition to the requirement to provide a statement that the entire delay was unintentional. See <i>Clarification of the Practice for Requiring Additional Information in Petitions Filed in Patent Applications and Patents Based on Unintentional Delay</i> , 85 FR 12222 (March 2, 2020). See MPEP 711.03(c)(II)(C)-(F) for additional guidance on the information required to establish that the entire delay was unintentional.				
PETITIONER(S) REQUEST THAT THE DELAYED PAYMENT OF THE MAINTENANCE FEE BE ACCEPTED AND THE PATENT REINSTATED				
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES 37 CFR 1.378(c) states: "Any petition under this section must be signed in compliance with 37 CFR 1.33(b)."				
I certify, in accordance with 37 CFR 1.4(d)(4) that I am				

- ☐ An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.
- ☒ An attorney or agent registered to practice before the Patent and Trademark Office
- ☐ A sole patentee
- ☐ A joint patentee; I certify that I am authorized to sign this submission on behalf of all the other patentees as evidenced by the power of attorney in the application
- ☐ A joint patentee; all of whom are signing this e-petition
- ☐ The assignee of record of the entire interest that qualifies as an authorized party under 37 CFR 1.33(b)

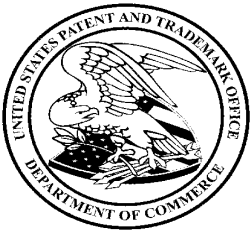
Patent Practitioner

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature

Signature	/Randall S. Svihla/		
Name	Randall Svihla	Registration Number	56273

Electronic Patent Application Fee Transmittal				
Application Number:		10849190		
Filing Date:		20-May-2004		
Title of Invention:		OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD		
First Named Inventor/Applicant Name:		Won-ik Cho		
Filer:		Randall Scott Svihla		
Attorney Docket Number:		1793.1290		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
MAINTENANCE FEE DUE AT 11.5 YEARS	1553	1	7700	7700
PET. DELAY PYMT MAINTAIN PATENT IN FORCE	1558	1	2100	2100
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				9800



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Patent No. 7266055 :
Issue Date: September 4, 2007 :
Application No. 10849190 :DECISION GRANTING PETITION
Filed: May 20, 2004 :UNDER 37 CFR 1.378(b)
Attorney Docket No. 1793.1290 :

This is a decision on the electronic petition, filed September 3, 2021, under 37 CFR 1.378(b) to accept the unintentionally delayed payment of the 11.5 year maintenance fee for the above-identified patent.

The petition is **GRANTED**.

The maintenance fee is accepted, and the above-identified patent reinstated as of September 3, 2021. This decision also constitutes notice that the fee has been accepted. An electronic copy of the petition and this decision has been created as an entry in the Image File Wrapper. Nevertheless, petitioner should print and retain an independent copy.

Telephone inquiries related to this electronic decision should be directed to the Electronic Business Center at 1-866-217-9197.

Electronic Acknowledgement Receipt	
EFS ID:	43681582
Application Number:	10849190
Patent Number:	7266055
Confirmation Number:	7296
Petition Issued Date:	September 3,2021
Title of Invention:	OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD
First Named Inventor/Applicant Name:	Won-ik Cho
Customer Number:	21171
Filer:	Randall Scott Svihla
Filer Authorized By:	
Attorney Docket Number:	1793.1290
Receipt Date:	03-SEP-2021
Filing Date:	20-MAY-2004
Time Stamp:	12:51:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$9800
RAM confirmation Number	E202193C51113097
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	ePetition Request Form	petition-request.pdf	47951	no	2
			19d568bd948edcf50eccc3620543a743cbe04f147		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40254	no	2
			1afca823bcc7420307cee6234a4f3e8d6609d144		
Warnings:					
Information:					
Total Files Size (in bytes):			88205		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,266,055 B2
APPLICATION NO. : 10/849190
DATED : September 4, 2007
INVENTOR(S) : Won-ik Cho et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 12, Line 41, in Claim 21, after "each" delete "to".

Signed and Sealed this

Eleventh Day of March, 2008

A handwritten signature in black ink, appearing to read "Jon W. Dudas". The signature is stylized with a large, looped initial "J" and a distinct "D".

JON W. DUDAS
Director of the United States Patent and Trademark Office



Attorney Docket No. 1793.1290

CofC

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Won-ik CHO et al.

Application No.: 10/849,190

ATTENTION

Confirmation No.: 7296

CERTIFICATE OF CORRECTION

Filed: May 20, 2004

BRANCH

U.S. Patent No.: 7,266,055

Issued: September 4, 2007

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME
AND METHOD

REQUEST FOR CERTIFICATE OF CORRECTION

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Certificate
of Correction
NOV 19 2007

Sir:

Patentees respectfully request that a Certificate of Correction be issued in the subject patent, pursuant to 35 USC § 254 and 37 CFR § 1.322, to correct the error shown on the attached Form PTO-1050. A check in the amount of \$100 to cover the cost of the Certificate is attached.

One or more of the errors shown on the attached Form PTO-1050 is or are within the responsibility of the applicant; each thereof is of a clerical or typographical nature or of minor character and occurred in good faith, and the correction thereof is consistent with the prosecution record.

Respectfully submitted,

STAAS & HALSEY LLP

Date: NOV. 15, 2007

By: *[Signature]*
Gene M. Garner, II
Registration No. 34,172

1201 New York Ave, N.W., 7th Floor
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501

11/16/2007 SZEWDIE1 00000005 7266055
01 FC:1811

100.00 DP

NOV 29 2007

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO : 7,266,055

DATED : September 4, 2007

INVENTOR(S) : Won-ik CHO et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 12, Line 41, in Claim 21, after "each" delete "to".

MAILING ADDRESS OF SENDER:
STAAS & HALSEY LLP
1201 New York Avenue, N.W.
7th Floor
Washington, DC 20005

PATENT NO. 7,266,055

No. of add'l copies
@ 304 per page

⇒

NOV 29 2007



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	09/04/2007	7266055	1793.1290	7296
21171	7590	08/15/2007		
STAAS & HALSEY LLP SUITE 700 1201 NEW YORK AVENUE, N.W. WASHINGTON, DC 20005				

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 498 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Won-ik Cho, Seoul, KOREA, REPUBLIC OF;
Byung-ryul Ryoo, Suwon-si, KOREA, REPUBLIC OF;
Young-pil Park, Seoul, KOREA, REPUBLIC OF;
No-cheol Park, Seoul, KOREA, REPUBLIC OF;

PART B -- FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail

Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885



INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21171 7590 04/27/2007

STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296

TITLE OF INVENTION: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$0	\$1700	07/27/2007
EXAMINER		ART UNIT	CLASS-SUBCLASS	07/27/2007 AENDAF2 00300097 10849190		
HINDI, NABIL Z		2627	369-044140	01 FC:1501 02 FC:1504 1403.00 OP 302.00 OP		

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
- (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 STAAS & HALSEY LLP

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

SAMSUNG ELECTRONICS CO., LTD.

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

SUWON-SI, REPUBLIC OF KOREA

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☒ Issue Fee
- ☒ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☒ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 19-3935 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature

DARLEEN J. STOCKLEY

Date

July 26, 2007

Typed or printed name

Registration No.

34,257

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296
21171	7590	07/18/2007	EXAMINER	
STAAS & HALSEY LLP			HINDI, NABIL Z	
SUITE 700			ART UNIT	
1201 NEW YORK AVENUE, N.W.			PAPER NUMBER	
WASHINGTON, DC 20005			2627	
			MAIL DATE	DELIVERY MODE
			07/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

**UNITED STATES DEPARTMENT OF COMMERCE****U.S. Patent and Trademark Office**

Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
10849190	5/20/04	CHO ET AL.	1793.1290

STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER

NABIL Z. HINDI

ART UNIT**PAPER**

2627

20070717

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

The IDS dated June 29, 2007 is considered by the examiner and a copy of the 1449 is mailed with this latter.

Nabil Hindi
NABIL HINDI
PRIMARY EXAMINER
GROUP 2500
2627

ATTACHMENT 1(g)



LIST OF ADDITIONAL SUBMITTED DOCUMENTS

ATTORNEY DOCKET NO. 1793.1290	APPLICATION NO. 10/849,190
FIRST NAMED INVENTOR Won-ik CHO, et al.	
FILING DATE May 20, 2004	GROUP ART UNIT 2627

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialing same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE
	AA						
	AB						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION YES NO	
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

			TRANSLATION YES NO	
	AE	Chinese Office Action for corresponding Chinese Patent Application No.: 2004100684337 dated March 30, 2007		X

EXAMINER <i>Nabil Haddad</i>	DATE CONSIDERED <i>7/16/07</i>
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

FORM PTO-1449

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

Sheet 1 of 1

ATTORNEY DOCKET NO.

APPLICATION NO.

1793.1290

10/849,190

FIRST NAMED INVENTOR

Won-ik CHO, et al.

FILING DATE

GROUP/ART UNIT

May 20, 2004

2627

OIP INFORMATION DISCLOSURE STATEMENT

(Use several sheets if necessary)

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE
NA	AA	2002/0006090	01/17/02	Kawano			
	AB						
	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO		ABSTRACT
NA	AG	1335613	02/13/02	CHINA			Abstract of corresponding document US 2002/0006090 is provided
	AH						
	AI						
	AJ						
	AK						
	AL						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

TRANSLATION
YES NO

	AM	Examiner Nabil Hindi	Date 7/16/07		
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296
21171 7590 07/18/2007 STAAS & HALSEY LLP SUITE 700 1201 NEW YORK AVENUE, N.W. WASHINGTON, DC 20005			EXAMINER HINDI, NABIL Z	
			ART UNIT 2627	PAPER NUMBER
			MAIL DATE 07/18/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



UNITED STATES DEPARTMENT OF COMMERCE

U.S. Patent and Trademark Office

Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
10849190	5/20/04	CHO ET AL.	1793.1290

STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER

NABIL Z. HINDI

ART UNIT	PAPER
2627	20070709

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

The IDS dated June 11 and the duplicate copy dated June 29 is considered by the examiner and a copy of the 1449 is mailed with this letter.


NABIL HINDI
PRIMARY EXAMINER
GROUP 2500
2627



ATTACHMENT 1(g)

LIST OF ADDITIONAL SUBMITTED DOCUMENTS	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2004	2627

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialing same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE
	AA						
	AB						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION	
							YES	NO
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

					TRANSLATION	
					YES	NO
	AE	Chinese Patent Office Action, mailed March 30, 2007 and issued in corresponding Chinese Patent Application No. 2004100684337				X

EXAMINER	<i>Nabil Hndy</i>	DATE CONSIDERED	<i>7/9/07</i>
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.			



Sheet 1 of 1

FORM PTO-1449 INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY DOCKET NO. 1793.1290	APPLICATION NO. 10/849,190
	FIRST NAMED INVENTOR Won-ik CHO, et al.			
	FILING DATE May 20, 2004		GROUP ART UNIT 2627 <i>2627</i>	

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE
<i>AA</i>	AA	2002/0006090	01/17/2002	Kawano			
	AB						
	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO	ABSTRACT
	AG	1335613	02/13/2002	China	US 2002/0006090 (Reference AA) corresponds to CN 1335613 (Reference AG)	X
	AH					
	AI					
	AJ					
	AK					
	AL					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

		TRANSLATION YES NO
	AM	

EXAMINER

Nabil Hinch
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DATE CONSIDERED

7/9/07

Revised January, 2005

ATTACHMENT 1(g)



LIST OF ADDITIONAL SUBMITTED DOCUMENTS

ATTORNEY DOCKET NO.	APPLICATION NO.
1793.1290	10/849,190
FIRST NAMED INVENTOR	
Won-ik CHO, et al.	
FILING DATE	GROUP ART UNIT
May 20, 2004	2627

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialing same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE
	AA						
	AB						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION	
							YES	NO
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

			TRANSLATION	
			YES	NO
	AE	Chinese Office Action for corresponding Chinese Patent Application No.: 2004100684337 dated March 30, 2007		X

EXAMINER

DATE CONSIDERED

*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

FORM PTO-1449

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

Sheet 1 of 1

ATTORNEY DOCKET NO.

APPLICATION NO.

1793.1290

10/849,190

FIRST NAMED INVENTOR

Won-ik CHO, et al.

FILING DATE

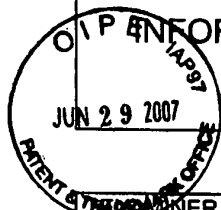
May 20, 2004

GROUP ART UNIT

2627

INFORMATION DISCLOSURE STATEMENT

(Use several sheets if necessary)



U.S. PATENT DOCUMENTS

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~~AA~~	AA	2002/0006090	01/17/02	Kawano			
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	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO		ABSTRACT
	AG	1335613	02/13/02	CHINA			Abstract of corresponding document US 2002/0006090 is provided
	AH						
	AI						
	AJ						
	AK						
	AL						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

TRANSLATION
YES NO

	AM			
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Attorney Docket No. 1793.1290

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re Patent Application of:

Won-ik CHO, et al.

Application No.: 10/849,190

Group Art Unit: 2627

Confirmation No. 7296

Filed: May 20, 2004

Examiner: HINDI, NABIL Z.

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME
AND METHOD

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the duty of disclosure provisions of 37 CFR § 1.56, there is hereby provided certain information which the Examiner may consider material to the examination of the subject U.S. patent application. It is requested that the Examiner make this information of record if it is deemed material to the examination of the subject application.

1. Enclosures accompanying this Information Disclosure Statement are:

- 1a. ☒ Form PTO-1449.
- 1b. ☐ Copy(ies) of IDS citation(s), except for U.S. Patents and U.S. Patent Application publications.
- 1c. ☐ English language copy of a communication(s) from a foreign Patent Office or a PCT International Search Report.
- 1d. ☐ English language translation (complete, Abstract or relevant portion(s)) attached to non-English language publications as indicated on the attached Form PTO-1449.
- 1e. ☐ Explanations of Relevancy of References (ATTACHMENT 1(e), hereto) for providing a concise explanation of non-English publications.
- 1f. ☐ List of Copending Applications (ATTACHMENT 1(f), hereto).
- 1g. ☐ List of Additional Submitted Documents (ATTACHMENT 1(g), hereto)

2. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(b).

(Check either Item 2a or 2b or 2c or 2d)

- 2a. ☐ Within three months of the filing date of a national application;
- 2b. ☐ Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application.
- 2c. ☐ Before the mailing of a first Office Action on the merits; or
- 2d. ☐ Before the mailing of a first Office Action after the filing of a Request for Continued Examination under § 1.114.

3. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(c) after the period specified in paragraph 2 above but before the mailing date of any of a Final Office Action under § 1.113, a Notice of Allowance under § 1.311 or an action that otherwise closes prosecution in the application, AND

(Check either Item 3a or 3b; Item 3b to be checked if any reference known for more than 3 months)

- 3a. ☐ The § 1.97(e) Statement in Item 5 below is applicable; OR
 3b. ☐ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
☐ enclosed.
☐ to be charged to Deposit Account No. 19-3935.

4. ☒ This Information Disclosure Statement is filed under 37 CFR § 1.97(d) after the period specified in paragraph 3 above, but on or before payment of the Issue Fee, AND

- 4a. ☒ The § 1.97(e) Statement in Item 5 below is applicable; AND
 4b. ☒ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
☒ enclosed.
☐ to be charged to Deposit Account No. 19-3935.

5. ☒ Statement under § 1.97(e) (*applicable if Item 3a or Item 4a is checked*)
(Check either Item 5a or 5b)

- 5a. ☒ In accordance with 37 CFR § 1.97(e)(1), it is stated that each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.
 5b. ☐ In accordance with 37 CFR § 1.97(e)(2), it is stated that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known by any individual designated in § 1.56(c) more than three months prior to the filing of this Information Disclosure Statement.

6. ☐ This is a continuation/divisional/continuation-in-part application under 37 CFR § 1.53(b).

(Check appropriate Items 6a and/or 6b)

- 6a. ☐ Copies of the publications listed on the attached Form PTO-1449 which were previously cited in prior application Serial No. ___, filed on ___, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, have been omitted pursuant to 37 CFR § 1.98(d).
 6b. ☐ Copies of the publications listed on the attached Form PTO-1449 which were not previously cited in prior application Serial No. ___, filed on ___, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, are provided herewith.

7. ☐ This is a Request for Continued Examination under 37 CFR § 1.114.
(Check either Item 7a or 7b)
- 7a. ☐ The Issue Fee has not been paid.
- 7b. ☐ A Petition to Withdraw from issue under 37 CFR § 1.313(c) is filed concurrently herewith or has been granted. A Request for Continued Examination under 37 CFR § 1.114, after payment of the Issue Fee, is proper in accordance with 37 CFR § 1.114(a), respectively.
8. ☐ This is a Supplemental Information Disclosure Statement.
(Check either Item 8a or 8b)
- 8a. ☐ This Supplemental Information Disclosure Statement under 37 CFR § 1.97(f) supplements the Information Disclosure Statement filed on _____. A bona fide attempt was made to comply with 37 CFR § 1.98, but inadvertent omissions were made. These omissions have been corrected herein. Accordingly, additional time is requested so that this Supplemental IDS can be considered as if properly filed on _____.
- 8b. ☐ This Supplemental Information Disclosure Statement is timely filed within one (1) month of the Notice under 37 CFR §§ 1.97 and 1.98, mailed _____.
9. ☐ In accordance with 37 CFR § 1.98, a concise explanation of what is presently understood to be the relevance of each non-English language publication is:
(Check appropriate Items 9a, 9b, 9c and/or 9d)
- 9a. ☐ satisfied for the non-English language publication(s) cited on the enclosed "English language version of the search report or action which indicates the degree of relevance found by the foreign office". (See MPEP § 609, Minimum Requirements for an Information Disclosure Statement, Part A(3): Concise Explanation of Relevance, 8th Ed., Rev. 2)
- 9b. ☐ set forth in the application.
- 9c. ☐ satisfied for the non-English language publication(s) indicated on the attached Form PTO-1449 as having an English language translation (complete or relevant portion(s)) attached thereto.
- 9d. ☐ enclosed as Attachment 1(e), hereto.
10. No admission is made that the information cited in this Statement is, or is considered to be, material to patentability nor a representation that a search has been made (other than search report(s) from a counterpart foreign application or a PCT International Search Report, if submitted herewith). 37 CFR §§ 1.97(g) and (h).

11. The Commissioner is authorized to credit any overpayment or charge any additional fee required under 37 CFR § 1.17 for this Information Disclosure Statement to Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Dated: June 29, 2007
1201 New York Ave., N.W., 7th Floor
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501

By: Darleen J. Stockley
Darleen J. Stockley
Registration No. 24,257

Sheet 1 of 1

FORM PTO-1449

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY DOCKET NO.

APPLICATION NO.

1793.1290

10/849,190

FIRST NAMED INVENTOR

Won-ik CHO, et al.

FILING DATE

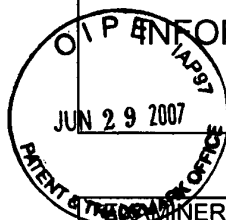
May 20, 2004

GROUP/ART UNIT

2627

INFORMATION DISCLOSURE STATEMENT

(Use several sheets if necessary)



U.S. PATENT DOCUMENTS

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OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

TRANSLATION
YES NO

	AM			
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ATTACHMENT 1(g)



LIST OF ADDITIONAL SUBMITTED DOCUMENTS

ATTORNEY DOCKET NO. 1793.1290	APPLICATION NO. 10/849,190
FIRST NAMED INVENTOR Won-ik CHO, et al.	
FILING DATE May 20, 2004	GROUP ART UNIT 2627

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FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB- CLASS	<u>TRANSLATION</u> YES NO	
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

							<u>TRANSLATION</u> YES NO	
	AE	Chinese Office Action for corresponding Chinese Patent Application No.: 2004100684337 dated March 30, 2007						X

EXAMINER	DATE CONSIDERED
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

[19] 中华人民共和国国家知识产权局

[51] Int. Cl⁷

G11B 7/135

[12] 发明专利申请公开说明书

[21] 申请号 01123344.3

[43] 公开日 2002 年 2 月 13 日

[11] 公开号 CN 1335613A

[22] 申请日 2001.7.16 [21] 申请号 01123344.3

[30] 优先权

[32] 2000.7.14 [33] JP [31] 213800/2000

[32] 2000.7.31 [33] JP [31] 230809/2000

[32] 2000.8.22 [33] JP [31] 250465/2000

[71] 申请人 TDK 株式会社

地址 日本东京都

[72] 发明人 河野纪行

[74] 专利代理机构 中国专利代理(香港)有限公司

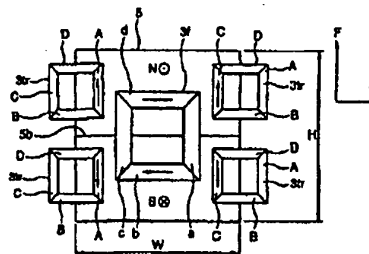
代理人 陈 弄 王忠忠

权利要求书 5 页 说明书 23 页 附图页数 24 页

[54] 发明名称 光拾取器中所使用的物镜驱动装置

[57] 摘要

在至少包含一个两极磁化的磁铁的磁路的同一个磁隙内,安装有一个线圈单元,该线圈单元上安装有一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈。



ISSN 1008-4274

知识产权出版社出版

权 利 要 求 书

1. 用于光拾取器中的一种物镜驱动装置, 包括:
一个磁路, 包括被两极磁化的一个磁铁; 以及
一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜
5 线圈,
其中所述聚焦线圈、跟踪线圈以及倾斜线圈都位于所述磁路的一个磁隙内。
2. 依据权利要求 1 的一种物镜驱动装置, 其中磁路包含若干磁铁, 线圈单元设置在由磁铁形成的磁隙内。
- 10 3. 依据权利要求 1 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 以及所述聚焦线圈、跟踪线圈以及倾斜线圈都分别安装于所述印刷电路板上。
4. 依据权利要求 1 的一种物镜驱动装置, 其中所述线圈单元包括若干第一印刷电路板以及第二印刷电路板, 所述聚焦线圈和所述跟
15 踪线圈都位于所述第一印刷电路板上, 所述倾斜线圈位于所述第二电路板上。
5. 依据权利要求 1 的一种物镜驱动装置, 其中线圈单元包含若干第一印刷电路板和第二印刷电路板, 聚焦线圈和倾斜线圈安装在第一印刷电路板内, 而跟踪线圈安装在第二印刷电路板内。
- 20 6. 依据权利要求 1 的一种物镜驱动装置, 其中所述聚焦线圈的数目为一, 所述跟踪线圈的数目为偶数, 所述倾斜线圈的数目为二, 其中所述磁铁是在聚焦方向上被两极磁化的。
7. 依据权利要求 1 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述倾斜线圈的数目为二,
25 其中所述磁铁是在跟踪方向上被两极磁化的。
8. 用于光拾取器的一种物镜驱动装置, 包括:
两个磁路, 每一个都包括一个两极磁化的磁铁; 以及
一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜
线圈,
30 其中, 所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内。
9. 依据权利要求 8 的一种物镜驱动装置, 其中磁路包含若干磁

铁, 线圈单元设置在由磁铁形成的磁隙内。

10. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈、跟踪线圈以及所述倾斜线圈都分别安装在所述印刷电路板上。

5 11. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元包括若干第一印刷电路板以及第二印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装于所述第一印刷电路板上, 所述倾斜线圈位于所述第二印刷电路板上。

10 12. 依据权利要求 8 的一种物镜驱动装置, 其中线圈单元包含若干第一印刷电路板和第二印刷电路板, 聚焦线圈和倾斜线圈安装在第一印刷电路板内, 而跟踪线圈安装在第二印刷电路板内。

13. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元被固定在沿平行于跟踪方向延伸的透镜支架的两个侧面上。

15 14. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈的数目为一, 所述跟踪线圈的数目为偶数, 所述倾斜线圈的数目为二, 同时, 所述磁铁是被在聚焦方向上两极磁化的。

15. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述倾斜线圈的数目为二, 同样, 所述磁铁是在聚焦方向上被两极磁化的。

20 16. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈缠绕在透镜支架的侧面, 所述跟踪线圈以及所述倾斜线圈分别安装在沿平行于所述跟踪方向延伸的两个侧面上。

17. 依据权利要求 16 的一种物镜驱动装置, 其中安装于透镜支架的一个面上的所述跟踪线圈以及所述倾斜线圈的数目分别为二。

25 18. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈和所述倾斜线圈都叠加在所述聚焦线圈上。

19. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈和所述倾斜线圈都缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从所述侧面上凸出来。

30 20. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从所述侧面上凸出来, 所述倾斜线圈都叠加在聚焦线圈上。

21. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈都叠加在聚焦线圈上, 所述倾斜线圈缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从该侧面上凸出来。

22. 在光拾取器中所用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号, 对物镜倾角进行调节, 该装置包括:

一个磁路, 包括被两极磁化的一个磁铁; 以及

一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

10 其中所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内,

其中聚焦伺服的执行是通过将电流分别提供给若干聚焦线圈, 从而在若干聚焦线圈内所产生驱动力的总和, 而实现的,

15 其中对所述物镜的倾斜调节利用了由于所述多个驱动力之间的差而产生的围绕活动部件的重心的力矩而实现的。

23. 依据权利要求 22 的一种物镜驱动装置, 其中磁路包含若干磁铁, 线圈单元设置在由磁铁形成的磁隙内。

24. 依据权利要求 22 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及跟踪线圈都分别安装于所述
20 印刷电路板上。

25. 依据权利要求 22 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装于所述印刷电路板上。

26. 依据权利要求 22 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述磁铁是在跟踪方向上被两极磁化的。

27. 在光拾取器中所使用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号来调节物镜倾角, 所述装置包括:

一个磁路, 包括一个两极磁化的磁铁; 以及

30 一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

其中, 所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所

述磁路的一个磁隙内，

其中，跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈，而在所述若干聚焦线圈内产生的驱动力的总和而实现的，

其中，对物镜的倾角的调节是由多个驱动力之间的差而围绕活动
5 部件的重心产生了力矩，从而实现的。

28. 依据权利要求 27 的一种物镜驱动装置，其中磁路包含若干磁铁，线圈单元设置在由磁铁形成的磁隙内。

29. 依据权利要求 27 的一种物镜驱动装置，其中所述线圈单元
10 包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都安装于所述印刷电路板上。

30. 依据权利要求 27 的一种物镜驱动装置，其中所述线圈单元包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都安装在所述印刷电路板上。

31. 依据权利要求 27 的一种物镜驱动装置，其中所述聚焦线圈
15 的数目为一，所述跟踪线圈的数目为偶数，所述磁铁在聚焦方向上被两极磁化。

32. 在光拾取器中所使用的一种物镜驱动装置，用于检测光盘倾角，以便依据所述光盘的倾角信号来调节物镜倾角，所述装置包括：
两个磁路，分别包括一个两极磁化的磁铁；以及
20 一个线圈单元，包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈，

其中，所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内，

其中，跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈，
25 而在所述若干聚焦线圈内产生的驱动力的总和而实现的，

其中，对物镜的倾角的调节是由多个驱动力之间的差而围绕活动部件的重心产生了力矩，从而实现的。

33. 依据权利要求 32 的一种物镜驱动装置，其中磁路包含若干磁铁，线圈单元设置在由磁铁形成的磁隙内。

30 34. 依据权利要求 32 的一种物镜驱动装置，其中所述线圈单元包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都分别安装于所述印刷电路板上。

35. 依据权利要求 32 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装在所述印刷电路板上。

5 36. 依据权利要求 32 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述磁铁在聚焦方向上被两极磁化。

37. 在光拾取器中所使用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号来调节物镜倾角, 所述装置包括:
两个磁路, 分别包括一个两极磁化的磁铁; 以及
10 一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

其中, 所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内,

15 其中, 跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈, 而在所述若干聚焦线圈内产生的驱动力的总和而实现的,

其中, 对物镜的倾角的调节是由多个驱动力之间的差而围绕活动部件的重心产生了力矩, 从而实现的。

38. 依据权利要求 37 的一种物镜驱动装置, 其中磁路包含若干磁铁, 线圈单元设置在由磁铁形成的磁隙内。

20 39. 依据权利要求 37 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都分别安装于所述印刷电路板上。

40. 依据权利要求 37 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装在所述
25 印刷电路板上。

41. 依据权利要求 37 的一种物镜驱动装置, 其中所述聚焦线圈的数目为一, 所述跟踪线圈的数目为偶数, 所述磁铁在聚焦方向上被两极磁化。

说明书

光拾取器中所使用的物镜驱动装置

技术领域

- 5 本发明涉及构成一个光盘单元的光拾取器中所使用的物镜驱动装置，该光拾取器将一束光斑投射到记录媒体上，以便从光记录媒体上读出信息。

背景技术

- 构成一个光盘单元的光拾取器一般是由物镜驱动装置构成的，该物镜驱动装置包括一个物镜以及用于将光传送到物镜上并接收从物镜来的光的一个光学系统，所述物镜驱动装置位于光系统安装台上。物镜驱动装置由一个活动部件和一个固定部件构成。其中活动部件包括一个物镜、聚焦线圈以及跟踪线圈。固定部件包括一个磁路。活动部件通过四个导线被支承在固定部件上，其中，四个导线中的每个导线都被由象粘弹性部件这样的弹性减振器部件部分包围，并被其握住。

- 作为不仅能在聚焦方向以及跟踪方向上驱动物镜，还能校正光盘上作为影像形成的光斑的像差和散光的一种物镜驱动装置，我们知道在日本专利公开平 9-231595 中公开了这样一种装置。本发明设备的特征在于，如图 24、25 和 26 所示，在与光盘相对的透镜支架 1101 的表面，至少放置了沿光盘的径向方向或物镜 1103 的切线方向延伸的一对光传感器 1301、1302；在光盘的径向方向中，在透镜支架 1101 的一个侧面或两个侧面上，放置有用于校正物镜的倾角的线圈 1105；在与透镜支架 1101 的侧面相对而放置的一对轭(yoke)1113 和 1114 上，放置有一对反极性磁部件 1106 和 1107，用于以这样一种方式校正物镜的倾角，即，这对反极性磁部件与线圈 1105 的位置相应，由此，依据光传感器 1301 和 1302 的输出，就可检测到相对于光盘 1110 的物镜的倾角。依据这样检测到的物镜倾角，以及所计算出的准直仪光轴和物镜光轴间的移动值，向线圈 1105 提供了一个用于倾角校正的电流，因而驱动了线圈 1105，并且，由于线圈 1105 和反极性磁部件 1106 和 1107 之间的电磁相互作用，从而驱动了透镜支架 1101 的侧面，这样，可以以自由倾斜方式，对透镜支架 1101 的侧面进行伺

服控制。

光传感器 1301 和 1302 分别被安装在透镜支架 1101 的物镜 1103 的两侧，且如图 25 所示，它们用来接收由光头发射出的以及由光盘槽所衍射的主光束 (primary light) 1201, 1202。如图 27 所示，来自光传感器 1301, 1302 的电信号被放大器 1407, 1408 放大，之后，被差分输入到一个差分放大器 1403。从差分放大器 1403 的输出中，可以计算出光盘 1100 和透镜支架 1101 之间的倾角。

如图 27 所示，根据如此计算出的倾角以及物镜光轴和准直仪光轴之间的偏移，最好是，利用设置在 ROM (只读存储器) 内的预置部件 1404，计算出透镜的一个最佳倾角；根据上述两个计算结果，经过一个相位补偿电路 1405 以及一个驱动放大器 1406，来驱动倾角校正线圈 1105，用于伺服控制。

参见透镜支架 1101 的结构，在其平面内，形成有两个狭缝 1102，通过这两个狭缝，可以分别插入与其相关的轭部件 1109；在透镜支架 1101 的中心部分，安装有物镜 1103；在透镜支架 1101 的一对彼此相向的侧面上，放置有用于两个跟踪驱动的矩形扁平线圈 1104，因而总共有四个线圈 1104。同样，在透镜支架 1101 的在光盘径向方向 (R) 上的两个相向的面上，作为用于倾角校正的线圈 1105，放置了一对矩形扁平线圈；在用于倾角校正的线圈 1105 的上方和下方放置有印刷电路板 (未示出)，它们是通过铜箔部件 1115、1116 而得到支撑的。

在激励器底座 1108 上，设计有轭部件 1109、1110；轭部件 1109、1110 通过磁铁 1111、1112，构成了一个重要的闭合磁路，用于聚焦方向以及跟踪方向的驱动。同样，在激励器底座 1108 的两个侧面上，放置有两个侧轭 1113、1114，用于透镜支架的倾角调节的驱动，这两个侧轭的顶视图分别表现为一个马蹄形。并且，在侧轭 1113、1114 中的每一个侧轭中，都放置有极性相反的长磁铁 1106 和 1107，它们被如此放置，使得他们与用于倾角校正的线圈 1105 的顶面和底面对应。

同样，与上述情况相似，在激励器底座 1108 上，通过铜箔部件 1119、1120，还放置有一个方形印刷电路板 1117、1118。并且，四个磷青铜的弹簧导线 1121 以这样一种方式与透镜支架 1101 连接，使

得弹簧导线 1121 分别由位于弹簧线 1121 两端的印刷电路板所固定；这样，由弹簧导线 1121 对透镜支架 1101 进行了弹性支撑（对于弹簧导线 1121 的固定，请看图 26 所示的平面图）。

在图 24 中，参考字符 F 表示物镜激励器的移动系统的聚焦轴，R 表示其跟踪轴，T 表示其光盘切线轴。

接下来，将依据参照图 25 的相关技术，对透镜支架 1101 的倾角驱动进行说明。在位于透镜支架 1101 的在光盘径向方向上的两个表面上的、分别用于向右和向左倾角校正的线圈 1105 的电流方向被设定为相同，并且，所放置的与用于倾角校正的线圈 1105 的上、下两侧相对应的左、右磁铁 1106 和 1107 的磁场方向对称的情况下，则，依据傅雷明（Fleming）原理，右线圈和左线圈的电磁驱动力在方向上彼此不同（请看图 25 中的箭头标记 F、F'）。因此，由于所表示的透镜支架 1101 的重心或支承中心实质上在同一点，因而在透镜支架 1101 围绕这一点旋转的情况下，可以对物镜相对于光盘 1100 的倾角进行校正。

但是，在上述传统技术中，为了校正分别源于用来跟踪伺服以及聚焦伺服的线圈以及磁铁的物镜的倾角，必须另外放置一个线圈 1105 以及磁铁 1106、1107，用于倾角校正，这会增加物镜驱动装置的成本。同时，在传统技术中，必须将用于倾角校正的线圈 1105 以及磁铁 1106、1107 放置在支承物镜 1103 的物镜支架 1101 的在光盘 1100 径向方向一侧的面上，这会增加物镜驱动装置的宽度和重量。

发明概述

本发明试图解决在传统技术中所发现的上述问题。

现在，将参照图 1 对用来解决上述问题的本发明的第一方面进行说明，其中所述图 1 与本发明的第一实施例相对应。依据第一个方面，在至少具有一个其两极已被磁化的磁铁 5 的磁路的同一个磁隙 5g 内，放置有一个线圈单元 3，其上安装有聚焦线圈 3f、跟踪线圈 3tr 以及倾斜线圈 3ti。

在第一个方面中，将被两极磁化的磁铁 5 用来对物镜的倾角进行校正，这样，可以避免专门提供用于校正上述物镜倾角的一个专用磁铁。

以下, 我们还会将参照图 11, 对用于解决上述问题的本发明的第二方面进行说明, 其中, 图 11 与本发明的第二实施例相对应。依据第二方面, 有两个完整的磁路, 每一个磁路都至少具有一个被两极磁化的磁铁 105, 在两个磁路的每一个磁路的磁隙 105g 内, 放置有一个线圈单元 103, 其上安装有一个聚焦线圈 103f、跟踪线圈 103tr 以及倾斜线圈 103ti。

在第二个方面中, 将已两极磁化的磁铁 105 用来对物镜倾角进行校正, 这样可以避免专门提供用来对物镜倾斜进行校正的专用磁铁。

另外, 以下, 我们还将参照图 18, 对用于解决上述问题的本发明的第三方面进行说明, 其中, 图 18 与本发明的第三实施例相对应。依据第三个方面, 提供了用于光拾取器的一种物镜驱动装置, 它能检测到光盘的倾斜, 并依据光盘倾斜信号, 对物镜的倾角进行调节, 其中, 在至少具有一个被两极磁化的磁铁 205 的磁路的同一个磁隙 205g 内, 放置有一个线圈单元 203, 其上安装有若干聚焦线圈 203f1、203fr 以及跟踪线圈 103t。电流被分别提供给若干聚焦线圈 203f1、203fr, 且由于聚焦线圈 203f1、203fr 的驱动力的总和, 而执行聚焦伺服。由于上述驱动力的不同, 从而围绕活动部件的中心产生了力矩, 因此, 伴随聚焦伺服, 还可校正物镜 202 的倾斜。

在第三个方面中, 由于若干聚焦线圈 203f1 和 203fr 的操作, 因而不仅可以执行聚焦伺服, 还可以执行对物镜 202 的倾角的调节。

附图的简要说明

图 1 是依据本发明的用于光拾取器的物镜驱动装置的第一实施例的分解视图;

图 2 是依据本发明的第一实施例中所采用的磁路的侧视图;

图 3 是第一实施例的配置图, 它显示了在聚焦方向上, 磁铁与位于第一实施例的自重位置上的聚焦线圈/跟踪线圈之间的位置关系;

图 4 是第一实施例的配置图, 它显示了在聚焦方向上, 磁铁与位于第一实施例的自重位置上的倾斜线圈的位置关系;

图 5 是对第一实施例进行修改了的配置图, 它显示了在聚焦方向中, 磁铁与位于修正后的自重位置上的倾斜线圈之间的位置关系;

图 6 是对第一实施例进行修改后所采用的磁路的平面图;

图 7 是修改后的配置图,它显示了在聚焦方向中,磁铁与位于修正后的自重位置上的聚焦线圈/跟踪线圈之间的位置关系;

图 8 是第一实施例的线圈单元的一种修改方案;

图 9 是第一实施例的另一修改方案的分解视图;

5 图 10 是图 9 所示的物镜驱动装置所采用的磁路的平面视图;

图 11 是依据本发明的用于光拾取器的物镜驱动装置的第二实施例的分解视图;

图 12 是第二实施例的一修改方案的分解视图;

10 图 13A 和 13B 是图 9 所示的物镜驱动装置所采用的磁路的平面视图;

图 14 是对第二实施例进行另一修改后的分解视图;

图 15 是图 14 所示的物镜驱动装置的前视图;

15 图 16 是对图 14 所示的第二实施例进行修改后的配置图,显示了在聚焦方向中,磁铁与位于第一实施的自重位置上的跟踪线圈/倾斜线圈之间的位置关系;

图 17 是对图 14 所示第二实施例进行修改后的配置图,显示了在聚焦方向中,磁铁与位于第一实施的自重位置上的跟踪线圈/倾斜线圈之间的位置关系;

20 图 18 是依据本发明的用于光拾取器的物镜驱动装置的第三实施例的分解视图;

图 19 是第三实施例的配置图,显示了在聚焦方向中,磁铁与位于第三实施的自重位置上的聚焦线圈/跟踪线圈之间的位置关系;

图 20 是一张电路结构框图,该电路用于本发明第三实施例所采用的聚焦伺服以及倾斜驱动;

25 图 21 是将在第三实施例中所执行的聚焦伺服以及倾斜伺服的解释图;特别是,图 21A 显示了其中产生了具有相同方向的驱动力的情况;图 21B 显示了分别产生了具有相反方向的驱动力的情况;

图 22 是对第三实施例进行修改后的分解透视图;

30 图 23 是对第三实施例进行修改后的排列图,它显示了在聚焦方向上,磁铁与位于经修改后的方案的自重位置上的聚焦线圈/跟踪线圈之间的位置关系;

图 24 是传统的物镜驱动装置的分解透视图;

图 25 是在传统物镜驱动装置中所执行的倾斜校正驱动操作的解释图;

图 26 是传统物镜驱动装置中所采用的一个激励器的平面图; 以及

图 27 是一张框图, 它显示了在传统物镜驱动装置中所采用的电路结构, 用于执行倾斜校正驱动操作。

最佳实施例的详细说明

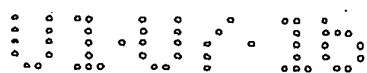
10 (第一实施例)

现在, 图 1 是在依据本发明的在光拾取器中所适用的物镜驱动装置的第一实施例的分解透视图。在图 1 中, 参考字符的表示内容分别如下: 参考字符 1 表示透镜支架, 2 表示物镜, 3 表示线圈单元, 3f 表示聚焦线圈, 3tr 表示跟踪线圈, 3ti 表示倾斜线圈, 5 表示一个
15 磁铁, 5g 表示一个磁隙。

透镜支架 1 是由挠曲弹性的高模数轻金属例如是镁合金构成的, 或是由混有碳纤维的树脂构成的。使用这样材料, 使得透镜支架 1 自身具有较高的挠曲弹性模数, 这样, 就会具有较高的高阶谐振频率。正是由于这一点, 所以, 透镜支架 1 能够招架得住光盘单元的速度的增长。
20

在透镜支架 1 中, 形成有两个凹口部分 1a, 它们分别都在跟踪方向 T 上延伸。还有, 将同样是形成于透镜支架 1 内的物镜安装部分 1b 制造得厚度均匀。

这两个凹口部分 1a 中的每一个凹口部分都具有一个表面, 在这个表面上, 形成有用于增强绝缘的一个绝缘保护膜 (未示出)。提供这样一种保护膜的原因是: 由于用作透镜支架 1 的材料的例如象镁合金这样的高挠曲弹性模数的轻金属或是混有碳纤维的树脂都具有高导电率, 所以需要安装在凹口部分 1a 上的线圈单元 3 的绝缘体必须安全。当在透镜支架 1 的凹口部分 1a 的表面上没有形成用于增强绝缘的绝缘保护膜的情况下, 用于增强绝缘的绝缘保护膜 (未示出) 可
25 形成于线圈 3 的部分中, 该部分将要被安装到凹口部分 1a 上, 因而能确保线圈单元 3 的绝缘。
30



线圈单元 3 是一种层叠的线圈单元, 它包括: 所需数目的印刷电路板 31, 每一块电路板都具有这样一种结构, 其上形成有一个聚焦线圈 3f 以及四个跟踪线圈 3tr; 以及, 所需数目的印刷电路板 32, 每一块电路板上都具有两个倾斜线圈 3ti, 上述两种印刷电路板 31 和 32 交替层叠, 一个叠在另一个的顶部, 从而提供了一种图形结构, 作为一个线圈单元。聚焦线圈 3f 位于印刷电路板 31 的中心部分; 相对于物镜光轴方向的包含支承物镜 2 的透镜支架的活动部件的重心位置, 跟踪线圈 3tr 位于其右侧和左侧 (在跟踪线圈方向 T 上), 即位于两个上一段和下一段的聚焦线圈 3f 的右侧和左侧。四个跟踪线圈 3tr 是串联连接的。顺便提一句, 跟踪线圈 3tr 也可以由两个跟踪线圈构成。相对于印刷电路板 32 的中心, 两个倾斜线圈 3ti 位于其右和左 (在跟踪线圈方向 T 上)。两个倾斜线圈 3ti 是串联连接的。

印刷电路板 31 和 32 可被层叠, 一个层叠在另一个的顶部, 例如, 可通过以这样一种方式, 将印刷电路板 32 的两个侧面夹持在两个印刷电路板 31 之间, 使得, 当从跟踪方向 T 观察它们时, 它们是对称排列的。在这种情况下, 可使在各个方向上的驱动点一致, 因此能够避免在驱动点不一致时会引起的谐振 (纵向 (pitching) 谐振, 偏移 (yawing) 谐振)。

前述说明涉及这样一种结构, 即, 在每一个印刷电路板 31 内, 都形成有聚焦线圈 3f 和跟踪线圈 3tr。但是, 聚焦线圈 3f 和跟踪线圈 3tr 还可以分别形成于两个印刷电路板上。此外, 如图 8 所示, 线圈单元 3' 可以具有印刷电路板 31' 和印刷电路板 32', 其中聚焦线圈 3f 和 3ti 形成在印刷电路板 31' 上, 而跟踪线圈 3tr 形成在印刷电路板 32' 上。图 8 表明四个跟踪线圈 3ti 形成在印刷电路板 32' 上, 然而, 在印刷电路板 32' 可以形成两个跟踪线圈 3ti。同样在这些结构中, 印刷电路板还可以位于另一个印刷电路板的顶部, 这样, 当从跟踪方向 T 看上去的时候, 它们是左右对称的, 由此可以部门驱动点不一致时可能引发的谐振。

线圈单元 3 被插入并被连结在凹口部分 1a 上, 这样, 它就被固定在透镜支架 1 上。在线圈单元 3 的位于跟踪方向 T 上的两端, 形成有六个 V 槽 3v, 而六个导电弹性部件 4 的一端部分分别由焊料 (未示出) 固定到六个 V 槽 3v 上。在导电弹性部件 4 用作引线的情况下,

其中的两个用于驱动聚焦线圈、两个用于驱动跟踪线圈，两个用于驱动倾斜线圈的情况下：即总共提供了六个导电弹性部件。顺便提一句，四个导电弹性部件 4 足以弹性支承用作活动部件的透镜支架 1，因此，在使用四个导电弹性部件 4 的情况下，引线（未示出）被连接到剩余线圈上。

磁铁 5 以这样一种方式连接到位于轭底座 6 上的轭 7 上，即，按照磁铁 5 的 N 和 S 极之间的边界线 5b 沿聚焦方向 F 对磁铁 5 进行两极磁化。如图 2 所示，N 和 S 极之间的边界线 5b 位于沿聚焦方向 F 的磁铁 5 的中心，两个磁铁 5 相对排列，在它们之间形成了一个磁隙 5g，磁力线 B 在磁隙 5g 的聚焦方向 F 上反转。顺便提一句，如图 9 所示，磁路可以包括一个磁铁 5，并且该线圈单元也可以设置在磁隙 5g' 中。图 10 表明，磁路包含了磁铁 5'，可以获得和线圈在提供包含如上所述的两个磁铁 5 和 5g 的磁路的情况下的操作相似的操作。由于此，整个物镜驱动装置可以紧凑地制造。这里磁隙意味着空气间隙或气路，在图 9 中，磁隙 5g' 由一个磁铁形成。

磁铁 5 的宽度 W 是这样确定的，使得如图 3 所示，当线圈单元 3 位于活动部件的可移动中间位置处的磁隙 5g 内时，其中，活动部件被导电弹性部件 4 以悬臂方式可移动支承，也就是说，当线圈单元 3 处于四个跟踪线圈 3tr 的（沿平行于聚焦方向 F 延伸的）垂直侧 A 和 C 的聚焦方向 F 上的活动部件的自重位置时，其中所述四个跟踪线圈位于两个上段和下段中的右侧和左侧，则右和左内部垂直侧 A 和 C 可以位于磁隙 5g（它点出了存在于两个相互面对的磁铁 5 的宽度 W 内的一个空隙）内；同样，如图 4 所示，对于位于一行的右部和左部的两个倾斜线圈 3ti 的（与聚焦方向 F 平行延伸的）垂直侧 a' 和 c'，右侧和左侧的外部垂直面 a' 和 c' 可以位于磁隙 5g 内。同样，磁铁 5 高度 H 是这样确定的，如图 3 所示，位于印刷电路板 31 中心的单独的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b 和 d，同时还有跟踪线圈 3tr 的（与聚焦方向 F 垂直延伸的）水平侧 B 和 C 的上外部水平侧和下外部水平侧 B 和 D，都可以位于磁隙 5g（它指出了两个相互面对的磁铁 5 的高度 H 内存在的一个空隙）内；同样，如图 4 所示，倾斜线圈 3ti 的（沿垂直于聚焦 F 延伸的）水平侧 b' 和 d' 可以位于磁隙 5g 内。

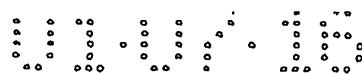
如图 3 所示, 处于磁铁 5 的 N 和 S 极之间的边界线 5b 位于聚焦线圈 3f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b、d 的下侧 b 和上侧 d 之间的中部; 位于上段跟踪线圈 3tr 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B、D 的底面 B, 与下段跟踪线圈 3tr 的 (沿垂直于聚焦方向 F 的) 水平侧 B、D 的顶侧 D 上之间的中部; 如图 4 所示; 位于倾斜线圈 3ti 的 (沿与聚焦方向 F 垂直的方向延伸的) 水平侧 b'、d' 的底面 b' 和顶侧 d' 之间的中部。磁铁 5 的中部实质上与线圈单元 3 的中心一致。

在图 3 中, 在电流可以流入跟踪线圈 3tr 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3tr 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A、C, 因此, 依据傅雷明的左手定律, 在四个跟踪线圈 3tr 内, 产生了相同方向的驱动力。同样, 在电流可以流入聚焦线圈 3f 的情况下, 由于电流流入聚焦线圈 3f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b、d, 因此, 依据傅雷明的左手定律, 在聚焦线圈 3f 内, 在聚焦方向 F 上产生了驱动力。

在图 4 中, 在电流可以流入倾斜线圈 3ti 的情况下, 由于 (由箭头所标记的) 电流流入倾斜线圈 3ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b'、d', 因此, 依据傅雷明的左手定律, 在两个倾斜线圈 3ti 内, 在聚焦方向 F 上, 产生了相反方向的驱动力 F'。由于相反方向的驱动力 F', 产生了围绕活动部件的重心的一个力矩, 从而能够调整透镜支架 1 的倾斜度; 从而调整物镜 2 的倾角。

如上所述, 在聚焦线圈 3f、跟踪线圈 3tr 同时还有倾斜线圈 3ti 被排列在至少包含一个磁铁的磁路的同一磁隙 5g 内时, 不仅可以实现聚焦伺服和跟踪伺服, 同时还有倾斜伺服 (即物镜 2 的倾角调节)。这可以避免提供专门用于调节物镜 2 的倾角的磁铁。由于这一点, 可以减少部件的数目, 可以以低成本来调节物镜 2 的倾角, 因而, 可以压缩整个物镜驱动装置。

前述说明涉及这样一种结构, 在这种结构中, 在印刷电路板 32 的中心的右侧和左侧, 安装有两个倾斜线圈 3ti。但是, 即便是在图 5 所示的这种结构中, 也可以获得类似的影响, 在图 5 的结构中, 相对于印刷电路板 32 的中心, 在 (在聚焦方向 F 上的) 其上部和下部, 安装有两个倾斜线圈 3ti。



在这种情况下，如此构造线圈 3，使得如图 7 所示，有所需数目的印刷电路板（未示出），其中，每一个印刷电路板都具有包含一个跟踪线圈 3tr 以及四个聚焦线圈 3f 的结构，如图 5 所示，线圈 3 有所需数目的印刷电路板（未示出），其中，每个印刷电路板都具有两个倾斜线圈 3ti，这两种印刷电路板中的一种位于另一种印刷电路板的顶部，彼此交替出现。

前述说明涉及这样一种结构，在这种结构中，聚焦线圈 3f 和跟踪线圈 3tr 位于同一印刷电路板上。但是，也可以采用这样一种结构，在这种结构中，聚焦线圈 3f 和跟踪线圈 3tr 分别位于两个印刷电路板上。在这种情况下，同样也是一种印刷电路板位于另一种印刷电路板顶部，以便当从跟踪方向 T 看上去的时候，是左右对称的。

在这种结构中，磁铁 5 如图 6 所示，按照磁铁 5 的 N 和 S 极之间的边界线 5b 在跟踪方向 T 上两极磁化，并被联结到轭底座 6 的轭 7 上。如图 6 所示，N 和 S 极之间的边界线 5b 位于跟踪方向 T 上的磁铁 5 的中心。磁隙 5g 是由于两个磁铁 5 相互面对排列而形成的，在磁隙 5g 中，磁力线 B 的方向在跟踪方向 T 上反转。顺便提一句，另一种可替换的方案是，如图 9 和 10 所示，可以使用单独一个磁铁 5 来代替使用两个磁铁 5。在此情况下，N 和 S 极之间的边界线位于沿跟踪方向 T 的磁铁 5 的中心。由于此缘故，整个物镜驱动装置可以制得紧凑些。

磁铁 5 的宽度 W 是这样确定的，如图 7 所示，当线圈单元 3 位于活动部件的可移动中间位置处的磁隙 5g 内时，其中，活动部件被导电弹性部件 4 以悬臂方式可移动支承，即当线圈单元 3 处于聚焦方向 F 上的活动部件的自重位置时，不仅排列在两个上段和下段内的右侧和左侧的四个聚焦线圈 3f 的（沿平行于聚焦方向 F 的）垂直侧 a 和 c 的右侧和左侧外部垂直侧 a 和 c，而且，如图 5 所示，排列在两个上段和下段内的两个线圈 3ti 的（与聚焦方向 F 平行延伸的）垂直侧 a' 和 c'，能够分别位于磁隙 5g（它点出了存在于两个相互面对的磁铁 5 的宽度 W 内的一个空隙）内。同样，如图 7 所示，磁铁 5 的高度 H 是这样确定的，使得不仅是上段的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b、d 的底侧 b、下段的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b、d 的顶侧 d、以及跟踪线圈 3tr 的（与

5 聚焦方向 F 垂直延伸的) 水平侧 B 和 D, 同时还有如图 5 所示, 上段的倾斜线圈 3ti 的 (与聚焦方向 F 垂直延伸的) 水平侧 b'、d' 的顶侧 d', 以及下段的倾斜线圈 3ti 的 (与聚焦方向 F 垂直延伸的) 水平侧 b'、d' 的底侧 b', 都可分别位于磁隙 5g (它指出了两个相互面对的磁铁 5 的高度 H 内存在的一个空隙) 内。

10 磁铁 5 的 N 和 S 极之间的边界线 5b 不仅如图 7 所示, 位于右聚焦线圈 3f 的 (与聚焦方向 F 平行延伸的) 垂直侧 a、c 的左侧 c 与左聚焦线圈 3f 的 (与聚焦方向 F 平行延伸的) 垂直侧 a、c 的右侧 a 的中部, 位于跟踪线圈 3tr 的 (与聚焦方向 F 平行延伸的) 垂直侧 A、C 的右侧 A 和左侧 C 的中部, 而且还如图 5 所示, 位于倾斜线圈 3ti 的 (与聚焦方向 F 平行延伸的) 垂直侧 a'、c' 的右侧 a' 和左侧 c' 的中部。磁铁 5 的中心实质上与线圈单元 3 的中心一致。

15 在图 7 中, 当允许电流流入跟踪线圈 3tr 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3tr 的 (与聚焦方向 F 平行延伸的) 垂直侧 A、C, 因此, 依据傅雷明的左手定律, 在跟踪线圈 3tr 内, 在跟踪方向 T 上产生了一个驱动力; 当允许电流流入聚焦线圈 3f 的情况下, 由于 (由箭头所标记的) 电流流入聚焦线圈 3f 的 (与聚焦方向 F 垂直延伸的) 水平侧 b、d, 因而, 依据傅雷明的左手定律, 在跟踪方向 T 上, 分别产生了具有相同方向的驱动力。

20 在图 5 中, 当允许电流流入倾斜线圈 3ti 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3ti 的 (与聚焦方向 F 平行延伸的) 垂直侧 a'、c', 因此, 依据傅雷明的左手定律, 在两个倾斜线圈 3ti 内, 在跟踪方向 T 上产生了方向相反的驱动力。由于相反方向的驱动力, 围绕活动部件的重心产生了一个力矩, 因而, 能够调节透镜支架 25 1 的倾角, 从而调节物镜 2 的倾角。

(实施例 2)

30 现在, 图 11 是一张透视图, 它显示了依据本发明的物镜驱动装置的第二实施例。在图 11 中, 参考字符的意义分别表示如下: 101 表示一个透镜支架, 102 表示物镜, 103 表示一个线圈单元, 103f 表示一个聚焦线圈, 103tr 表示一个跟踪线圈, 103ti 表示一个倾斜线圈, 105 表示一个磁铁, 105 表示一个磁隙。

透镜支架 101 是由挠曲弹性的高模数轻金属例如是铝合金构成的，或是由混有碳纤维的树脂构成的。使用这样材料，使得透镜支架 101 自身具有较高的挠曲弹性模数，这样，就会具有较高的阶谐频率。正是由于这一点，所以，透镜支架 101 能够招架得住光盘单元
5 的速度的增长。

参见光盘支架 101 的另一种结构，在其平面上，形成有两个缝隙 111，通过这两个缝隙，可以插入磁铁 105 以及靶 107（在后面将会对这两者进行说明）；在透镜支架 101 的中心部分，安装有物镜 102；在对跟踪方向 T 有一个直角的延伸的透镜支架 101 的一对侧面中的每个侧面上，设计安装有两个顶部和底部支持片 112，用于固定住导电
10 弹性部件 104（也将在下文中对起进行讨论）的一个端部分；对于在平行于跟踪方向 T 延伸的透镜支架 101 的一对侧表面，固定有线圈单元 103（这将在下文中对起进行讨论）。

用于增强绝缘的绝缘保护膜（未示出）分别形成于透镜支架 101 的（与跟踪方向 F 平行延伸的）一对侧表面的表面上。提供这种绝缘
15 保护膜的原因是，由于用作透镜支架 101 的材料的例如是铝合金这样的具有挠曲弹性的高模数的轻金属或是混有碳纤维的树脂具有高导电率，所以，要确保将要安装到支架 101 上的线圈单元 103 的绝缘性。当在透镜支架 101 的（与跟踪方向 F 平行延伸的）一对侧面的表面上
20 没有形成这种用于增强绝缘的绝缘保护膜时，可以在将要安装到透镜支架 101 上的线圈单元 103 的部件上形成用于加强绝缘的绝缘保护膜，因而确保了线圈单元 103 的绝缘。

现在，参见线圈单元 103，所需数目的印刷电路板 131，其中，每个印刷电路板都具有由一个聚焦线圈 103f 和四个跟踪线圈 103tr
25 构成的一种结构，所需数目的印刷电路板 132，其中，每个印刷电路板都具有由两个倾斜线圈 103ti 构成的结构，这两种电路板层叠在一起，或一个位于另一个的顶部，从而形成了一个线圈单元 103。聚焦线圈 103f 位于印刷电路板 131 的中心部分；相对于包含物镜支架 101 的物镜光轴方向的活动部件的重心的位置，跟踪线圈 103tr 位于该位置
30 的（在跟踪方向 T 上的）右方向和左方向，其中物镜支架 101 用于支承物镜 102，即，在两个上段和下段内的聚焦线圈 103f 的右侧和左侧。四个跟踪线圈 103tr 是串联连接的。顺便提一句，也可以用两

个跟踪线圈来替代四个跟踪线圈 103tr。相对于印刷电路板 32 的中心，位于一行内的两个倾斜线圈 103ti 位于该中心的（在跟踪线圈方向 T 上的）右面和左面。两个倾斜线圈 103ti 是串联连接。

印刷电路板 131 和 132 可以以这样一种方式层叠，即对印刷电路板 131 的（沿平行于跟踪方向 T 延伸的）两个侧表面以及印刷电路板 132 的（沿平行于跟踪方向 T 延伸的）两个侧表面进行安装，使得从跟踪方向 T 看上去是对称的，例如，可以将印刷电路板 131 安装在物镜一侧 102 的内部，将印刷电路板 132 安装在物镜 102 一侧的外部。在这种情况下，可以将各个方向上的驱动点做得彼此一致，从而可以避免在驱动点不一致时有可能产生的（纵向谐振，偏移谐振）谐振。

前述说明涉及这样一种结构，其中，聚焦线圈 103f 和跟踪线圈 103tr 形成于同一个印刷电路板 131 上。但是，也可以使聚焦线圈 3f 和跟踪线圈 3tr 分别形成于两个不同的印刷电路板上。此外，如图 8 所示，线圈单元 3' 可以具有印刷电路板 31' 和印刷电路板 32'，其中聚焦线圈 3f 和 3ti 形成在印刷电路板 31' 上，而跟踪线圈 3tr 形成在印刷电路板 32' 上。图 8 表明四个跟踪线圈 3ti 形成在印刷电路板 32' 上，然而，在印刷电路板 32' 可以形成两个跟踪线圈 3ti。同样在这些结构中，印刷电路板还可以位于另一个印刷电路板的顶部，这样，当从跟踪方向 T 看上去的时候，它们是左右对称的，由此可以部门驱动点不一致时可能引发的谐振。

用焊料（未示出）将四个导电弹性部件 104 的一个端部分别固定在透镜支架 101 的支承片 112 上，在上述透镜支架 101 上固定有线圈单元 103。驱动跟踪线圈必须有两个引线，驱动跟踪线圈必须有两个引线，驱动倾斜线圈必须有两个引线，这样，总共必须有六个驱动引线。这里，有四个单元的这种导电弹性部件 104 就足以弹性支承用作活动部件的透镜支架 101 了。这里，导电弹性部件 104 也可以用作引线。因此，四个导电弹性部件 104 被用作六个引线中的四个引线，而其它引线（未示出）连接到余下线圈上。

这两个线圈单元 103 分别位于两个磁隙 105g 内，而导电弹性部件 104 的另一个端部分别穿过引线底座 108，并通过焊接被固定在底板 109 上。由于这一点，所以，安装在线圈单元 103 上的聚焦线圈 103f、跟踪线圈 103tr 以及倾斜线圈 103ti 可以位于磁隙 105g 内，

同时，以悬臂方式对包含用于支承物镜 2 的透镜支架 101 的活动部件进行支承，使其相对于包含磁铁 105、轭底座 106、轭 107、引线底座 108 以及底板 109 的固定部件来说，是活动的。

图 11 中所采用的磁路的结构，同时，还有在图 11 所示的装置的线圈单元中使用的聚焦线圈、跟踪线圈以及倾斜线圈的排列和操作，都与前述第一实施例相似，这里，就省略对它的说明（参见图 2 到 4）。

如上所述，依据本发明，有两个完整的磁路，每一个磁路都至少包括两极磁化的一个磁铁 105，并且，在这两个磁路 105 中的每一个磁路中的磁隙 105g 内，不仅安装有聚焦线圈 103f 以及跟踪线圈 103tr，还安装有倾斜线圈 103ti。正是由于这一特征，不仅可以获得聚焦伺服以及跟踪伺服，还可以获得倾斜伺服（即对物镜 102 的倾角的调节）。因此，消除了这样一种需要，即，必须提供一个专门用于调节物镜 102 的倾角的磁铁。这可以减少部件数目，可以以低成本调节物镜 102 的倾角，也可减小整个物镜驱动装置的尺寸。

上述说明涉及这样一种结构，其中，相对于印刷电路板 132 的中心，两个倾斜线圈 103ti（在跟踪方向 T 上）分别位于其右侧和左侧。但是，与第一实施例相似，即便是在两个倾斜线圈 103ti 分别位于印刷电路板 132 的中心的（在聚焦方向 F 的）上面和下面的情况下，也能得到相似的结果。在这种情况下，磁路的结构以及线圈单元的操作都与第一实施例相似，这里，就省去对它的说明（参见图 5 至 7）。顺便一提，如图 12 所示，两个磁路可以分别包含一个磁铁 105'。在此情况下，磁铁 105' 和磁轭 107' 分别提供在透镜支架 101' 的相对于其中心的外侧。在此结构中，缝隙 111 不必提供在透镜支架 101' 中，因此，整个物镜驱动装置可以制得紧凑些。这一情况下的磁路如图 13A 和 13B 所示。这里磁隙意味着空气间隙或气路，在图 13A 中，磁隙 105g' 由两个磁铁形成，而在图 13B 中，磁隙 105g' 由一个磁铁形成。

在上述结构中，线圈单元 103 被接合并被固定在透镜支架 101 的一对侧面上，该侧面在平行于跟踪方向上延伸。但是，即便是在以下的另外一种结构中，也能获得相似的效果，在这种结构中，如图 9 所示，存在两个完整的磁路，每个磁路都至少包括一个在聚焦方向 F 上两极磁化的磁铁 105，且在磁路的每个磁隙 105g 内，安装有聚焦

线圈 130f,同时还安装有跟踪线圈 130tr 以及倾斜线圈 130ti,其中,各个聚焦线圈 130f 都缠绕在透镜支架 101 的侧面,而跟踪线圈 130tr 以及倾斜线圈 130ti 都分别被安装在透镜支架 101 的(沿跟踪方向 T 延伸的)的两个侧面上。顺便提一句,如图 12 所示,两个磁路可以
5 分别包括一个磁铁。

每一种聚焦线圈 130f 都是带有作为其缠绕框的透镜支架 101 的一种绕组线圈,这样,与作为形成于印刷电路板上的结构的聚焦线圈相比,聚焦线圈 130f 还是很容易制造的。

跟踪线圈 130tr 以及倾斜线圈 130ti 是安装于聚焦线圈 130f 顶部
10 部的一个无芯线圈。但是,跟踪线圈 130tr 以及倾斜线圈 130ti 也可以是形成于印刷电路板上的的一种结构。同样,跟踪线圈 130tr 以及倾斜线圈 130ti 也可以是一种绕组线圈,其中,如图 15 所示,在透镜支架 101 的(沿平行于跟踪方向 T 延伸的)侧面上,设计有线圈缠绕框 113,线圈就分别缠绕在这些线圈缠绕框 113 上。另外,跟踪线圈
15 130tr 以及倾斜线圈 130ti 中的一个就可以安装在聚焦线圈 130f 上,而另一个可以缠绕在线圈缠绕框 113 上。

按照磁铁 105 的 N 和 S 极之间的边界线 1105b,对磁铁 105 在聚焦方向 F 上进行两极磁化,且磁铁 105 与位于底座 106 上的靴 107 联结在一起。

20 磁铁 105 的宽度 W 是这样确定的,当处于活动部件的可移动的中间位置时,其中的活动部件由导电弹性部件 104 以悬臂方式可移动支承,这就是说,当处于聚焦方向 F 上的活动部件的自重位置上时,如图 16 所示,透镜支架 101 被安装在磁隙 105g 内。不仅两个跟踪线圈 130tr 的(沿平行于聚焦方向 F 延伸的)垂直侧 A 和 C 的右和
25 左内部垂直侧 A 和 C,而且两个倾斜线圈 130tr 的(沿平行于聚焦方向 F 延伸的)垂直面 a'和 c'的右和左外部垂直侧 a'和 c'都可以分别位于磁隙 105g(它指出了两个相互面对的磁铁 105 的宽度 W 内存在的一个空隙)内;其中上述两个跟踪线圈 130tr 位于聚焦方向 F 上的上段,同时还位于在跟踪方向 T 上的一行内的右侧和左侧;而上述两个
30 倾斜线圈 130tr 位于聚焦方向 F 上的下段,同时还位于跟踪方向 T 上的一行内的右侧和左侧。还可以这样确定磁铁 105 的高度 H,如图 16 所示,跟踪线圈 130tr 的(沿垂直于聚焦方向 F 延伸的)水平侧 B

和 D, 同时还有倾斜线圈 130ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b' 和 d' 都可以分别位于磁隙 105g (它指出了存在于两个相互面对的磁铁 105 的高度 H 内的一个空隙) 内。

如图 16 所示, 磁铁 105 的 N 和 S 极之间的边界线 105b 位于跟踪线圈 130tr 的 (沿聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B 的下面, 同时还位于倾斜线圈 130ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b' 和 d' 的底侧 b' 和顶侧 d' 的中间。磁铁 105 的中心实质上与透镜支架 101 的中心一致。

聚焦线圈 130f 位于磁铁 105 的 N 和 S 极之间的作为其边界线的边界线 105b 的上面和下面。上、下聚焦线圈 130f 是串联连接的, 但上、下聚焦线圈 130f 的电流的方向相反。在两个磁隙 105g 内的磁力线方向相反。

在图 14 和 15 中, 跟踪线圈 130tr 和倾斜线圈 130ti 的所有侧面都安装在透镜支架 1 的 (沿平行于跟踪方向 T 延伸的) 一个侧面上。但是, 这并不是一种限定, 还可以采用另一种结构; 即, 可将安装在磁隙 105g 内的以及能产生驱动力的面安装在透镜支架 1 的一个侧面上, 其中, 所述能产生驱动力的面例如可以是跟踪线圈 130tr (参见图 16) 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A、C, 当允许电路流入跟踪线圈 130tr 的情况下, 它可以在跟踪方向 T 上产生同一方向的驱动力。

透镜支架 101 位于两个磁隙 105g 中, 导电弹性部件 104 的另一个侧端穿过一个引线底座 108, 被焊接而固定在底板 109 上。这是由于这一点, 聚焦线圈 130f、跟踪线圈 130tr 以及倾斜线圈 130ti 可以位于磁隙 105g 内, 同时, 可以以悬臂方式支承包含支承物镜 102 的透镜支架 101 的活动部件, 以便相对于包括磁铁 5、轭底座 106、轭 107、引线底座 108 以及底板 109, 可以移动所述活动部件。

在图 14 中, 当允许电流流入聚焦线圈 130f 的情况下, 由于聚焦线圈 130f 内的电流流入了磁隙 105g, 因而依据傅雷明的左手定律, 在聚焦方向 F 上, 产生了驱动力。

在图 16 中, 在允许电流流入跟踪线圈 130tr 的情况下, 由于在两个跟踪线圈 130tr 内的 (由箭头标记出的) 电流流入了跟踪线圈 130tr 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A 和 C, 因而依据傅

雷明的左手定律，在跟踪方向 T 上，产生了相同方向的驱动力；以及，在允许电流流入倾斜线圈 130ti 的情况下，由于在两个倾斜线圈 130ti 内的（由箭头标记出的）电流流入了倾斜线圈 130ti 的（沿垂直于聚焦方向 F 延伸的）水平侧 b' 和 d'，因而依据雷明的左手定律，在聚焦方向 F 上，产生了相反方向的驱动力 F'。由于反方向驱动力 F'，从而围绕活动部件的中心产生了一个力矩，因而可以调节透镜支架 101 的倾角，从而，可以调节物镜 102 的倾角。

上述说明涉及这样一种结构，在这种结构中，在跟踪方向 T 上，两个跟踪线圈 130tr 和两个倾斜线圈 130ti 是左右对称的，在两个跟踪线圈 130tr 内产生了相同方向的驱动力，在两个倾斜线圈 130ti 内，产生了相反方向的驱动力。但是，如图 17 所示，跟踪线圈 130tr 的（沿平行于聚焦方向 F 的）垂直侧 A 可以位于磁铁 105 的宽度 W 的内部，跟踪线圈 130tr 的（沿平行于聚焦方向 F 的）垂直侧 C 可以位于磁铁 105 的宽度 W 的外部；同时，倾斜线圈 130ti 在跟踪方向 T 上，相对于磁铁 1105 的中心向外移动。还可以如图 16 所示，用两个跟踪线圈 130tr 来代替跟踪线圈 130tr；如图 17 所示，还可以用两个倾斜线圈 130ti 来代替倾斜线圈 130ti。另外，如图 17 所示，跟踪线圈 130tr 在数量上可以是一个，如图 16 所示，倾斜线圈 130ti 在数量上可以是两个。在上述这些结构中的任一结构中，都可以减轻物镜驱动装置的重置。

（实施例 3）

现在，图 18 是依据本发明的物镜驱动装置的第三实施例的透视图。在图 18 中，参考符号的意义分别如下，201 表示一个透镜支架，202 表示一个物镜，203 表示一个线圈单元，205 表示一个磁铁。

透镜支架 201 与先前所说明的第一实施例中采用的透镜支架 1 的结构相似。

线圈单元 203 包括所需数目的印刷电路板 203p，它们一个层叠在另一个的顶部，而每一个印刷电路板 203p 都包括一个跟踪线圈 203t 以及四个聚焦线圈 203fl 和 203fr。跟踪线圈 203t 位于印刷电路板 203p 的中央，而聚焦线圈 203fl 以及 203fr 位于上、下两段内，且相对于活动部件的物镜光轴方向的重心位置，它们位于该重心的右侧和左侧，其中，所述活动部件包括支承物镜 202 的透镜支架 201，

这就是说，聚焦线圈 203fl 和 203fr 位于跟踪线圈 203t 的右侧和左侧。聚焦线圈 203fl 的数目以及聚焦线圈 203fr 的数目可以分别为一个。因此，由于电流是分别提供给左和右聚焦线圈 203fl 和 203fr 的，所以左和右聚焦线圈 203fl 和 203fr 不是串联连接的，而且是彼此独立的。

前述说明涉及这样一种结构，其中，左和右聚焦线圈 203fl、203fr 以及跟踪线圈 203t 位于同一印刷电路板 203p 上。但是，作为对第三实施例的修改，可以分别将左和右聚焦线圈 203fl、203fr 以及跟踪线圈 203t 放置在两个印刷电路板上。同样，在这个实施例中，将要设置在印刷电路板上的聚焦线圈的数目为偶数，将要设置在印刷电路板上的跟踪线圈的数目为一。

线圈单元 203 被插入并被联结到透镜支架 201 的四口部件 201a 上，从而被固定到透镜支架 201 上。在线圈单元 203 的（在跟踪方向 T 上的）两端，形成了六个 V 槽 203v，而六个导电弹性部件 204 的一个侧端被焊料 203h 分别固定在六个 V 槽 203v 上。被用作引线的导电弹性部件 203 是由用于聚焦线圈驱动的两个部件 204 构成的，即总共是由六个部件 204 构成的。

顺便提一句，四个导电部件 204 足以弹性支承用作活动部件的透镜支架 201，因此，在采用四个导电弹性部件 204 来支承透镜支架 201 的情况下，引线（未示出）连接到剩余线圈上。

当前实施例中所采用的磁路与如图 6 所示的第一实施例中采用的磁路相似。此外，如图 9 和 10 所示，磁路可以包含一个磁铁。在此情况下，N 和 S 极之间的边界线位于沿跟踪方向 T 的磁铁 5 的中心。由于此缘故，整个物镜驱动装置可以制得紧凑些。磁铁 205 的宽度 W 是这样确定的，使得，在活动部件的可移动的中间位置处，其中由导电弹性部件 204 以悬臂方式来可移动地支承活动部件，这就是说，如图 19 所示，在活动部件在聚焦方向 F 上的自重位置处，当线圈单元 203 位于磁隙 205g 内时，在两个上、下段的左聚焦线圈 203fl 的垂直侧 a 和 c 的（沿平行于聚焦方向 F 的）右和左外部垂直侧 c 和 a，同时还有位于两个上、下段的右聚焦线圈 203fr，都可以分别位于磁隙 205（它指出了存在于相互面对的磁铁 205 的宽度 W 之间的一个空

隙)内。同样,磁铁 205 的高度 H 是这样确定的,如图 19 所示,上
 段聚焦线圈 203fl 和 203fr 的(沿垂直于聚焦方向 F 延伸的)水平侧
 b 和 d 的底侧 b,下段聚焦线圈 203fl 和 203fr 的(沿垂直于聚焦方
 向 F 延伸的)的顶侧 d,以及跟踪线圈 203t 的(沿垂直于聚焦方向 F
 5 延伸的)水平侧 B 和 D,都可以分别安装在磁隙 205g(它指出了存在
 于相互面对的磁铁 205 的高度 W 内的一个空隙)内。

如图 19 所示,磁铁 205 的 N 和 S 极之间的边界线 205b 不仅被设
 置在跟踪线圈 203t 的(沿平行于聚焦方向 F 延伸的)垂直侧 A 和 C
 之间的中部,而且还被设置在左聚焦线圈 203fl 的(沿平行于聚焦方
 10 向 F 延伸的)垂直侧 a、c 的右侧与右聚焦线圈 203fr 的(沿平行于
 聚焦线圈 F 延伸的)垂直侧 a、c 的左侧 c 之间的中部。磁铁 205 的
 中心实质上与线圈单元 203 的中心一致。

线圈单元 203 分别位于磁隙 205g 内,导电弹性部件 204 的另一
 一个侧端分别穿过引线底座 208,通过焊接而被固定在底板 209 上。如
 15 此,安装在线圈单元 203 上的聚焦线圈 203fl、203fr 以及跟踪线圈
 203t 都位于磁隙 205g 内,同时,以悬臂方式,对包含支承物镜 202
 的透镜支架 201 的活动部件进行支承,使得,其相对于包含磁铁 205、
 轭底座 206、轭 207、引线底座 208 以及底板 209 的固定部件,可以
 活动。

20 可以使用单独准备的倾角检测器,也可以利用光拾取器所给的再
 现信号,来检测光盘的倾角。

利用倾角检测器或是利用光拾取器的再现信号而得到的倾斜误
 差信号以及聚焦误差信号,被输入到图 20 所示的一个控制电路;以
 及,控制电路计算最佳电流 I_l 以及 I_r ,其中所述电流能促使图 19
 25 所示的聚焦线圈 203fl 以及 203fr,使其能同时校正聚焦误差和倾斜
 误差,此后,控制电路将所计算的电流 I_l 和 I_r 输出。作为受控目标
 的物镜驱动装置,不仅执行聚焦驱动操作,同时还在聚焦方向 F 上移
 动,而且还执行倾斜驱动操作,其中,聚焦驱动操作的执行,是由于
 响应了图 21A 所示的电流 I_l 和 I_r ,而产生了作为驱动力 F_l 和 F_r 的
 30 总和的一个力;而倾斜驱动操作的执行,是由于围绕透镜支架 201 的
 重心 G 产生了力矩 $M = F_l \times d - F_r \times d$,这种力矩是由于驱动力 F_l
 和 F_r 之间的差产生的。这里, d 表示透镜支架 201 的重心 G 与聚焦

线圈 203fl、203fr 之间的距离。

现在，图 21B 显示了与图 21A 不同的一种情况，所产生的驱动力 F_l 和 F_r 在相反的两个方向上。在这种情况下，将要在聚焦方向 F 上移动的一个力是 $F_l + (-F_r)$ ，而倾斜力矩为 $F_l \times d - (-F_r \times d)$ 。

- 5 无论如何，物镜驱动装置利用函数 $(F_l + F_r)$ 执行一个聚焦驱动操作，利用函数 $(F_l - F_r)$ 执行一个倾斜驱动操作。

左和右聚焦线圈 203fl 以及 203fr 不仅可以执行聚焦伺服，还能调节物镜 102 的倾角。因此，消除了这样一种需要，即，提供专用于调节物镜 202 的倾角的一个线圈以及一个磁铁。这可以减少部件数
10 目，可以以低成本来调节物镜 202 的倾角，还可减少整个物镜驱动装置的尺寸。

在跟踪线圈 203 被推动的情况下，由于（由图 19 中的箭头所表示的）电流流入了跟踪线圈 203t 的（在平行于聚焦方向 F 上延伸的）垂直侧 A 和 C ，因而在跟踪方向 T 上，产生了相同方向的驱动力，这
15 样，依据记录媒体的离心率，可以在跟踪方向 T 上移动物镜 202。

在线圈单元 203 被插入并被联结到透镜支架 201 的四口部件 201a 的情况下，磁隙 205g 的数目可以减小到一。这还可以减小部件的数目，可以以低成本调节物镜 202 的倾角，还可减小整个物镜驱动装置的尺寸。

- 20 在上述实施例中，利用左和右聚焦线圈 203fl 和 203fr，不仅可以实现聚焦伺服，还可以实现对物镜 202 的倾角的调节。但是，在以下结构中，也可提供相似的效果：即，如图 22 所示，一个线圈单元 203 包括所需数目的印刷电路板 203p，这些电路板一个位于另一个的顶部，这些电路板 203p 中的每一个都包括一个聚焦线圈 203f 以及四个跟踪线圈 203t；聚焦线圈 203f 位于每一个印刷电路板 203p 的中
25 央；跟踪线圈 203tu 和 203td 分别位于活动部件的中心上沿物镜光轴方向的上部和下部，所述活动部件包括支承物镜 202 的一个透镜支架 201，这就是说，跟踪线圈 203tu 以及 203td 位于沿聚焦线圈 203f 分别向上和向下延伸的两个右行和左行内；以及按照磁铁 205 的 N 和
30 S 极之间的边界线 205b，在聚焦方向上，对磁铁 205 进行两极磁化。在这种结构中，磁路与图 2 所示的第一实施例中采用的磁路相似。顺便提一句，如图 9 所示，磁路可以包括一个磁铁 $5'$ ，并且该线圈单

元也可以设置在磁隙 5g' 中。磁路如图 10 所示, 可以获得和线圈在磁路包含了如上所述的两个磁铁和磁隙的情况下的操作相似的操作。

5 这里, 另一种可替换的方案是, 跟踪线圈 203tu 和 203td 在数目上分别也可以是一个。由于电流是单独提供给上、下跟踪线圈 203tu 和 203td 的, 因而它们没有串联连接, 但它们是独立连接的。

10 在这种结构中, 聚焦线圈 203f 以及跟踪线圈 203tu、203td 位于同一个印刷电路板 203p 上。但是, 聚焦线圈 203f 以及跟踪线圈 203tu、203td 也可以分别位于两个不同的印刷电路板上。在这种情况下, 同样, 印刷电路板上的聚焦线圈以及跟踪线圈的数目也分别是一以及偶数。

15 磁铁 205 的宽度 W 是这样确定的, 在活动部件的可移动的中间位置处, 其中, 由导电弹性部件 204 以悬臂方式对活动部件进行可活动的支承, 这就是说, 在聚焦方向 F 上的活动部件的自重位置处, 如图 23 所示, 当线圈单元 203 位于磁隙 205g 内时, 两个上段的右和左跟踪线圈 203tu 的 (沿平行于聚焦方向延伸的) 垂直侧 A 和 C 的右和左内部垂直侧 C 和 A, 同时还有两个下段的右和左跟踪线圈 203td, 都可以分别位于磁隙 205g (它指出了存在于相互面对的磁铁 205 的宽度 W 内的一个空隙) 内。同样, 可以这样确定磁铁 205 的高度, 如图 20 23 所示, 不仅是位于印刷电路板 203p 中心处的聚焦线圈 203f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b 和 d, 同时还有上段跟踪线圈 203tu 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的顶侧 D, 以及下段跟踪线圈 203td 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B, 都可以分别安装在磁隙 205g (它指出了存在于相互面对的磁铁 205 的高度 W 内的一个空隙) 内。

30 如图 23 所示, 磁铁 205 的 N 和 S 极之间的边界线 205b, 不仅位于聚焦线圈 203f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b 和 d 的顶侧 b 和底侧 d 之间的中部, 而且还位于上段跟踪线圈 203tu 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B 以及下段跟踪线圈 203td 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的顶侧 D 之间的中部。这样, 磁铁 205 的中心实质上与线圈单元 203 的中心一致。

利用倾斜检测器或利用光拾取器的再现信号所得到的一个倾斜误差信号以及跟踪误差信号,被输入到一个校正电路,该电路与图 20 所示的控制电路相似;以及,控制电路计算最佳电流 I_u 以及 I_d , 如图 23 所示,上述电流能促进跟踪线圈 203tu 以及 203td,使得能同时校正跟踪误差以及倾斜误差,之后,控制电路输出所得到的电流 I_u 和 I_d 。作为受控目标的物镜驱动装置,不仅执行跟踪驱动操作,同时还在聚焦方向 F 上移动,而且还执行一个倾斜驱动操作,其中,聚焦驱动操作的执行,是由于响应了电流 I_l 和 I_r ,而产生了作为驱动力(未示出)的总和的一个力;而倾斜驱动操作的执行,是由于围绕透镜支架 201 的重心产生了力矩,这种力矩是由于驱动力之间的差产生的。

在聚焦线圈 203f 被驱动的情况下,由于(由图 18 中的箭头所标记的)电流流入图 18 的聚焦线圈 203f 的沿着与垂直于聚焦方向 F 的水平侧 b 和 d,因而,在聚焦方向 F 上,产生了相同方向的驱动力,这样,物镜 202 可以依据记录媒体表面的振动而在聚焦方向 F 上移动。

此外,在第三实施例中可以由具有聚焦线圈和跟踪线圈的控制单元的倾斜驱动的系统可以应用于根据图 11 和 12 所示的第二实施例的物镜驱动装置。

正如此前所说明的那样,依据本发明的第一方面,提供了一种物镜驱动装置,其中将一个其上安装有聚焦线圈、跟踪线圈以及倾斜线圈的线圈单元放置在磁路的同一个磁隙内,所述磁路至少包括一个磁铁。在本物镜驱动装置中,可以利用用于聚焦和跟踪驱动的磁铁,对物镜的倾角进行调节,这样作,消除了一种需要,即必须提供专用于调节物镜倾角的一个磁铁。因此,依据本发明的第一方面,有可能防止由于对物镜的倾角进行调节所引起的成本的增加,以及物镜驱动装置的尺寸的增加。

同样,依据本发明的第二方面,提供了一种物镜驱动装置,其中,有两个完整的磁路,每个磁路都至少包括被两极磁化的一个磁铁,并且,在两个磁路中每个磁路的磁隙内,都安装有一个线圈单元,其上安装有一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈。在当前的物镜驱动装置中,可以利用用于聚焦以及跟踪驱动的磁铁,对物镜的倾

角进行调节，这样做会消除提供专用于调节物镜倾角的一个磁铁的需要。因此，依据本发明的第二方面，有可能防止由对物镜倾角的调节而引起的物镜驱动装置的成本的增加，以及其尺寸的增加。

- 5 另外，依据本发明的第三方面，提供了一种物镜驱动装置，其中，
 其上安装有若干聚焦线圈以及一个跟踪线圈的一个线圈单元位于磁
 路的同一个磁隙内，所述磁路至少包括一个两极磁化的磁铁，电流是
 被分别提供给包含在线圈单元内的若干聚焦线圈的，因而能依据响应
 所提供的电流而产生的驱动力的和来执行聚焦伺服，以及，由于驱动
 力之间的差而产生了围绕活动部件重心的一个力矩，从而可以在执行
 10 聚焦伺服的同时，对物镜的倾角进行调节。在本物镜驱动装置中，利
 用右和左聚焦线圈，不仅可以实现聚焦伺服，还能对物镜的倾角进行
 调节，这样会消除提供专用于调节物镜倾角的一个线圈和一个磁铁的
 需要。因此，依据本发明的第三方面，有可能防止由对物镜倾角的调
 节而引起的物镜驱动装置的成本的增加，以及其尺寸的增加。

说明书附图

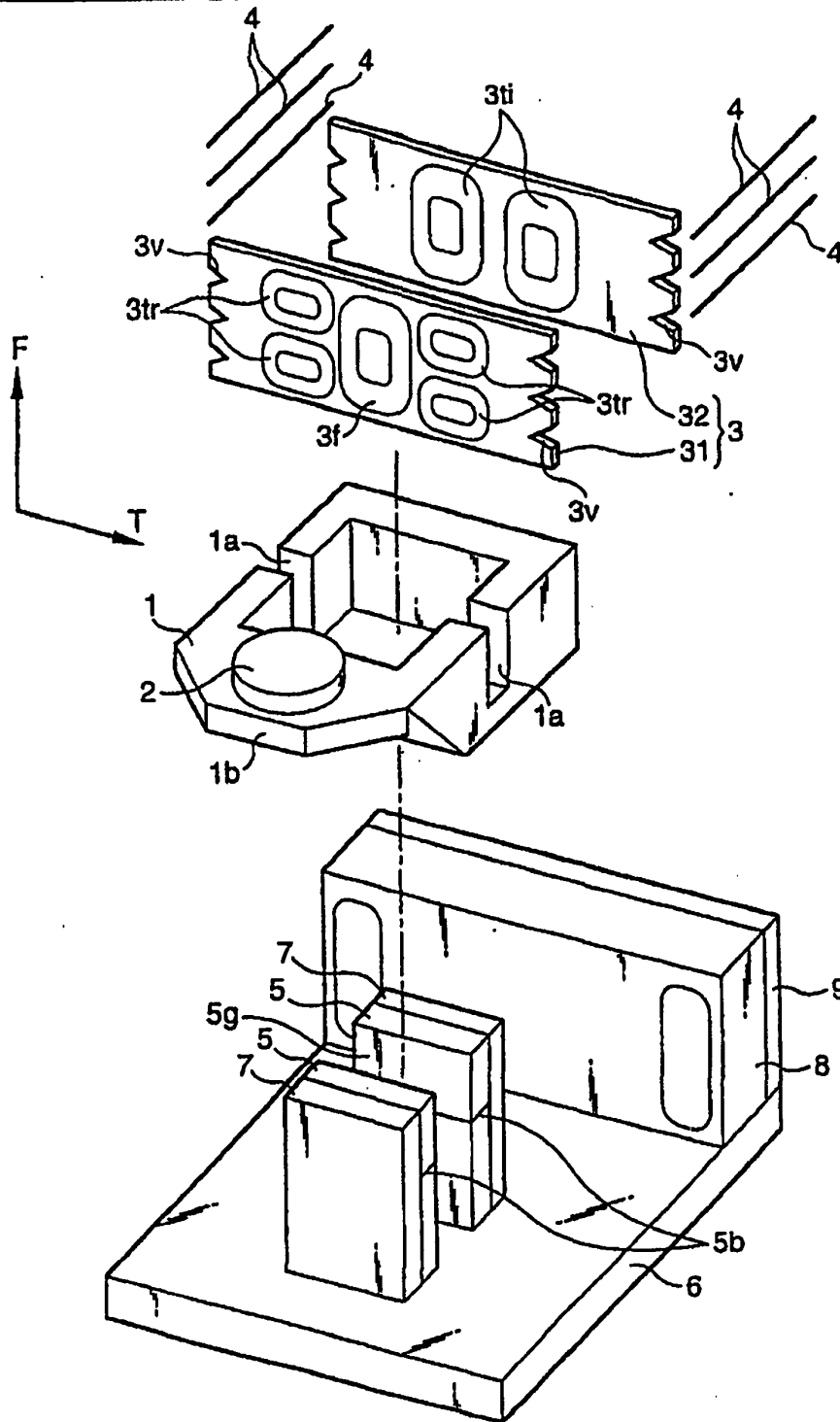


图 1
1

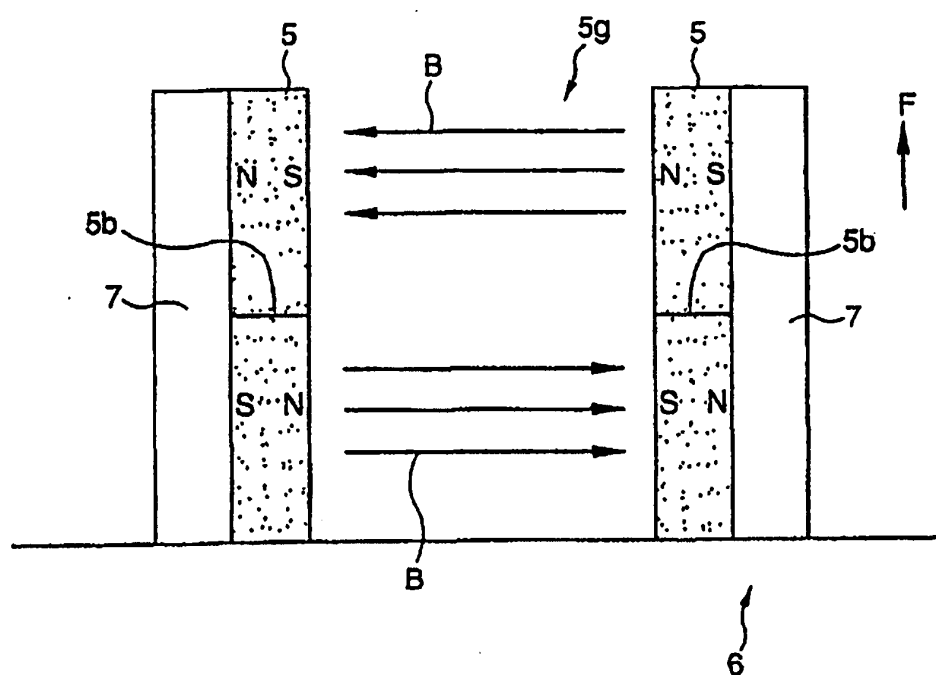


图 2

01.07.18

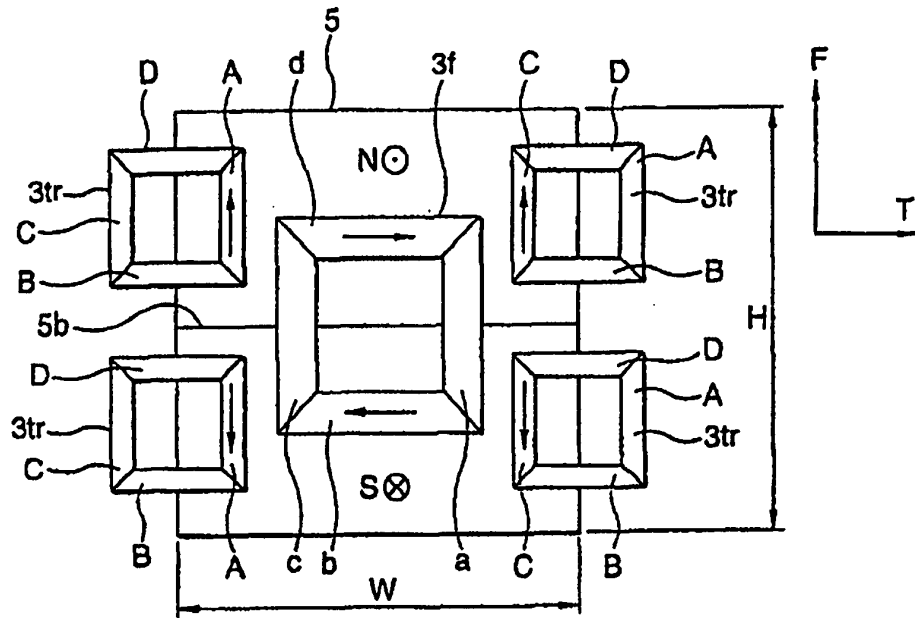


图 3

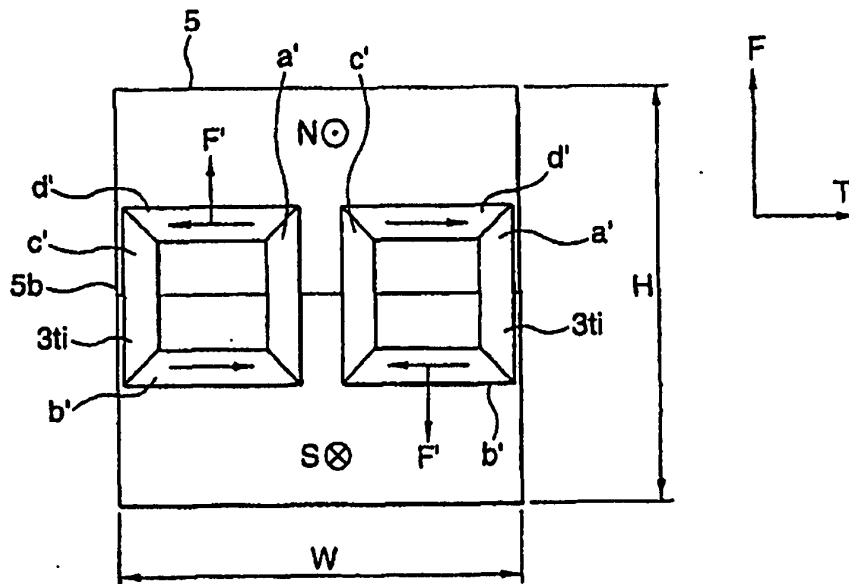


图 4

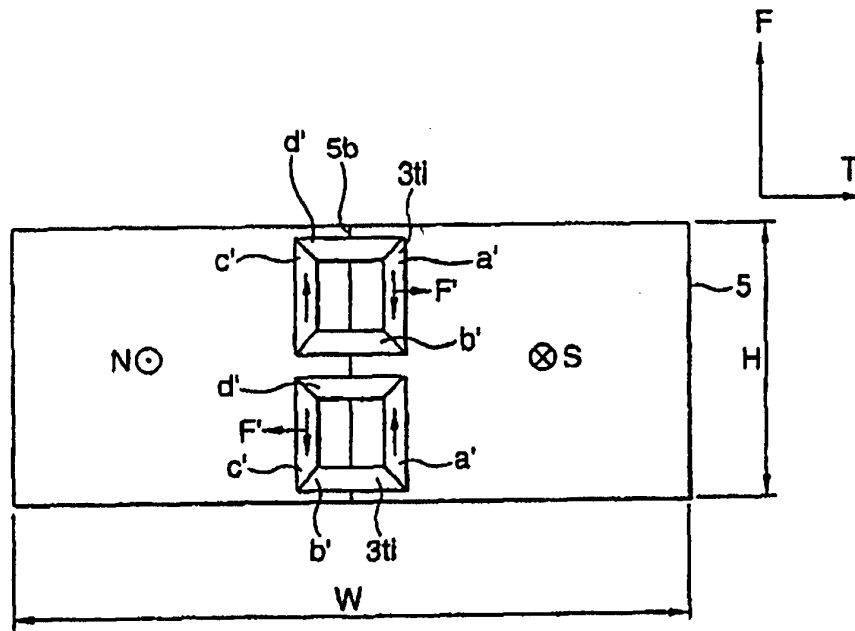


图 5

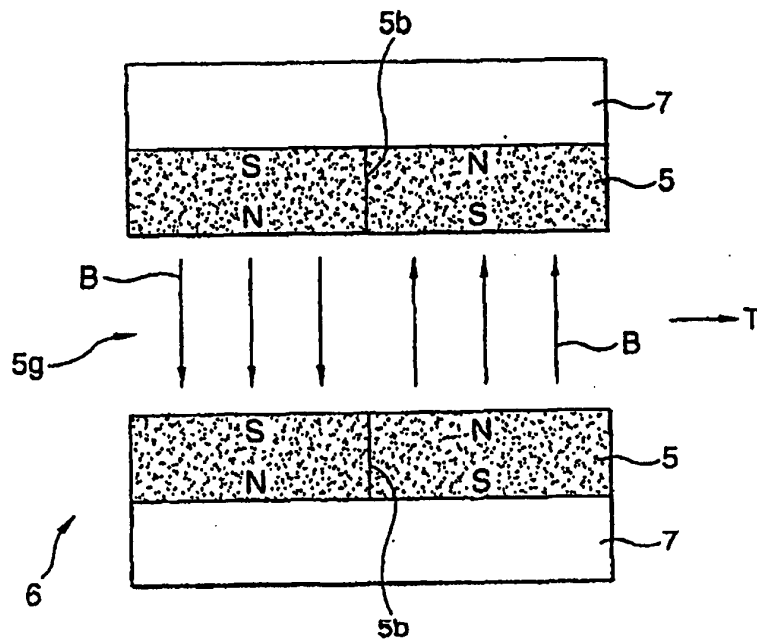
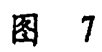


图 6



01.05.15

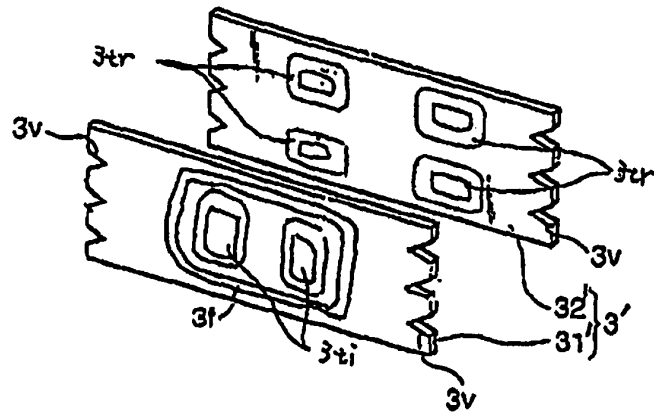


图 8

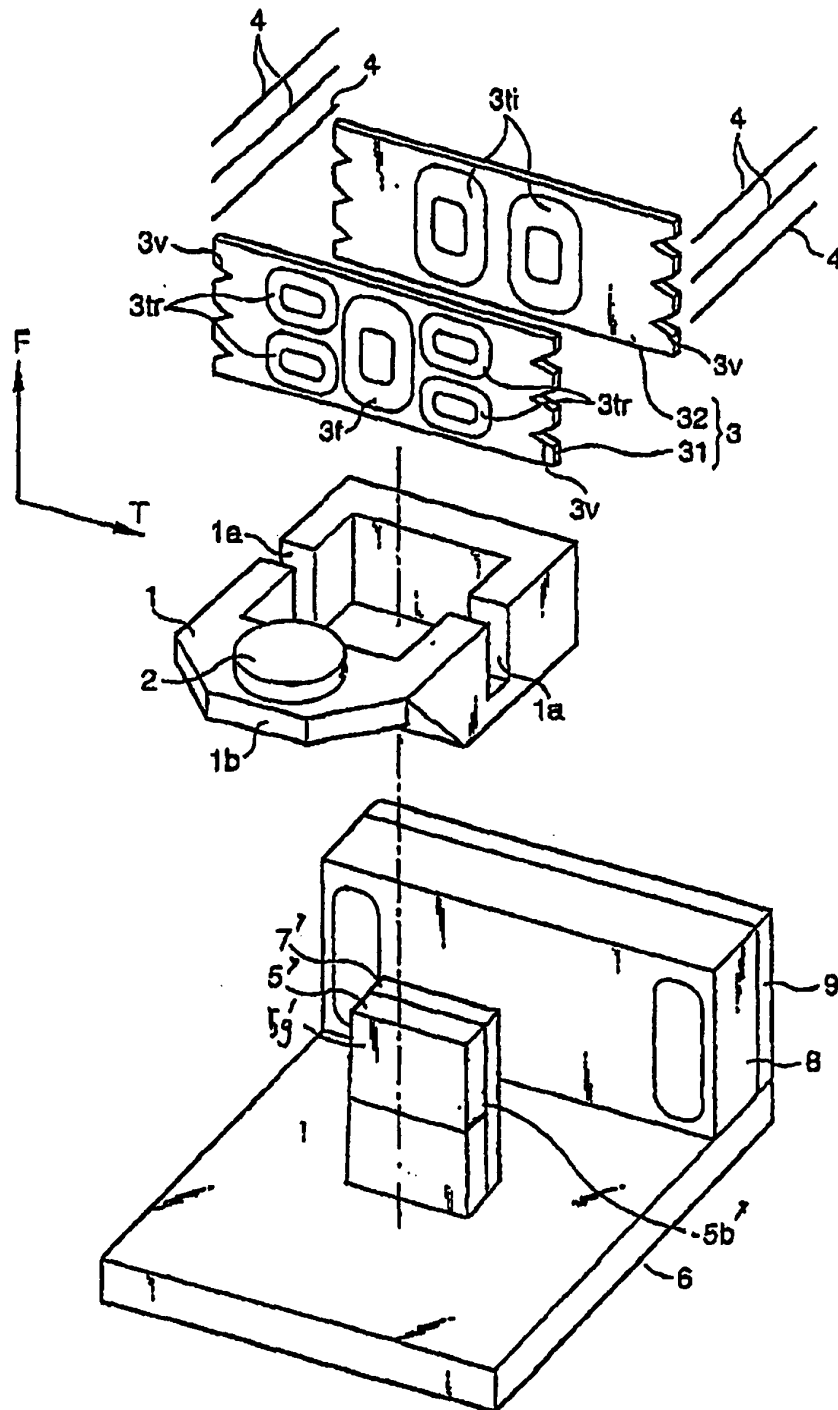


图 9

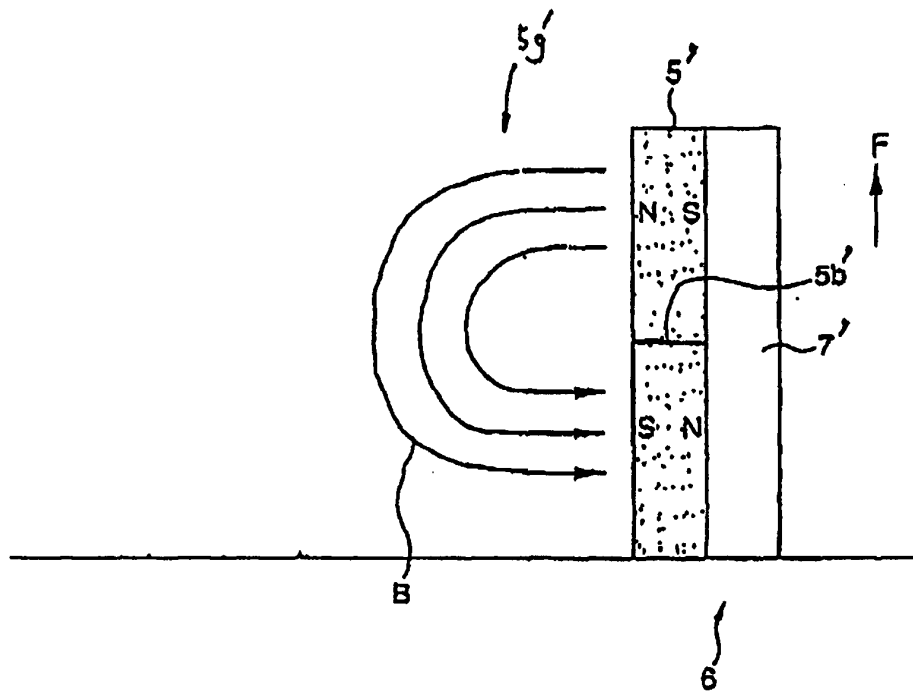


图 10

01.07.15

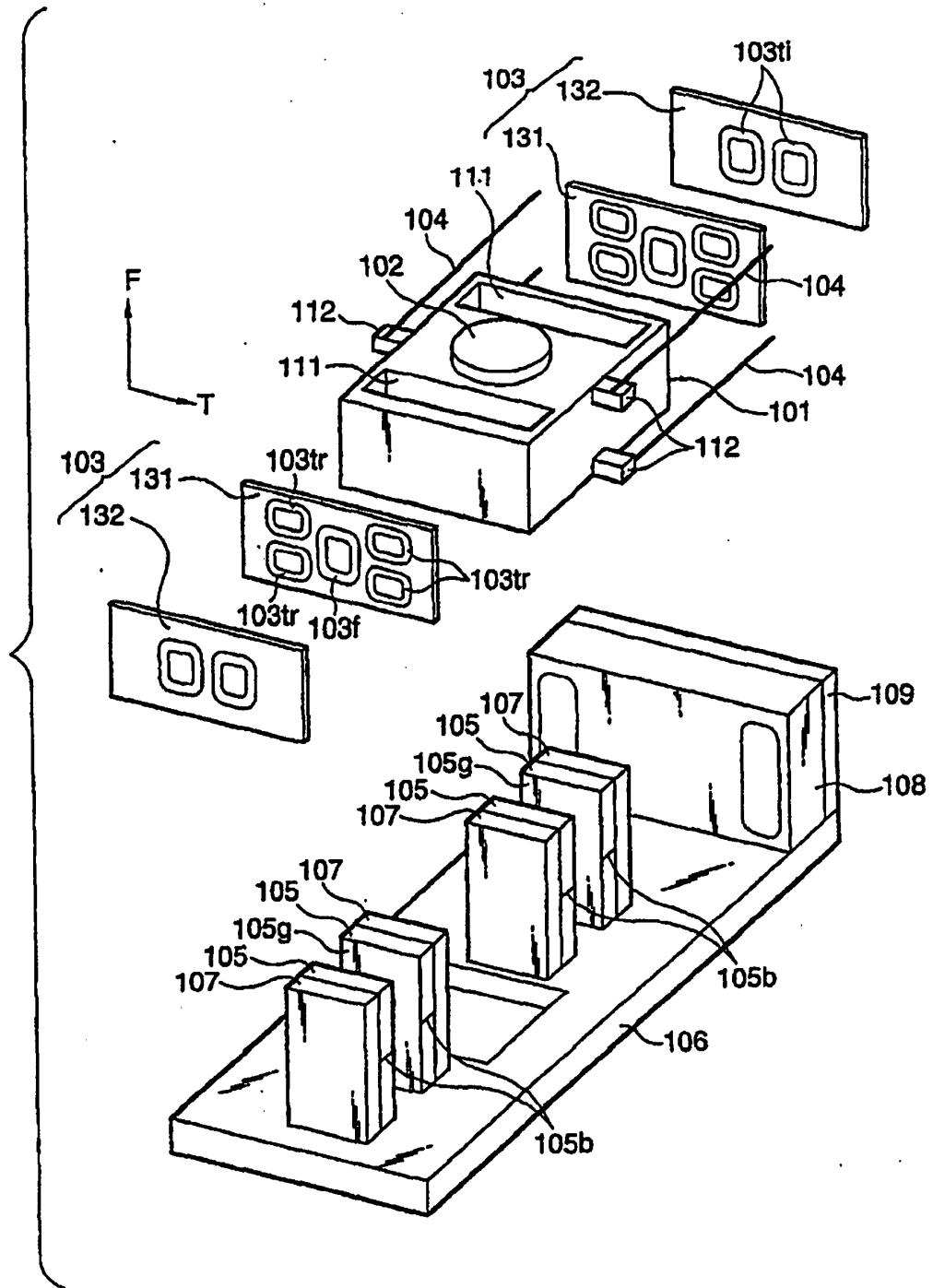


图 11

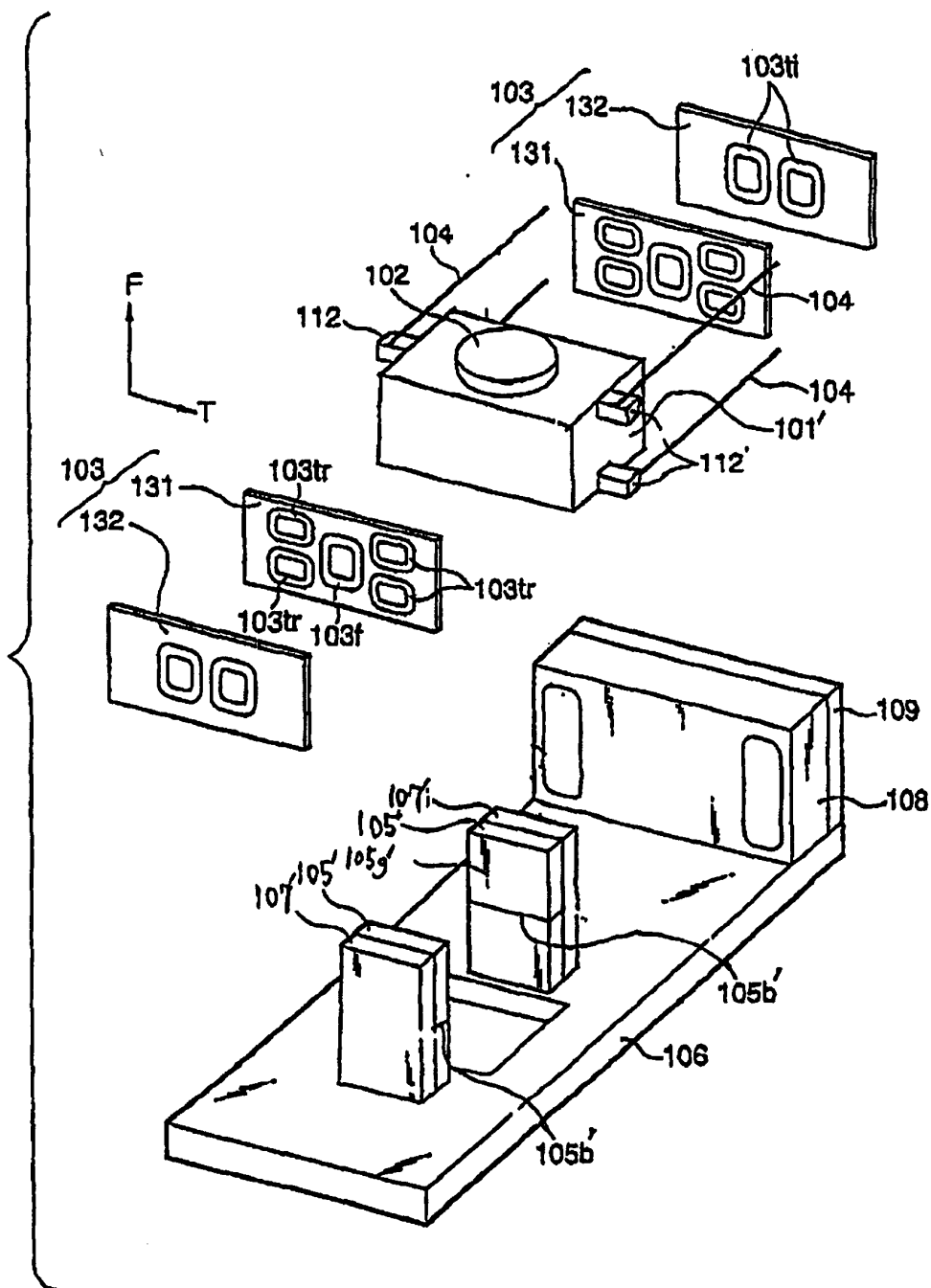


图 12
10

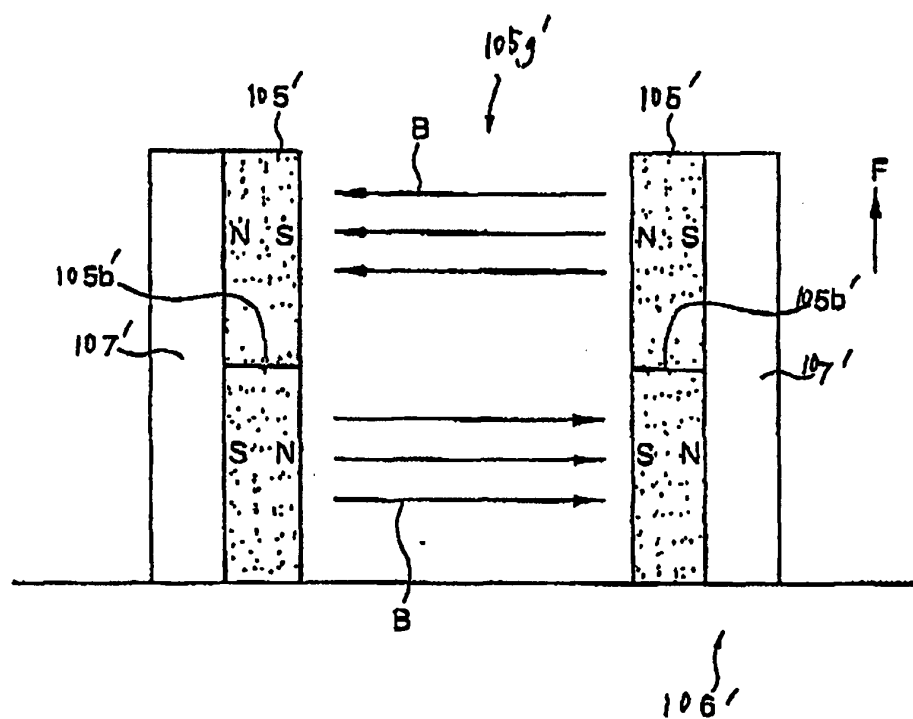


图 13A

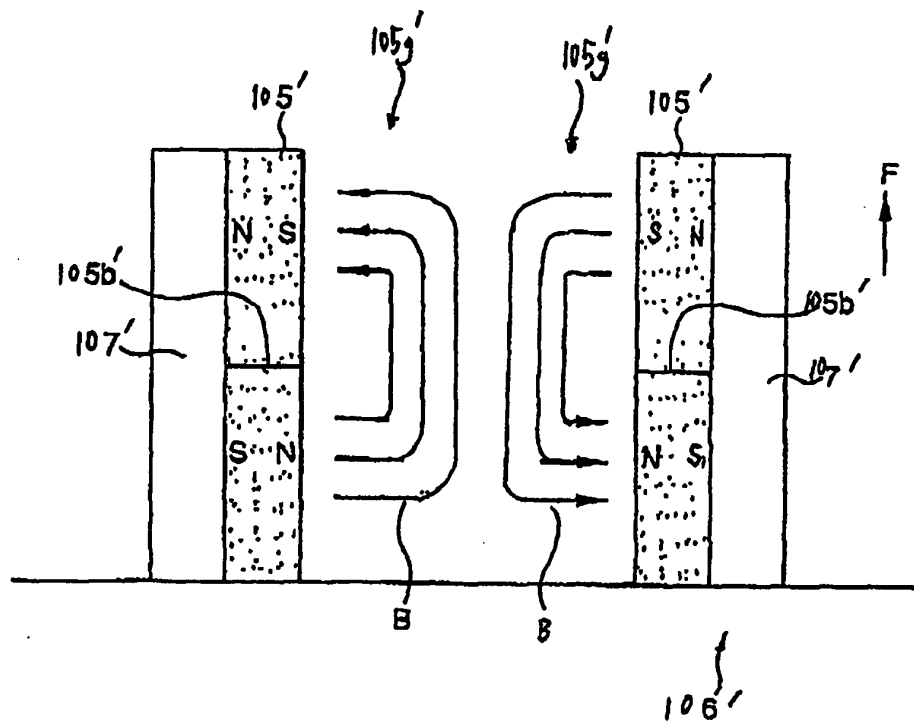


图 13B

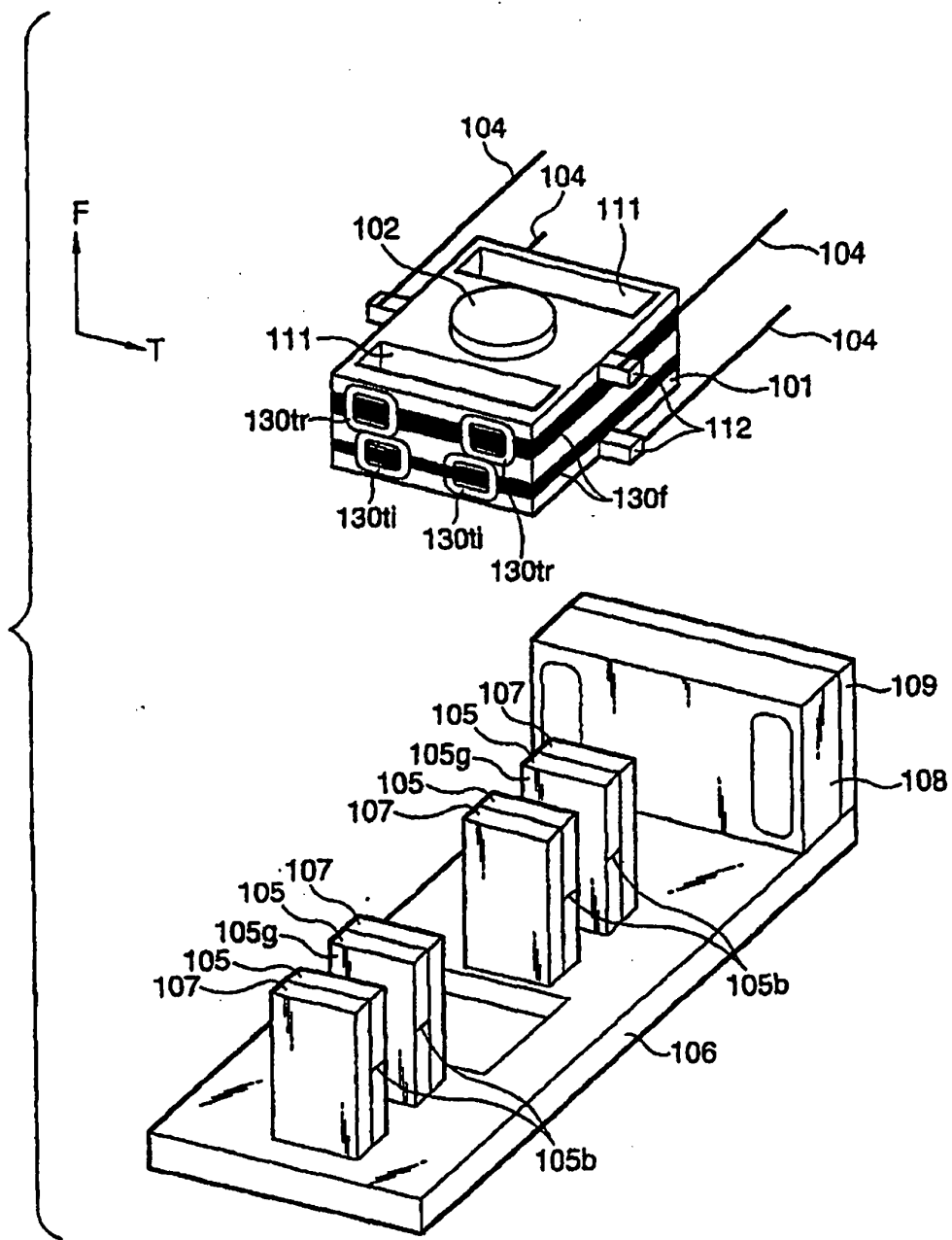


图 14

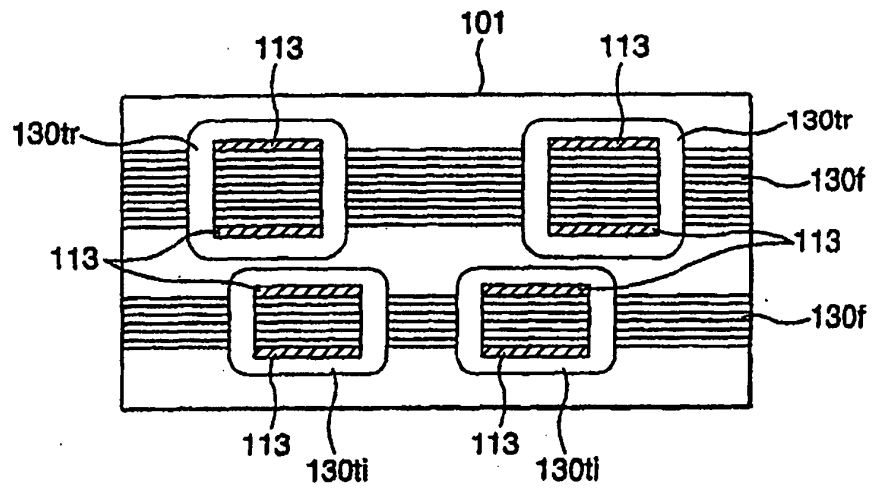


图 15

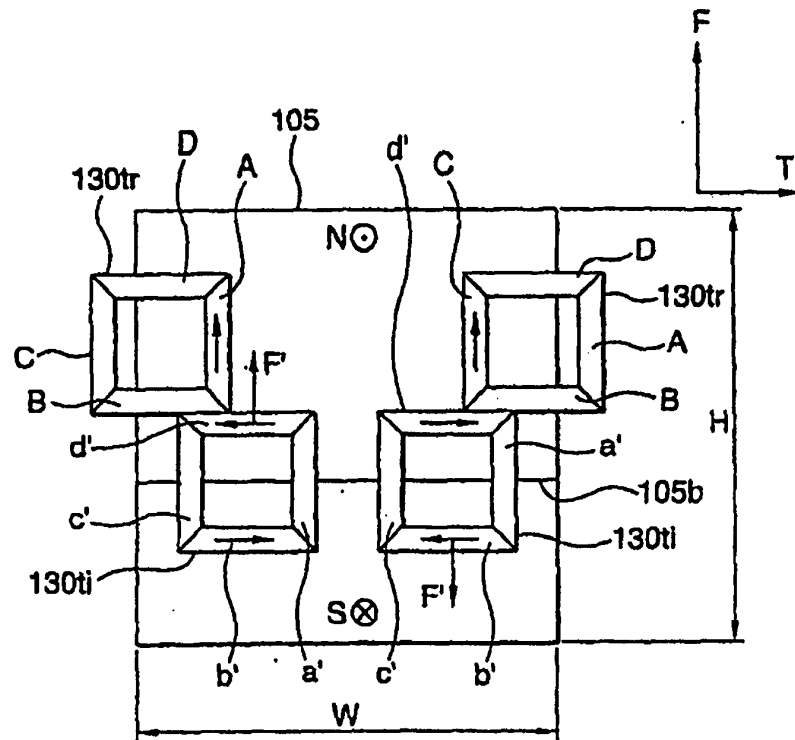


图 16

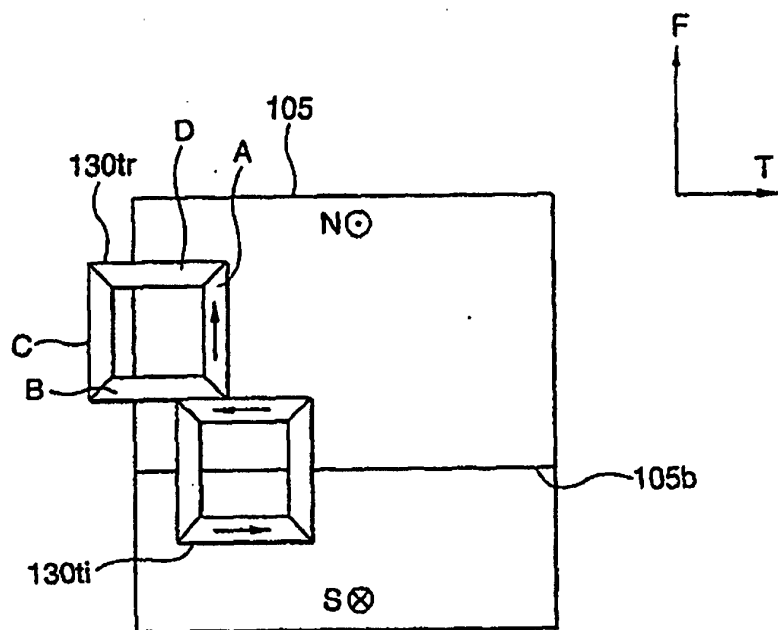


图 17

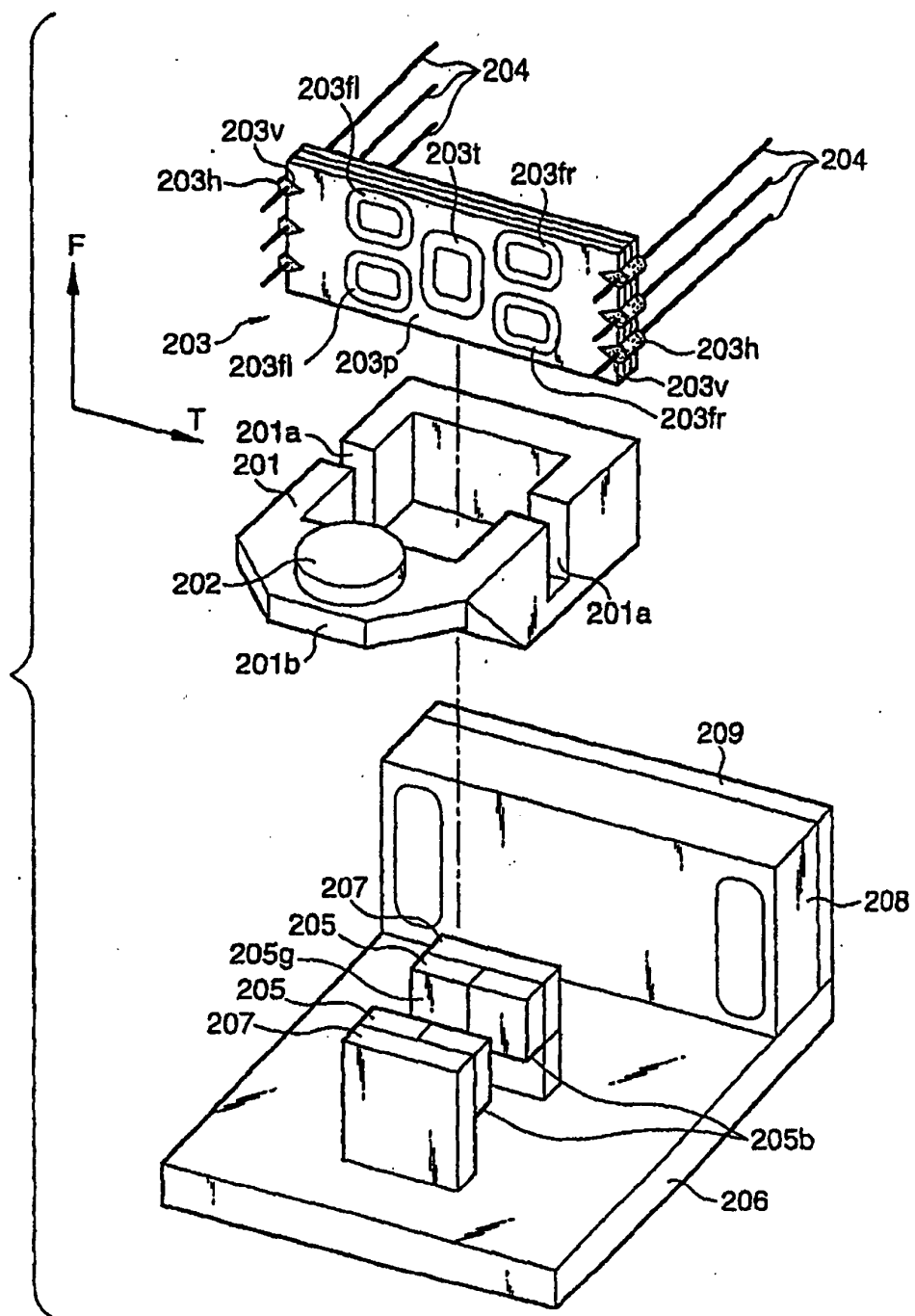


图 18

16

17

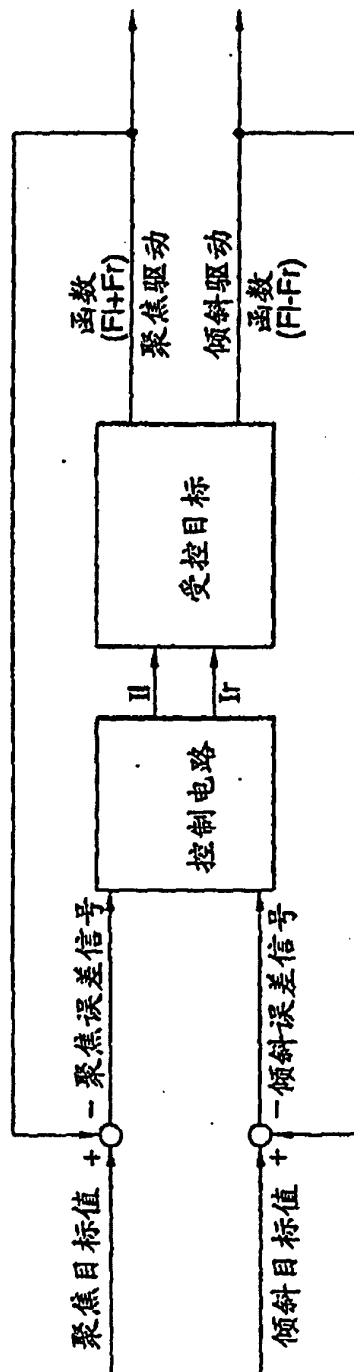


图 20

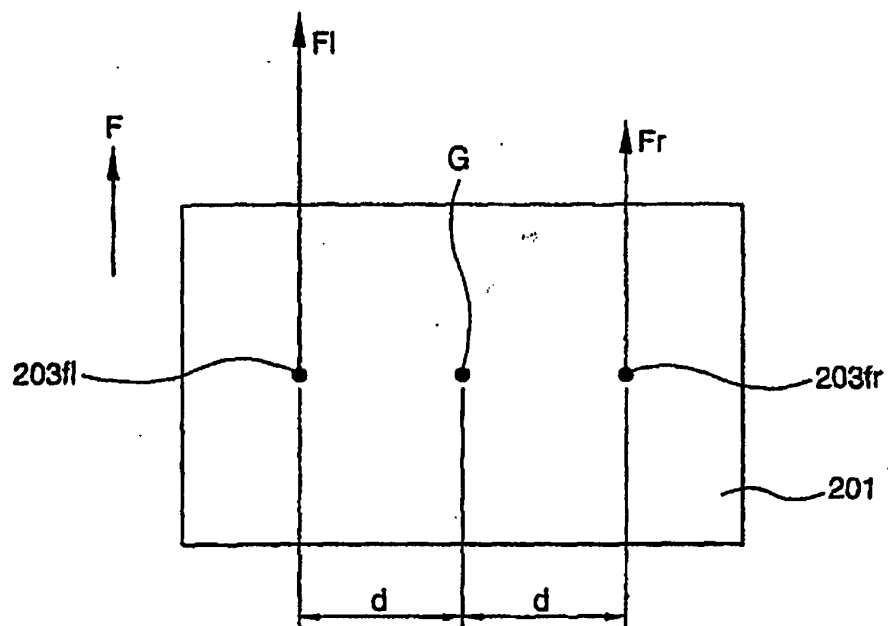


图 21A

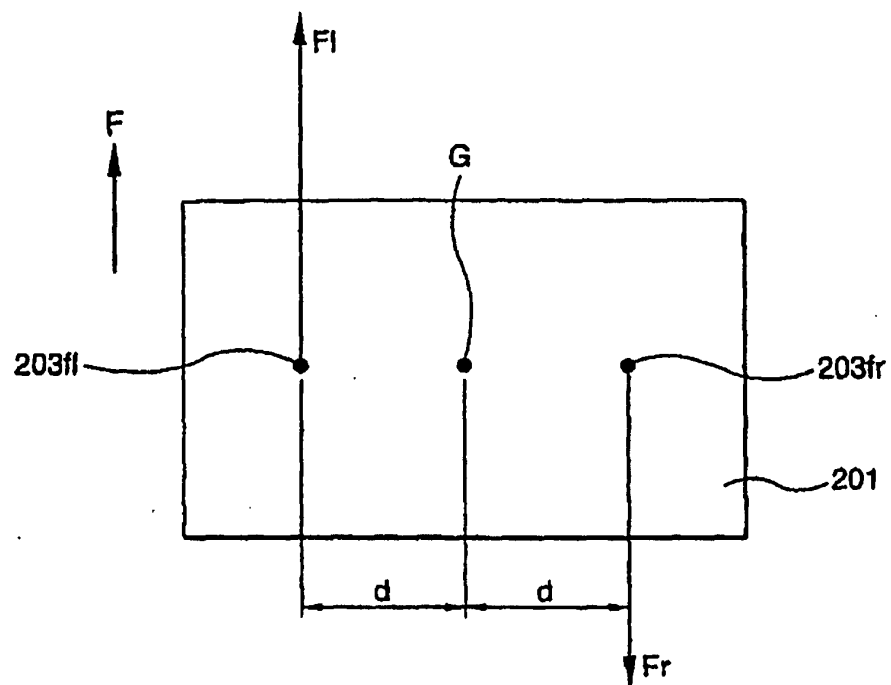


图 21B

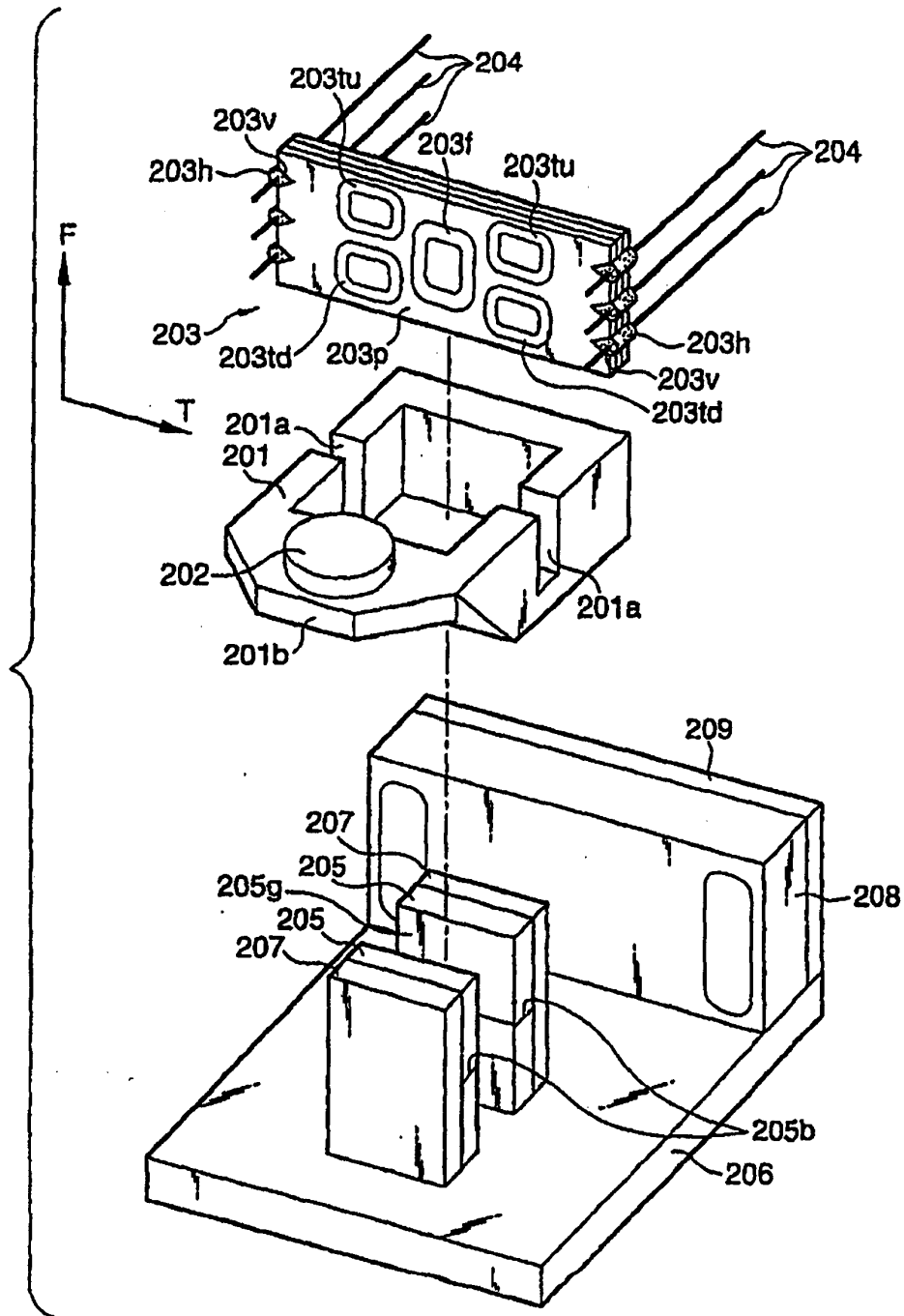


图 22

20

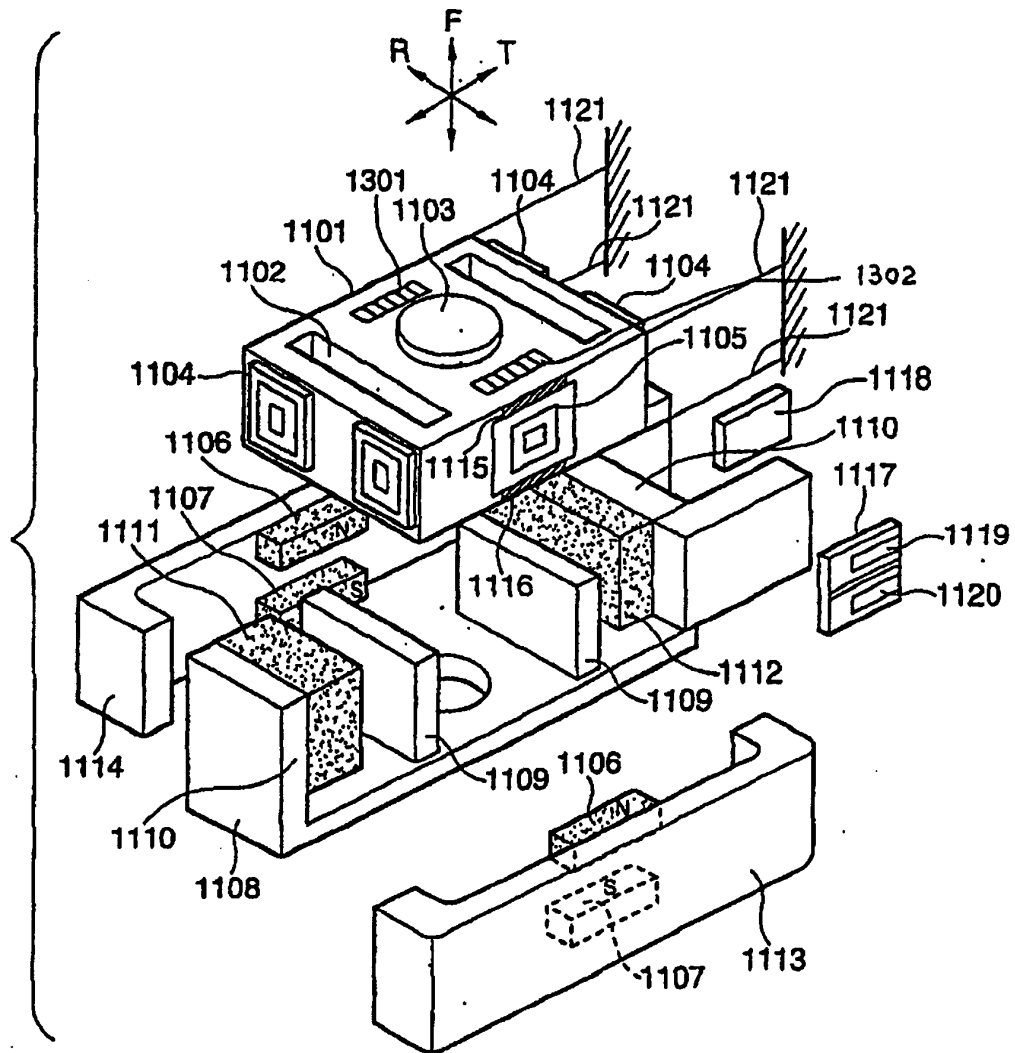


图 24

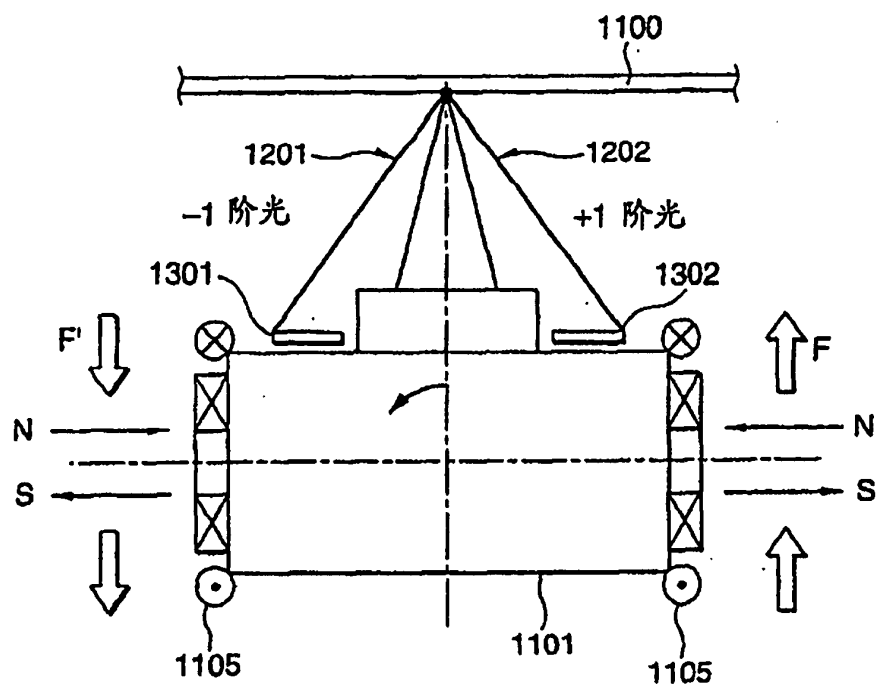


图 25

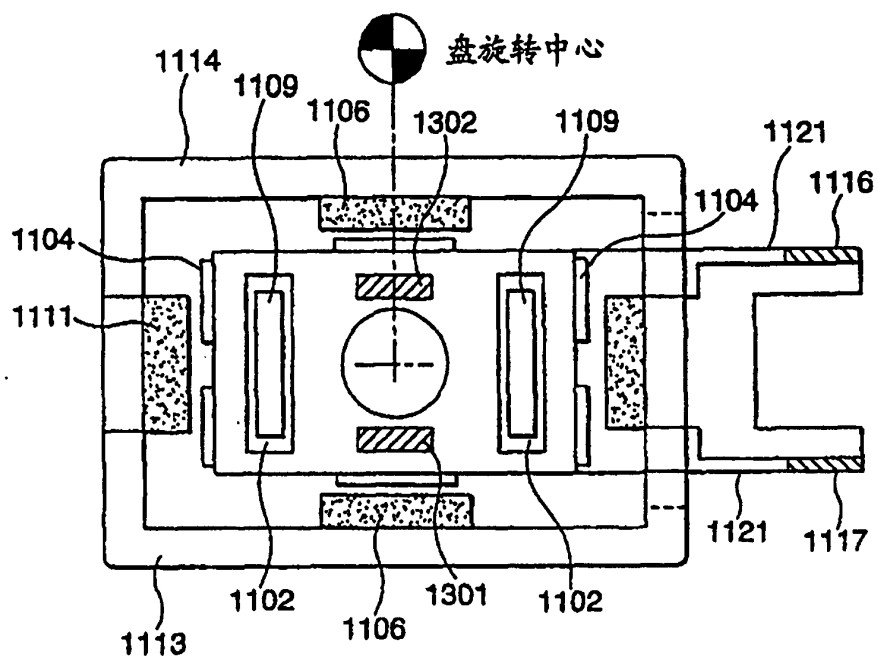


图 26





[Handwritten signature]

Attorney Docket No. 1793.1290

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Won-ik CHO, et al.

Application No.: 10/849,190

Group Art Unit: 2627

Confirmation No. 7296

Filed: May 20, 2004

Examiner: HINDI, NABIL Z.

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME
AND METHOD

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the duty of disclosure provisions of 37 CFR § 1.56, there is hereby provided certain information which the Examiner may consider material to the examination of the subject U.S. patent application. It is requested that the Examiner make this information of record if it is deemed material to the examination of the subject application.

1. Enclosures accompanying this Information Disclosure Statement are:
 - 1a. ☒ Form PTO-1449.
 - 1b. ☒ Copy(ies) of IDS citation(s), except for U.S. Patents and U.S. Patent Application publications.
 - 1c. ☐ English language copy of a communication(s) from a foreign Patent Office or a PCT International Search Report.
 - 1d. ☐ English language translation (complete, Abstract or relevant portion(s)) attached to non-English language publications as indicated on the attached Form PTO-1449.
 - 1e. ☒ Explanations of Relevancy of References (ATTACHMENT 1(e), hereto) for providing a concise explanation of non-English publications.
 - 1f. ☐ List of Copending Applications (ATTACHMENT 1(f), hereto).
 - 1g. ☒ List of Additional Submitted Documents (ATTACHMENT 1(g), hereto).
2. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(b):

(Check either Item 2a or 2b or 2c or 2d)

 - 2a. ☐ Within three months of the filing date of a national application;
 - 2b. ☐ Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application.
 - 2c. ☐ Before the mailing of a first Office Action on the merits; or
 - 2d. ☐ Before the mailing of a first Office Action after the filing of a Request for Continued Examination under § 1.114.

06/12/2007 YPOLITE1 00000000 10049190

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3. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(c) after the period specified in paragraph 2 above but before the mailing date of any of a Final Office Action under § 1.113, a Notice of Allowance under § 1.311 or an action that otherwise closes prosecution in the application, AND

(Check either Item 3a or 3b; Item 3b to be checked if any reference known for more than 3 months)

- 3a. ☐ The § 1.97(e) Statement in Item 5 below is applicable; OR
 3b. ☐ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
☐ enclosed.
☐ to be charged to Deposit Account No. 19-3935.

4. ☒ This Information Disclosure Statement is filed under 37 CFR § 1.97(d) after the period specified in paragraph 3 above, but on or before payment of the Issue Fee, AND

- 4a. ☒ The § 1.97(e) Statement in Item 5 below is applicable; AND
 4b. ☒ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
☐ enclosed.
☒ to be charged to Deposit Account No. 19-3935.

5. ☒ Statement under § 1.97(e) (*applicable if Item 3a or Item 4a is checked*)
(Check either Item 5a or 5b)

- 5a. ☒ In accordance with 37 CFR § 1.97(e)(1), it is stated that each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.
 5b. ☐ In accordance with 37 CFR § 1.97(e)(2), it is stated that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known by any individual designated in § 1.56(c) more than three months prior to the filing of this Information Disclosure Statement.

6. ☐ This is a continuation/divisional/continuation-in-part application under 37 CFR § 1.53(b).

(Check appropriate Items 6a and/or 6b)

- 6a. ☐ Copies of the publications listed on the attached Form PTO-1449 which were previously cited in prior application Serial No. ___, filed on ___, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, have been omitted pursuant to 37 CFR § 1.98(d).
 6b. ☐ Copies of the publications listed on the attached Form PTO-1449 which were not previously cited in prior application Serial No. ___, filed on ___, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, are provided herewith.

7. ☐ This is a Request for Continued Examination under 37 CFR § 1.114.
(Check either Item 7a or 7b)
- 7a. ☐ The Issue Fee has not been paid.
- 7b. ☐ A Petition to Withdraw from issue under 37 CFR § 1.313(c) is filed concurrently herewith or has been granted. A Request for Continued Examination under 37 CFR § 1.114, after payment of the Issue Fee, is proper in accordance with 37 CFR § 1.114(a), respectively.
8. ☐ This is a Supplemental Information Disclosure Statement.
(Check either Item 8a or 8b)
- 8a. ☐ This Supplemental Information Disclosure Statement under 37 CFR § 1.97(f) supplements the Information Disclosure Statement filed on _____. A bona fide attempt was made to comply with 37 CFR § 1.98, but inadvertent omissions were made. These omissions have been corrected herein. Accordingly, additional time is requested so that this Supplemental IDS can be considered as if properly filed on _____.
- 8b. ☐ This Supplemental Information Disclosure Statement is timely filed within one (1) month of the Notice under 37 CFR §§ 1.97 and 1.98, mailed _____.
9. ☐ In accordance with 37 CFR § 1.98, a concise explanation of what is presently understood to be the relevance of each non-English language publication is:
(Check appropriate Items 9a, 9b, 9c and/or 9d)
- 9a. ☐ satisfied for the non-English language publication(s) cited on the enclosed "English language version of the search report or action which indicates the degree of relevance found by the foreign office". (See MPEP § 609, Minimum Requirements for an Information Disclosure Statement, Part A(3): Concise Explanation of Relevance, 8th Ed., Rev. 2)
- 9b. ☐ set forth in the application.
- 9c. ☐ satisfied for the non-English language publication(s) indicated on the attached Form PTO-1449 as having an English language translation (complete or relevant portion(s)) attached thereto.
- 9d. ☐ enclosed as Attachment 1(e), hereto.
10. No admission is made that the information cited in this Statement is, or is considered to be, material to patentability nor a representation that a search has been made (other than search report(s) from a counterpart foreign application or a PCT International Search Report, if submitted herewith). 37 CFR §§ 1.97(g) and (h).

11. The Commissioner is authorized to credit any overpayment or charge any additional fee required under 37 CFR § 1.17 for this Information Disclosure Statement to Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Dated: June 11, 2007
1201 New York Ave., N.W., 7th Floor
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501

By: Darleen J. Stockley
Darleen J. Stockley
Registration No. 34,257



Sheet 1 of 1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP/ART UNIT
	May 20, 2004	2627

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE
	AA	2002/0006090	01/17/2002	Kawano			
	AB						
	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO	ABSTRACT
	AG	1335613	02/13/2002	China	US 2002/0006090 (Reference AA) corresponds to CN 1335613 (Reference AG)	X
	AH					
	AI					
	AJ					
	AK					
	AL					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

		TRANSLATION YES NO
	AM	

EXAMINER	DATE CONSIDERED
----------	-----------------

**ATTACHMENT 1(e)**

EXPLANATIONS OF RELEVANCY OF REFERENCES	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2004	2627

Chinese Patent Office Action, mailed March 30, 2007 and issued in corresponding Chinese Patent Application No. 2004100684337 cites Chinese Patent Publication No. 1335613 (Reference AG).

US 2002/0006090 (Reference AA) corresponds to CN 1335613 (Reference AG).



ATTACHMENT 1(g)

LIST OF ADDITIONAL SUBMITTED DOCUMENTS	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2004	2627

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialling same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE
	AA						
	AB						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB- CLASS	TRANSLATION YES NO	
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

							TRANSLATION YES NO	
	AE	Chinese Patent Office Action, mailed March 30, 2007 and issued in corresponding Chinese Patent Application No. 2004100684337						X

EXAMINER	DATE CONSIDERED
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

[19]中华人民共和国国家知识产权局

[51]Int. Cl⁷

G11B 7/135

[12] 发明专利申请公开说明书

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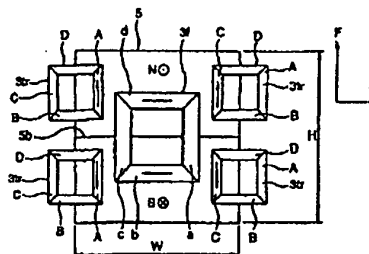
代理人 陈 霁 王忠忠

权利要求书 5 页 说明书 23 页 附图页数 24 页

[54] 发明名称 光拾取器中所使用的物镜驱动装置

[57] 摘要

在至少包含一个两极磁化的磁铁的磁路的同一个磁隙内,安装有一个线圈单元,该线圈单元上安装有一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈。



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知识产权出版社出版

权 利 要 求 书

1. 用于光拾取器中的一种物镜驱动装置，包括：
一个磁路，包括被两极磁化的一个磁铁；以及
一个线圈单元，包括一个聚焦线圈、一个跟踪线圈以及一个倾斜
5 线圈，
其中所述聚焦线圈、跟踪线圈以及倾斜线圈都位于所述磁路的一个磁隙内。
2. 依据权利要求1的一种物镜驱动装置，其中磁路包含若干磁铁，线圈单元设置在由磁铁形成的磁隙内。
- 10 3. 依据权利要求1的一种物镜驱动装置，其中所述线圈单元包括若干印刷电路板，以及所述聚焦线圈、跟踪线圈以及倾斜线圈都分别安装于所述印刷电路板上。
4. 依据权利要求1的一种物镜驱动装置，其中所述线圈单元包括若干第一印刷电路板以及第二印刷电路板，所述聚焦线圈和所述跟踪
15 线圈都位于所述第一印刷电路板上，所述倾斜线圈位于所述第二电路板上。
5. 依据权利要求1的一种物镜驱动装置，其中线圈单元包含若干第一印刷电路板和第二印刷电路板，聚焦线圈和倾斜线圈安装在第一印刷电路板内，而跟踪线圈安装在第二印刷电路板内。
- 20 6. 依据权利要求1的一种物镜驱动装置，其中所述聚焦线圈的数目为一，所述跟踪线圈的数目为偶数，所述倾斜线圈的数目为二，其中所述磁铁是在聚焦方向上被两极磁化的。
7. 依据权利要求1的一种物镜驱动装置，其中所述聚焦线圈的数目为偶数，所述跟踪线圈的数目为一，所述倾斜线圈的数目为二，
25 其中所述磁铁是在跟踪方向上被两极磁化的。
8. 用于光拾取器的一种物镜驱动装置，包括：
两个磁路，每一个都包括一个两极磁化的磁铁；以及
一个线圈单元，包括一个聚焦线圈、一个跟踪线圈以及一个倾斜
线圈，
30 其中，所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内。
9. 依据权利要求8的一种物镜驱动装置，其中磁路包含若干磁

铁, 线圈单元设置在由磁铁形成的磁隙内。

10. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈、跟踪线圈以及所述倾斜线圈都分别安装在所述印刷电路板上。

5 11. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元包括若干第一印刷电路板以及第二印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装于所述第一印刷电路板上, 所述倾斜线圈位于所述第二印刷电路板上。

12. 依据权利要求 8 的一种物镜驱动装置, 其中线圈单元包含若干
10 于第一印刷电路板和第二印刷电路板, 聚焦线圈和倾斜线圈安装在第一印刷电路板内, 而跟踪线圈安装在第二印刷电路板内。

13. 依据权利要求 8 的一种物镜驱动装置, 其中所述线圈单元被固定在沿平行于跟踪方向延伸的透镜支架的两个侧面上。

14. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈的
15 数目为一, 所述跟踪线圈的数目为偶数, 所述倾斜线圈的数目为二, 同时, 所述磁铁是被在聚焦方向上两极磁化的。

15. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述倾斜线圈的数目为二, 同样, 所述磁铁是在聚焦方向上被两极磁化的。

20 16. 依据权利要求 8 的一种物镜驱动装置, 其中所述聚焦线圈缠绕在透镜支架的侧面, 所述跟踪线圈以及所述倾斜线圈分别安装在沿平行于所述跟踪方向延伸的两个侧面上。

17. 依据权利要求 16 的一种物镜驱动装置, 其中安装于透镜支架的一个面上的所述跟踪线圈以及所述倾斜线圈的数目分别为二。

25 18. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈和所述倾斜线圈都叠加在所述聚焦线圈上。

19. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈和所述倾斜线圈都缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从所述侧面上凸出来。

30 20. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从所述侧面上凸出来, 所述倾斜线圈都叠加在聚焦线圈上。

21. 依据权利要求 16 的一种物镜驱动装置, 其中所述跟踪线圈都叠加在聚焦线圈上, 所述倾斜线圈缠绕在线圈缠绕框上, 所述线圈缠绕框位于所述透镜支架的侧面上, 并从该侧面上凸出来。

22. 在光拾取器中所用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号, 对物镜倾角进行调节, 该装置包括:

一个磁路, 包括被两极磁化的一个磁铁; 以及

一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

10 其中所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内,

其中聚焦伺服的执行是通过将电流分别提供给若干聚焦线圈, 从而在若干聚焦线圈内所产生了驱动力的总和, 而实现的,

15 其中对所述物镜的倾斜调节利用了由于所述多个驱动力之间的差而产生的围绕活动部件的重心的力矩而实现的。

23. 依据权利要求 22 的一种物镜驱动装置, 其中磁路包含若干磁铁, 线圈单元设置在由磁铁形成的磁隙内。

24. 依据权利要求 22 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及跟踪线圈都分别安装于所述
20 印刷电路板上。

25. 依据权利要求 22 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装于所述印刷电路板上。

26. 依据权利要求 22 的一种物镜驱动装置, 其中所述聚焦线圈
25 的数目为偶数, 所述跟踪线圈的数目为一, 所述磁铁是在跟踪方向上被两极磁化的。

27. 在光拾取器中所使用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号来调节物镜倾角, 所述装置包括:

一个磁路, 包括一个两极磁化的磁铁; 以及

30 一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

其中, 所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所

述磁路的一个磁隙内，

其中，跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈，而在所述若干聚焦线圈内产生的驱动力的总和而实现的，

其中，对物镜的倾角的调节是由多个驱动力之间的差而围绕活动
5 部件的重心产生了力矩，从而实现的。

28. 依据权利要求 27 的一种物镜驱动装置，其中磁路包含若干磁铁，线圈单元设置在由磁铁形成的磁隙内。

29. 依据权利要求 27 的一种物镜驱动装置，其中所述线圈单元
10 包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都安装于所述印刷电路板上。

30. 依据权利要求 27 的一种物镜驱动装置，其中所述线圈单元包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都安装在所述印刷电路板上。

31. 依据权利要求 27 的一种物镜驱动装置，其中所述聚焦线圈
15 的数目为一，所述跟踪线圈的数目为偶数，所述磁铁在聚焦方向上被两极磁化。

32. 在光拾取器中所使用的一种物镜驱动装置，用于检测光盘倾角，以便依据所述光盘的倾角信号来调节物镜倾角，所述装置包括：
两个磁路，分别包括一个两极磁化的磁铁；以及
20 一个线圈单元，包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈，

其中，所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内，

其中，跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈，
25 而在所述若干聚焦线圈内产生的驱动力的总和而实现的，

其中，对物镜的倾角的调节是由多个驱动力之间的差而围绕活动部件的重心产生了力矩，从而实现的。

33. 依据权利要求 32 的一种物镜驱动装置，其中磁路包含若干磁铁，线圈单元设置在由磁铁形成的磁隙内。

30 34. 依据权利要求 32 的一种物镜驱动装置，其中所述线圈单元包括若干印刷电路板，所述聚焦线圈以及所述跟踪线圈都分别安装于所述印刷电路板上。

35. 依据权利要求 32 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装在所述印刷电路板上。

36. 依据权利要求 32 的一种物镜驱动装置, 其中所述聚焦线圈的数目为偶数, 所述跟踪线圈的数目为一, 所述磁铁在聚焦方向上被两极磁化。

37. 在光拾取器中所使用的一种物镜驱动装置, 用于检测光盘倾角, 以便依据所述光盘的倾角信号来调节物镜倾角, 所述装置包括:

两个磁路, 分别包括一个两极磁化的磁铁; 以及
10 一个线圈单元, 包括一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈,

其中, 所述聚焦线圈、所述跟踪线圈以及所述倾斜线圈都位于所述磁路的一个磁隙内,

其中, 跟踪伺服的执行是通过将电流分别提供给若干跟踪线圈, 而在所述若干聚焦线圈内产生的驱动力的总和而实现的,

其中, 对物镜的倾角的调节是由多个驱动力之间的差而围绕活动部件的重心产生了力矩, 从而实现的。

38. 依据权利要求 37 的一种物镜驱动装置, 其中磁路包含若干磁铁, 线圈单元设置在由磁铁形成的磁隙内。

39. 依据权利要求 37 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都分别安装于所述印刷电路板上。

40. 依据权利要求 37 的一种物镜驱动装置, 其中所述线圈单元包括若干印刷电路板, 所述聚焦线圈以及所述跟踪线圈都安装在所述印刷电路板上。

41. 依据权利要求 37 的一种物镜驱动装置, 其中所述聚焦线圈的数目为一, 所述跟踪线圈的数目为偶数, 所述磁铁在聚焦方向上被两极磁化。

说明书

光拾取器中所使用的物镜驱动装置

技术领域

- 5 本发明涉及构成一个光盘单元的光拾取器中所使用的物镜驱动装置，该光拾取器将一束光斑投射到记录媒体上，以便从光记录媒体上读出信息。

背景技术

- 构成一个光盘单元的光拾取器一般是由物镜驱动装置构成的，该物镜驱动装置包括一个物镜以及用于将光传送到物镜上并接收从物镜来的光的一个光学系统，所述物镜驱动装置位于光系统安装台上。物镜驱动装置由一个活动部件和一个固定部件构成。其中活动部件包括一个物镜、聚焦线圈以及跟踪线圈。固定部件包括一个磁路。活动部件通过四个导线被支承在固定部件上，其中，四个导线中的每个导线都被由象粘弹性部件这样的弹性减振器部件部分包围，并被其握住。

- 作为不仅能在聚焦方向以及跟踪方向上驱动物镜，还能校正正在盘上作为影象形成的光斑的像差和散光的一种物镜驱动装置，我们知道在日本专利公开平 9-231595 中公开了这样一种装置。本发明设备的特征在于，如图 24、25 和 26 所示，在与光盘相对的透镜支架 1101 的表面，至少放置了沿光盘的径向方向或物镜 1103 的切线方向延伸的一对光传感器 1301, 1302；在光盘的径向方向中，在透镜支架 1101 的一个侧面或两个侧面上，放置有用于校正物镜的倾角的线圈 1105；在与透镜支架 1101 的侧面相对而放置的一对轭(yoke)1113 和 1114 上，放置有一对反极性磁部件 1106 和 1107，用于以这样一种方式校正物镜的倾角，即，这对反极性磁部件与线圈 1105 的位置相应，由此，依据光传感器 1301 和 1302 的输出，就可检测到相对于光盘 1110 的物镜的倾角。依据这样检测到的物镜倾角，以及所计算出的准直仪光轴和物镜光轴间的移动值，向线圈 1105 提供了一个用于倾角校正的电流，因而驱动了线圈 1105，并且，由于线圈 1105 和反极性磁部件 1106 和 1107 之间的电磁相互作用，从而驱动了透镜支架 1101 的侧面，这样，可以以自由倾斜方式，对透镜支架 1101 的侧面进行伺

服控制。

光传感器对 1301 和 1302 分别被安装在透镜支架 1101 的物镜 1103 的两侧，且如图 25 所示，它们用来接收由光头发射出的以及由光盘槽所衍射的主光束 (primary light) 1201, 1202。如图 27 所示，来自光传感器 1301, 1302 的电信号被放大器 1407, 1408 放大，之后，被差分输入到一个差分放大器 1403。从差分放大器 1403 的输出中，可以计算出光盘 1100 和透镜支架 1101 之间的倾角。

如图 27 所示，根据如此计算出的倾角以及物镜光轴和准直仪光轴之间的偏移，最好是，利用设置在 ROM (只读存储器) 内的预置部件 1404，计算出透镜的一个最佳倾角；根据上述两个计算结果，经过一个相位补偿电路 1405 以及一个驱动放大器 1406，来驱动倾角校正线圈 1105，用于伺服控制。

参见透镜支架 1101 的结构，在其平面内，形成有两个狭缝 1102，通过这两个狭缝，可以分别插入与其相关的轭部件 1109；在透镜支架 1101 的中心部分，安装有物镜 1103；在透镜支架 1101 的一对彼此相向的侧面上，放置有用于两个跟踪驱动的矩形扁平线圈 1104，因而总共有四个线圈 1104。同样，在透镜支架 1101 的在光盘径向方向 (R) 上的两个相向的面上，作为用于倾角校正的线圈 1105，放置了一对矩形扁平线圈；在用于倾角校正的线圈 1105 的上方和下方放置有印刷电路板 (未示出)，它们是通过铜箔部件 1115、1116 而得到支撑的。

在激励器底座 1108 上，设计有轭部件 1109、1110；轭部件 1109、1110 通过磁铁 1111、1112，构成了一个重要的闭合磁路，用于聚焦方向以及跟踪方向的驱动。同样，在激励器底座 1108 的两个侧面上，放置有两个侧轭 1113、1114，用于透镜支架的倾角调节的驱动，这两个侧轭的顶视图分别表现为一个马蹄形。并且，在侧轭 1113、1114 中的每一个侧轭中，都放置有极性相反的长磁铁 1106 和 1107，它们被如此放置，使得他们与用于倾角校正的线圈 1105 的顶面和底面对应。

同样，与上述情况相似，在激励器底座 1108 上，通过铜箔部件 1119、1120，还放置有一个方形印刷电路板 1117、1118。并且，四个磷青铜的弹簧导线 1121 以这样一种方式与透镜支架 1101 连接，使

得弹簧导线 1121 分别由位于弹簧线 1121 两端的印刷电路板所固定；这样，由弹簧导线 1121 对透镜支架 1101 进行了弹性支撑（对于弹簧导线 1121 的固定，请看图 26 所示的平面图）。

在图 24 中，参考字符 F 表示物镜激励器的移动系统的聚焦轴，R 表示其跟踪轴，T 表示其光盘切线轴。

接下来，将依据参照图 25 的相关技术，对透镜支架 1101 的倾角驱动进行说明。在位于透镜支架 1101 的在光盘径向方向上的两个表面上的、分别用于向右和向左倾角校正的线圈 1105 的电流方向被设定为相同，并且，所放置的与用于倾角校正的线圈 1105 的上、下两侧相对应的左、右磁铁 1106 和 1107 的磁场方向对称的情况下，则，依据傅雷明（Fleming）原理，右线圈和左线圈的电磁驱动力在方向上彼此不同（请看图 25 中的箭头标记 F、F'）。因此，由于所表示的透镜支架 1101 的重心或支承中心实质上在同一点，因而在透镜支架 1101 围绕这一点旋转的情况下，可以对物镜相对于光盘 1100 的倾角进行校正。

但是，在上述传统技术中，为了校正分别源于用来跟踪伺服以及聚焦伺服的线圈以及磁铁的物镜的倾角，必须另外放置一个线圈 1105 以及磁铁 1106、1107，用于倾角校正，这会增加物镜驱动装置的成本。同时，在传统技术中，必须将用于倾角校正的线圈 1105 以及磁铁 1106、1107 放置在支承物镜 1103 的物镜支架 1101 的在光盘 1100 径向方向一侧的面上，这会增加物镜驱动装置的宽度和重量。

发明概述

本发明试图解决在传统技术中所发现的上述问题。

现在，将参照图 1 对用来解决上述问题的本发明的第一方面进行说明，其中所述图 1 与本发明的第一实施例相对应。依据第一个方面，在至少具有一个其两极已被磁化的磁铁 5 的磁路的同一个磁隙 5g 内，放置有一个线圈单元 3，其上安装有聚焦线圈 3f、跟踪线圈 3tr 以及倾斜线圈 3ti。

在第一个方面中，将被两极磁化的磁铁 5 用来对物镜的倾角进行校正，这样，可以避免专门提供用于校正上述物镜倾角的一个专用磁铁。

以下，我们还会将参照图 11，对用于解决上述问题的本发明的第二方面进行说明，其中，图 11 与本发明的第二实施例相对应。依据第二方面，有两个完整的磁路，每一个磁路都至少具有一个被两极磁化的磁铁 105，在两个磁路的每一个磁路的磁隙 105g 内，放置有一个线圈单元 103，其上安装有一个聚焦线圈 103f、跟踪线圈 103tr 以及倾斜线圈 103ti。

在第二个方面中，将已两极磁化的磁铁 105 用来对物镜倾角进行校正，这样可以避免专门提供用来对物镜倾斜进行校正的专用磁铁。

另外，以下，我们还将参照图 18，对用于解决上述问题的本发明的第三方面进行说明，其中，图 18 与本发明的第三实施例相对应。依据第三个方面，提供了用于光拾取器的一种物镜驱动装置，它能检测到光盘的倾斜，并依据光盘倾斜信号，对物镜的倾角进行调节，其中，在至少具有一个被两极磁化的磁铁 205 的磁路的同一个磁隙 205g 内，放置有一个线圈单元 203，其上安装有若干聚焦线圈 203f1、203fr 以及跟踪线圈 103t。电流被分别提供给若干聚焦线圈 203f1、203fr，且由于聚焦线圈 203f1、203fr 的驱动力的总和，而执行聚焦伺服。由于上述驱动力的不同，从而围绕活动部件的中心产生了力矩，因此，伴随聚焦伺服，还可校正物镜 202 的倾斜。

在第三个方面中，由于若干聚焦线圈 203f1 和 203fr 的操作，因而不仅可以执行聚焦伺服，还可以执行对物镜 202 的倾角的调节。

附图的简要说明

图 1 是依据本发明的用于光拾取器的物镜驱动装置的第一实施例的分解视图；

图 2 是依据本发明的第一实施例中所采用的磁路的侧视图；

图 3 是第一实施例的配置图，它显示了在聚焦方向上，磁铁与位于第一实施例的自重位置上的聚焦线圈/跟踪线圈之间的位置关系；

图 4 是第一实施例的配置图，它显示了在聚焦方向上，磁铁与位于第一实施例的自重位置上的倾斜线圈的位置关系；

图 5 是对第一实施例进行修改了的配置图，它显示了在聚焦方向中，磁铁与位于修正后的自重位置上的倾斜线圈之间的位置关系；

图 6 是对第一实施例进行修改后所采用的磁路的平面图；

图 7 是修改后的配置图，它显示了在聚焦方向中，磁铁与位于修正后的自重位置上的聚焦线圈/跟踪线圈之间的位置关系；

图 8 是第一实施例的线圈单元的一种修改方案；

图 9 是第一实施例的另一修改方案的分解视图；

5 图 10 是图 9 所示的物镜驱动装置所采用的磁路的平面视图；

图 11 是依据本发明的用于光拾取器的物镜驱动装置的第二实施例的分解视图；

图 12 是第二实施例的一修改方案的分解视图；

10 图 13A 和 13B 是图 9 所示的物镜驱动装置所采用的磁路的平面视图；

图 14 是对第二实施例进行另一修改后的分解视图；

图 15 是图 14 所示的物镜驱动装置的前视图；

15 图 16 是对图 14 所示的第二实施例进行修改后的配置图，显示了在聚焦方向中，磁铁与位于第一实施的自重位置上的跟踪线圈/倾斜线圈之间的位置关系；

图 17 是对图 14 所示第二实施例进行修改后的配置图，显示了在聚焦方向中，磁铁与位于第一实施的自重位置上的跟踪线圈/倾斜线圈之间的位置关系；

20 图 18 是依据本发明的用于光拾取器的物镜驱动装置的第三实施例的分解视图；

图 19 是第三实施例的配置图，显示了在聚焦方向中，磁铁与位于第三实施的自重位置上的聚焦线圈/跟踪线圈之间的位置关系；

图 20 是一张电路结构框图，该电路用于本发明第三实施例所采用的聚焦伺服以及倾斜驱动；

25 图 21 是将在第三实施例中所执行的聚焦伺服以及倾斜伺服的解释图；特别是，图 21A 显示了其中产生了具有相同方向的驱动力的一种情况；图 21B 显示了分别产生了具有相反方向的的驱动力的情况；

图 22 是对第三实施例进行修改后的分解透视图；

30 图 23 是对第三实施例进行修改后的排列图，它显示了在聚焦方向上，磁铁与位于经修改后的方案的自重位置上的聚焦线圈/跟踪线圈之间的位置关系；

图 24 是传统的物镜驱动装置的分解透视图；

图 25 是在传统物镜驱动装置中所执行的倾斜校正驱动操作的解释图；

图 26 是传统物镜驱动装置中所采用的一个激励器的平面图；以及

图 27 是一张框图，它显示了在传统物镜驱动装置中所采用的电路结构，用于执行倾斜校正驱动操作。

最佳实施例的详细说明

10 (第一实施例)

现在，图 1 是在依据本发明的在光拾取器中所适用的物镜驱动装置的第一实施例的分解透视图。在图 1 中，参考字符的表示内容分别如下：参考字符 1 表示透镜支架，2 表示物镜，3 表示线圈单元，3f 表示聚焦线圈，3tr 表示跟踪线圈，3ti 表示倾斜线圈，5 表示一个磁铁，5g 表示一个磁隙。

透镜支架 1 是由挠曲弹性的高模数轻金属例如是镁合金构成的，或是由混有碳纤维的树脂构成的。使用这样材料，使得透镜支架 1 自身具有较高的挠曲弹性模数，这样，就会具有较高的阶谐振频率。正是由于这一点，所以，透镜支架 1 能够招架得住光盘单元的速度的增长。

在透镜支架 1 中，形成有两个凹口部分 1a，它们分别都在跟踪方向 T 上延伸。还有，将同样是形成于透镜支架 1 内的物镜安装部分 1b 制造得厚度均匀。

这两个凹口部分 1a 中的每一个凹口部分都具有一个表面，在这个表面上，形成有用于增强绝缘的一个绝缘保护膜（未示出）。提供这样一种保护膜的原因是：由于用作透镜支架 1 的材料的例如象镁合金这样的高挠曲弹性模数的轻金属或是混有碳纤维的树脂都具有高导电率，所以需要安装在凹口部分 1a 上的线圈单元 3 的绝缘体必须安全。当在透镜支架 1 的凹口部分 1a 的表面上没有形成用于增强绝缘的绝缘保护膜的情况下，用于增强绝缘的绝缘保护膜（未示出）可形成于线圈 3 的部分中，该部分将要被安装到凹口部分 1a 上，因而能确保线圈单元 3 的绝缘。

线圈单元 3 是一种层叠的线圈单元, 它包括: 所需数目的印刷电路板 31, 每一块电路板都具有这样一种结构, 其上形成有一个聚焦线圈 3f 以及四个跟踪线圈 3tr; 以及, 所需数目的印刷电路板 32, 每一块电路板上都具有两个倾斜线圈 3ti, 上述两种印刷电路板 31 和 32 交替层叠, 一个叠在另一个的顶部, 从而提供了一种图形结构, 作为一个线圈单元. 聚焦线圈 3f 位于印刷电路板 31 的中心部分; 相对于物镜光轴方向的包含支承物镜 2 的透镜支架的活动部件的重心位置, 跟踪线圈 3tr 位于其右侧和左侧 (在跟踪线圈方向 T 上), 即位于两个上一段和下一段的聚焦线圈 3f 的右侧和左侧. 四个跟踪线圈 3tr 是串联连接的. 顺便提一句, 跟踪线圈 3tr 也可以由两个跟踪线圈构成. 相对于印刷电路板 32 的中心, 两个倾斜线圈 3ti 位于其右和左 (在跟踪线圈方向 T 上). 两个倾斜线圈 3ti 是串联连接的.

印刷电路板 31 和 32 可被层叠, 一个层叠在另一个的顶部, 例如, 可通过以这样一种方式, 将印刷电路板 32 的两个侧面夹持在两个印刷电路板 31 之间, 使得, 当从跟踪方向 T 观察它们时, 它们是对称排列的. 在这种情况下, 可使在各个方向上的驱动点一致, 因此能够避免在驱动点不一致时会引起的谐振 (纵向 (pitching) 谐振, 偏移 (yawing) 谐振).

前述说明涉及这样一种结构, 即, 在每一个印刷电路板 31 内, 都形成有聚焦线圈 3f 和跟踪线圈 3tr. 但是, 聚焦线圈 3f 和跟踪线圈 3tr 还可以分别形成于两个印刷电路板上. 此外, 如图 8 所示, 线圈单元 3' 可以具有印刷电路板 31' 和印刷电路板 32', 其中聚焦线圈 3f 和 3ti 形成在印刷电路板 31' 上, 而跟踪线圈 3tr 形成在印刷电路板 32' 上. 图 8 表明四个跟踪线圈 3ti 形成在印刷电路板 32' 上, 然而, 在印刷电路板 32' 可以形成两个跟踪线圈 3ti. 同样在这些结构中, 印刷电路板还可以位于另一个印刷电路板的顶部, 这样, 当从跟踪方向 T 看上去的时候, 它们是左右对称的, 由此可以部门驱动点不一致时可能引发的谐振.

线圈单元 3 被插入并被连结在凹口部分 1a 上, 这样, 它就被固定在透镜支架 1 上. 在线圈单元 3 的位于跟踪方向 T 上的两端, 形成有六个 V 槽 3v, 而六个导电弹性部件 4 的一端部分分别由焊料 (未示出) 固定到六个 V 槽 3v 上. 在导电弹性部件 4 用作引线的情况下,

其中的两个用于驱动聚焦线圈、两个用于驱动跟踪线圈，两个用于驱动倾斜线圈的情况下：即总共提供了六个导电弹性部件。顺便提一句，四个导电弹性部件 4 足以弹性支承用作活动部件的透镜支架 1，因此，在使用四个导电弹性部件 4 的情况下，引线（未示出）被连接到剩余线圈上。

5 磁铁 5 以这样一种方式连接到位于轭底座 6 上的轭 7 上，即，按照磁铁 5 的 N 和 S 极之间的边界线 5b 沿聚焦方向 F 对磁铁 5 进行两极磁化。如图 2 所示，N 和 S 极之间的边界线 5b 位于沿聚焦方向 F 的磁铁 5 的中心，两个磁铁 5 相对排列，在它们之间形成了一个磁隙 5g，磁力线 B 在磁隙 5g 的聚焦方向 F 上反转。顺便提一句，如图 9 所示，磁路可以包括一个磁铁 5，并且该线圈单元也可以设置在磁隙 5g' 中。图 10 表明，磁路包含了磁铁 5'，可以获得和线圈在提供包含如上所述的两个磁铁 5 和 5g 的磁路的情况下的操作相似的操作。由于此，整个物镜驱动装置可以紧凑地制造。这里磁隙意味着空气间
15 隙或气路，在图 9 中，磁隙 5g' 由一个磁铁形成。

磁铁 5 的宽度 W 是这样确定的，使得如图 3 所示，当线圈单元 3 位于活动部件的可移动中间位置处的磁隙 5g 内时，其中，活动部件被导电弹性部件 4 以悬臂方式可移动支承，也就是说，当线圈单元 3 处于四个跟踪线圈 3tr 的（沿平行于聚焦方向 F 延伸的）垂直侧 A 和 C 的聚焦方向 F 上的活动部件的自重位置时，其中所述四个跟踪线圈位于两个上段和下段中的右侧和左侧，则右和左内部垂直侧 A 和 C 可以位于磁隙 5g（它点出了存在于两个相互面对的磁铁 5 的宽度 W 内的一个空隙）内；同样，如图 4 所示，对于位于一行的右部和左部的两个倾斜线圈 3ti 的（与聚焦方向 F 平行延伸的）垂直侧 a' 和 c'，
20 右侧和左侧的外部垂直面 a' 和 c' 可以位于磁隙 5g 内。同样，磁铁 5 高度 H 是这样确定的，如图 3 所示，位于印刷电路板 31 中心的单独的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b 和 d，同时还有跟踪线圈 3tr 的（与聚焦方向 F 垂直延伸的）水平侧 B 和 C 的上外部水平侧和下外部水平侧 B 和 D，都可以位于磁隙 5g（它指出了两个相互面对的磁铁 5 的高度 H 内存在的一个空隙）内；同样，如图 4
30 所示，倾斜线圈 3ti 的（沿垂直于聚焦 F 延伸的）水平侧 b' 和 d' 可以位于磁隙 5g 内。

如图 3 所示, 处于磁铁 5 的 N 和 S 极之间的边界线 5b 位于聚焦线圈 3f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b、d 的下侧 b 和上侧 d 之间的中部; 位于上段跟踪线圈 3tr 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B、D 的底面 B, 与下段跟踪线圈 3tr 的 (沿垂直于聚焦方向 F 的) 水平侧 B、D 的顶侧 D 上之间的中部; 如图 4 所示; 位于倾斜线圈 3ti 的 (沿与聚焦方向 F 垂直的方向延伸的) 水平侧 b'、d' 的底面 b' 和顶侧 d' 之间的中部。磁铁 5 的中部实质上与线圈单元 3 的中心一致。

在图 3 中, 在电流可以流入跟踪线圈 3tr 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3tr 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A、C, 因此, 依据傅雷明的左手定律, 在四个跟踪线圈 3tr 内, 产生了相同方向的驱动力。同样, 在电流可以流入聚焦线圈 3f 的情况下, 由于电流流入聚焦线圈 3f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b、d, 因此, 依据傅雷明的左手定律, 在聚焦线圈 3f 内, 在聚焦方向 F 上产生了驱动力。

在图 4 中, 在电流可以流入倾斜线圈 3ti 的情况下, 由于 (由箭头所标记的) 电流流入倾斜线圈 3ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b'、d', 因此, 依据傅雷明的左手定律, 在两个倾斜线圈 3ti 内, 在聚焦方向 F 上, 产生了相反方向的驱动力 F'。由于相反方向的驱动力 F', 产生了围绕活动部件的重心的一个力矩, 从而能够调整透镜支架 1 的倾斜度; 从而调整物镜 2 的倾角。

如上所述, 在聚焦线圈 3f、跟踪线圈 3tr 同时还有倾斜线圈 3ti 被排列在至少包含一个磁铁的磁路的同一磁隙 5g 内时, 不仅可以实现聚焦伺服和跟踪伺服, 同时还有倾斜伺服 (即物镜 2 的倾角调节)。这可以避免提供专门用于调节物镜 2 的倾角的磁铁。由于这一点, 可以减少部件的数目, 可以以低成本来调节物镜 2 的倾角, 因而, 可以压缩整个物镜驱动装置。

前述说明涉及这样一种结构, 在这种结构中, 在印刷电路板 32 的中心的右侧和左侧, 安装有两个倾斜线圈 3ti。但是, 即便是在图 5 所示的这种结构中, 也可以获得类似的影响, 在图 5 的结构中, 相对于印刷电路板 32 的中心, 在 (在聚焦方向 F 上的) 其上部和下部, 安装有两个倾斜线圈 3ti。

在这种情况下，如此构造线圈 3，使得如图 7 所示，有所需数目的印刷电路板（未示出），其中，每一个印刷电路板都具有包含一个跟踪线圈 3tr 以及四个聚焦线圈 3f 的结构，如图 5 所示，线圈 3 有所需数目的印刷电路板（未示出），其中，每个印刷电路板都具有两个倾斜线圈 3ti，这两种印刷电路板中的一种位于另一种印刷电路板的顶部，彼此交替出现。

前述说明涉及这样一种结构，在这种结构中，聚焦线圈 3f 和跟踪线圈 3tr 位于同一印刷电路板上。但是，也可以采用这样一种结构，在这种结构中，聚焦线圈 3f 和跟踪线圈 3tr 分别位于两个印刷电路板上。在这种情况下，同样也是一种印刷电路板位于另一种印刷电路板顶部，以便当从跟踪方向 T 看上去的时候，是左右对称的。

在这种结构中，磁铁 5 如图 6 所示，按照磁铁 5 的 N 和 S 极之间的边界线 5b 在跟踪方向 T 上两极磁化，并被联结到轭底座 6 的轭 7 上。如图 6 所示，N 和 S 极之间的边界线 5b 位于跟踪方向 T 上的磁铁 5 的中心，磁隙 5g 是由于两个磁铁 5 相互面对排列而形成的，在磁隙 5g 中，磁力线 B 的方向在跟踪方向 T 上反转。顺便提一句，另一种可替换的方案是，如图 9 和 10 所示，可以使用单独一个磁铁 5 来代替使用两个磁铁 5。在此情况下，N 和 S 极之间的边界线位于沿跟踪方向 T 的磁铁 5 的中心。由于此缘故，整个物镜驱动装置可以制得紧凑些。

磁铁 5 的宽度 W 是这样确定的，如图 7 所示，当线圈单元 3 位于活动部件的可移动中间位置处的磁隙 5g 内时，其中，活动部件被导电弹性部件 4 以悬臂方式可移动支承，即当线圈单元 3 处于聚焦方向 F 上的活动部件的自重位置时，不仅排列在两个上段和下段内的右侧和左侧的四个聚焦线圈 3f 的（沿平行于聚焦方向 F 的）垂直侧 a 和 c 的右侧和左侧外部垂直侧 a 和 c，而且，如图 5 所示，排列在两个上段和下段内的两个线圈 3ti 的（与聚焦方向 F 平行延伸的）垂直侧 a' 和 c'，能够分别位于磁隙 5g（它点出了存在于两个相互面对的磁铁 5 的宽度 W 内的一个空隙）内。同样，如图 7 所示，磁铁 5 的高度 H 是这样确定的，使得不仅是上段的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b、d 的底侧 b、下段的聚焦线圈 3f 的（与聚焦方向 F 垂直延伸的）水平侧 b、d 的顶侧 d、以及跟踪线圈 3tr 的（与

磁铁 5 的 N 和 S 极之间的边界线 5b 不仅如图 7 所示，位于右聚焦线圈 3f 的（与聚焦方向 F 平行延伸的）垂直侧 a、c 的左侧 c 与左聚焦线圈 3f 的（与聚焦方向 F 平行延伸的）垂直侧 a、c 的右侧 a 的中部，位于跟踪线圈 3tr 的（与聚焦方向 F 平行延伸的）垂直侧 A、C 的右侧 A 和左侧 C 的中部，而且还如图 5 所示，位于倾斜线圈 3ti 的（与聚焦方向 F 平行延伸的）垂直侧 a'、c' 的右侧 a' 和左侧 c' 的中部，磁铁 5 的中心实质上与线圈单元 3 的中心一致。

在图 7 中, 当允许电流流入跟踪线圈 3tr 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3tr 的 (与聚焦方向 F 平行延伸的) 垂直侧 A、C, 因此, 依据傅雷明的左手定律, 在跟踪线圈 3tr 内, 在跟踪方向 T 上产生了一个驱动力; 当允许电流流入聚焦线圈 3f 的情况下, 由于 (由箭头所标记的) 电流流入聚焦线圈 3f 的 (与聚焦方向 F 垂直延伸的) 水平侧 b、d, 因而, 依据傅雷明的左手定律, 在跟踪方向 T 上, 分别产生了具有相同方向的驱动力。

在图 5 中, 当允许电流流入倾斜线圈 3ti 的情况下, 由于 (由箭头所标记的) 电流流入跟踪线圈 3ti 的 (与聚焦方向 F 平行延伸的) 垂直侧 a'、c', 因此, 依据傅雷明的左手定律, 在两个倾斜线圈 3ti 内, 在跟踪方向 T 上产生了方向相反的驱动力。由于相反方向的驱动力, 围绕活动部件的重心产生了一个力矩, 因而, 能够调节透镜支架 1 的倾角, 从而调节物镜 2 的倾角。

现在, 图 11 是一张透视图, 它显示了依据本发明的物镜驱动装置的第二实施例。在图 11 中, 参考字符的意义分别表示如下: 101 表示一个透镜支架, 102 表示物镜, 103 表示一个线圈单元, 103f 表示一个聚焦线圈, 103tr 表示一个跟踪线圈, 103ti 表示一个倾斜线圈, 105 表示一个磁铁, 105 表示一个磁隙。

透镜支架 101 是由挠曲弹性的高模数轻金属例如是镁合金构成的，或是由混有碳纤维的树脂构成的。使用这样材料，使得透镜支架 101 自身具有较高的挠曲弹性模数，这样，就会具有较高的高阶谐振频率。正是由于这一点，所以，透镜支架 101 能够招架得住光盘单元
5 的速度的增长。

参见光盘支架 101 的另一种结构，在其平面上，形成有两个缝隙 111，通过这两个缝隙，可以插入磁铁 105 以及轭 107（在后面将会对这两者进行说明）；在透镜支架 101 的中心部分，安装有物镜 102；在对跟踪方向 T 有一个直角的延伸的透镜支架 101 的一对侧面中的每个侧面上，设计安装有两个顶部和底部支持片 112，用于固定住导电弹性部件 104（也将在下文中对起进行讨论）的一个端部分；对于在
10 平行于跟踪方向 T 延伸的透镜支架 101 的一对侧表面，固定有线圈单元 103（这将在下文中对其进行讨论）。

用于增强绝缘的绝缘保护膜（未示出）分别形成于透镜支架 101 的（与跟踪方向 F 平行延伸的）一对侧表面的表面上。提供这种绝缘保护膜的原因是，由于用作透镜支架 101 的材料的例如是镁合金这样的具有挠曲弹性的高模数的轻金属或是混有碳纤维的树脂具有高导电率，所以，要确保将要安装到支架 101 上的线圈单元 103 的绝缘性。当在透镜支架 101 的（与跟踪方向 F 平行延伸的）一对侧面的表面上
15 没有形成这种用于增强绝缘的绝缘保护膜时，可以在将要安装到透镜支架 101 上的线圈单元 103 的部件上形成用于加强绝缘的绝缘保护膜，因而确保了线圈单元 103 的绝缘。

现在，参见线圈单元 103，所需数目的印刷电路板 131，其中，每个印刷电路板都具有由一个聚焦线圈 103f 和四个跟踪线圈 103tr 构成的一种结构，所需数目的印刷电路板 132，其中，每个印刷电路板都具有由两个倾斜线圈 103ti 构成的结构，这两种电路板层叠在一起，或一个位于另一个的顶部，从而形成了一个线圈单元 103。聚焦线圈 103f 位于印刷电路板 131 的中心部分；相对于包含物镜支架 101 的物镜光轴方向的活动部件的重心的位置，跟踪线圈 103tr 位于该位置
25 的（在跟踪方向 T 上的）右方向和左方向，其中物镜支架 101 用于支承物镜 102，即，在两个上段和下段内的聚焦线圈 103f 的右侧和左侧。四个跟踪线圈 103tr 是串联连接的。顺便提一句，也可以用两

个跟踪线圈来替代四个跟踪线圈 103tr. 相对于印刷电路板 32 的中心, 位于一行内的两个倾斜线圈 103ti 位于该中心的 (在跟踪线圈方向 T 上的) 右面和左面. 两个倾斜线圈 103ti 是串联连接.

印刷电路板 131 和 132 可以以这样一种方式层叠, 即对印刷电路板 131 的 (沿平行于跟踪方向 T 延伸的) 两个侧表面以及印刷电路板 132 的 (沿平行于跟踪方向 T 延伸的) 两个侧表面进行安装, 使得从跟踪方向 T 看上去是对称的, 例如, 可以将印刷电路板 131 安装在物镜一侧 102 的内部, 将印刷电路板 132 安装在物镜 102 一侧的外部. 在这种情况下, 可以将各个方向上的驱动点做得彼此一致, 从而可以避免在驱动点不一致时有可能产生的 (纵向谐振, 偏移谐振) 谐振.

前述说明涉及这样一种结构, 其中, 聚焦线圈 103f 和跟踪线圈 103tr 形成于同一个印刷电路板 131 上. 但是, 也可以使聚焦线圈 3f 和跟踪线圈 3tr 分别形成于两个不同的印刷电路板上. 此外, 如图 8 所示, 线圈单元 3' 可以具有印刷电路板 31' 和印刷电路板 32', 其中 15 聚焦线圈 3f 和 3ti 形成在印刷电路板 31' 上, 而跟踪线圈 3tr 形成在印刷电路板 32' 上. 图 8 表明四个跟踪线圈 3ti 形成在印刷电路板 32' 上, 然而, 在印刷电路板 32' 可以形成两个跟踪线圈 3ti. 同样在这些结构中, 印刷电路板还可以位于另一个印刷电路板的顶部, 这样, 当从跟踪方向 T 看上去的时候, 它们是左右对称的, 由此可以部 20 门驱动点不一致时可能引发的谐振.

用焊料 (未示出) 将四个导电弹性部件 104 的一个端部分分别固定在透镜支架 101 的支承片 112 上, 在上述透镜支架 101 上固定有线圈单元 103. 驱动跟踪线圈必须有两个引线, 驱动跟踪线圈必须有两个引线, 驱动倾斜线圈必须有两个引线, 这样, 总共必须有六个驱动 25 引线. 这里, 有四个单元的这种导电弹性部件 104 就足以弹性支承用作活动部件的透镜支架 101 了. 这里, 导电弹性部件 104 也可以用作引线. 因此, 四个导电弹性部件 104 被用作六个引线中的四个引线, 而其它引线 (未示出) 连接到余下线圈上.

这两个线圈单元 103 分别位于两个磁隙 105g 内, 而导电弹性部件 104 的另一个端部分分别穿过引线底座 108, 并通过焊接被固定在底板 109 上. 由于这一点, 所以, 安装在线圈单元 103 上的聚焦线圈 103f、跟踪线圈 103tr 以及倾斜线圈 103ti 可以位于磁隙 105g 内, 30

同时,以悬臂方式对包含用于支承物镜 2 的透镜支架 101 的活动部件进行支承,使其相对于包含磁铁 105、轭底座 106、轭 107、引线底座 108 以及底板 109 的固定部件来说,是活动的。

图 11 中所采用的磁路的结构,同时,还有在图 11 所示的装置的
5 线圈单元中使用的聚焦线圈、跟踪线圈以及倾斜线圈的排列和操作,都与前述第一实施例相似,这里,就省略对它的说明(参见图 2 到 4)。

如上所述,依据本发明,有两个完整的磁路,每一个磁路都至少包括两极磁化的一个磁铁 105,并且,在这两个磁路 105 中的每一个磁路中的磁隙 105g 内,不仅安装有聚焦线圈 103f 以及跟踪线圈
10 103tr,还安装有倾斜线圈 103ti。正是由于这一特征,不仅可以获得聚焦伺服以及跟踪伺服,还可以获得倾斜伺服(即对物镜 102 的倾角的调节)。因此,消除了这样一种需要,即,必须提供一个专门用于调节物镜 102 的倾角的磁铁。这可以减少部件数目,可以以低成本调节物镜 102 的倾角,也可减小整个物镜驱动装置的尺寸。

上述说明涉及这样一种结构,其中,相对于印刷电路板 132 的中心,两个倾斜线圈 103ti(在跟踪方向 T 上)分别位于其右侧和左侧。但是,与第一实施例相似,即便是在两个倾斜线圈 103ti 分别位于印刷电路板 132 的中心的(在聚焦方向 F 的)上面和下面的情况下,也能得到相似的结果。在这种情况下,磁路的结构以及线圈单元的操作
20 都与第一实施例相似,这里,就省去对它的说明(参见图 5 至 7)。顺便一提,如图 12 所示,两个磁路可以分别包含一个磁铁 105'。在此情况下,磁铁 105'和磁轭 107'分别提供在透镜支架 101'的相对于其中心的外侧。在此结构中,缝隙 111 不必提供在透镜支架 101'中,因此,整个物镜驱动装置可以制得紧凑些。这一情况下的磁路如图
25 13A 和 13B 所示。这里磁隙意味着空气间隙或气路,在图 13A 中,磁隙 105g'由两个磁铁形成,而在图 13B 中,磁隙 105g'由一个磁铁形成。

在上述结构中,线圈单元 103 被接合并被固定在透镜支架 101 的一对侧面上,该侧面在平行于跟踪方向上延伸。但是,即便是在以下的另外一种结构中,也能获得相似的效果,在这种结构中,如图 9 所
30 示,存在两个完整的磁路,每个磁路都至少包括一个在聚焦方向 F 上两极磁化的的磁铁 105,且在磁路的每个磁隙 105g 内,安装有聚焦

线圈 130f,同时还安装有跟踪线圈 130tr 以及倾斜线圈 130ti,其中,各个聚焦线圈 130f 都缠绕在透镜支架 101 的侧面,而跟踪线圈 130tr 以及倾斜线圈 130ti 都分别被安装在透镜支架 101 的(沿跟踪方向 T 延伸的)的两个侧面上。顺便提一句,如图 12 所示,两个磁路可以
5 分别包括一个磁铁。

每一种聚焦线圈 130f 都是带有作为其缠绕框的透镜支架 101 的一种绕组线圈,这样,与作为形成于印刷电路板上的结构的聚焦线圈相比,聚焦线圈 130f 还是很容易制造的。

跟踪线圈 130tr 以及倾斜线圈 130ti 是安装于聚焦线圈 130f 顶部的一个无芯线圈。但是,跟踪线圈 130tr 以及倾斜线圈 130ti 也可以是形成于印刷电路板上的的一种结构。同样,跟踪线圈 130tr 以及倾斜线圈 130ti 也可以是一种绕组线圈,其中,如图 15 所示,在透镜支架 101 的(沿平行于跟踪方向 T 延伸的)侧面上,设计有线圈缠绕框 113,线圈就分别缠绕在这些线圈缠绕框 113 上。另外,跟踪线圈
10 130tr 以及倾斜线圈 130ti 中的一个就可以安装在聚焦线圈 130f 上,而另一个可以缠绕在线圈缠绕框 113 上。

按照磁铁 105 的 N 和 S 极之间的边界线 1105b,对磁铁 105 在聚焦方向 F 上进行两极磁化,且磁铁 105 与位于轭底座 106 上的轭 107 联结在一起。

磁铁 105 的宽度 W 是这样确定的,当处于活动部件的可移动的中间位置时,其中的活动部件由导电弹性部件 104 以悬臂方式方式可移动支承,这就是说,当处于聚焦方向 F 上的活动部件的自重位置上时,如图 16 所示,透镜支架 101 被安装在磁隙 105g 内,不仅两个跟踪线圈 130tr 的(沿平行于聚焦方向 F 延伸的)垂直侧 A 和 C 的右和
20 左内部垂直侧 A 和 C,而且两个倾斜线圈 130tr 的(沿平行于聚焦方向 F 延伸的)垂直面 a'和 c'的右和左外部垂直侧 a'和 c'都可以分别位于磁隙 105g(它指出了两个相互面对的磁铁 105 的宽度 W 内存在的一个空隙)内;其中上述两个跟踪线圈 130tr 位于聚焦方向 F 上的上段,同时还位于在跟踪方向 T 上的一行内的右侧和左侧;而上述两个
25 倾斜线圈 130tr 位于聚焦方向 F 上的下段,同时还位于跟踪方向 T 上的一行内的右侧和左侧。还可以这样确定磁铁 105 的高度 H,如图 16 所示,跟踪线圈 130tr 的(沿垂直于聚焦方向 F 延伸的)水平侧 B
30

和 D, 同时还有倾斜线圈 130ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b' 和 d' 都可以分别位于磁隙 105g (它指出了存在于两个相互面对的磁铁 105 的高度 H 内的一个空隙) 内。

如图 16 所示, 磁铁 105 的 N 和 S 极之间的边界线 105b 位于跟踪
5 线圈 130tr 的 (沿聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B 的下面, 同时还位于倾斜线圈 130ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b' 和 d' 的底侧 b' 和顶侧 d' 的中间。磁铁 105 的中心实质上与透镜支架 101 的中心一致。

聚焦线圈 130f 位于磁铁 105 的 N 和 S 极之间的作为其边界线的
10 边界线 105b 的上面和下面。上、下聚焦线圈 130f 是串联连接的, 但上、下聚焦线圈 130f 的电流的方向相反。在两个磁隙 105g 内的磁力线方向相反。

在图 14 和 15 中, 跟踪线圈 130tr 和倾斜线圈 130ti 的所有侧面
都安装在透镜支架 1 的 (沿平行于跟踪方向 T 延伸的) 一个侧面上。
15 但是, 这并不是一种限定, 还可以采用另一种结构; 即, 可将安装在磁隙 105g 内的以及能产生驱动力的面安装在透镜支架 1 的一个侧面上, 其中, 所述能产生驱动力的面例如可以是跟踪线圈 130tr (参见图 16) 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A、C, 当允许电路流入跟踪线圈 130tr 的情况下, 它可以在跟踪方向 T 上产生同一方向
20 的驱动力。

透镜支架 101 位于两个磁隙 105g 中, 导电弹性部件 104 的另一个
侧端穿过一个引线底座 108, 被焊接而固定在底板 109 上。这是由于这一点, 聚焦线圈 130f、跟踪线圈 130tr 以及倾斜线圈 130ti 可以位于磁隙 105g 内, 同时, 可以以悬臂方式支承包含支承物镜 102
25 的透镜支架 101 的活动部件, 以便相对于包括磁铁 5、轭底座 106、轭 107、引线底座 108 以及底板 109, 可以移动所述活动部件。

在图 14 中, 当允许电流流入聚焦线圈 130f 的情况下, 由于聚焦
线圈 130f 内的电流流入了磁隙 105g, 因而依据傅雷明的左手定律, 在聚焦方向 F 上, 产生了驱动力。

30 在图 16 中, 在允许电流流入跟踪线圈 130tr 的情况下, 由于在两个跟踪线圈 130tr 内的 (由箭头标记出的) 电流流入了跟踪线圈 130tr 的 (沿平行于聚焦方向 F 延伸的) 垂直侧 A 和 C, 因而依据傅

雷明的左手定律, 在跟踪方向 T 上, 产生了相同方向的驱动力; 以及, 在允许电流流入倾斜线圈 130ti 的情况下, 由于在两个倾斜线圈 130ti 内的 (由箭头标记出的) 电流流入了倾斜线圈 130ti 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b' 和 d', 因而依据雷明的左手定律, 在聚焦方向 F 上, 产生了相反方向的驱动力 F'。由于反方向驱动力 F', 从而围绕活动部件的中心产生了一个力矩, 因而可以调节透镜支架 101 的倾角, 从而, 可以调节物镜 102 的倾角。

上述说明涉及这样一种结构, 在这种结构中, 在跟踪方向 T 上, 两个跟踪线圈 130tr 和两个倾斜线圈 130ti 是左右对称的, 在两个跟踪线圈 130tr 内产生了相同方向的驱动力, 在两个倾斜线圈 130ti 内, 产生了相反方向的驱动力。但是, 如图 17 所示, 跟踪线圈 130tr 的 (沿平行于聚焦方向 F 的) 垂直侧 A 可以位于磁铁 105 的宽度 W 的内部, 跟踪线圈 130tr 的 (沿平行于聚焦方向 F 的) 垂直侧 C 可以位于磁铁 105 的宽度 W 的外部; 同时, 倾斜线圈 130ti 在跟踪方向 T 上, 相对于磁铁 1105 的中心向外移动。还可以如图 16 所示, 用两个跟踪线圈 130tr 来代替跟踪线圈 130tr; 如图 17 所示, 还可以用两个倾斜线圈 130ti 来代替倾斜线圈 130ti。另外, 如图 17 所示, 跟踪线圈 130tr 在数量上可以是一个, 如图 16 所示, 倾斜线圈 130ti 在数量上可以是两个。在上述这些结构中的任一结构中, 都可以减轻物镜驱动装置的重量。

(实施例 3)

现在, 图 18 是依据本发明的物镜驱动装置的第三实施例的透视图。在图 18 中, 参考符号的意义分别如下, 201 表示一个透镜支架, 202 表示一个物镜, 203 表示一个线圈单元, 205 表示一个磁铁。

透镜支架 201 与先前所说明的第一实施例中采用的透镜支架 1 的结构相似。

线圈单元 203 包括所需数目的印刷电路板 203p, 它们一个层叠在另一个的顶部, 而每一个印刷电路板 203p 都包括一个跟踪线圈 203t 以及四个聚焦线圈 203fl 和 203fr。跟踪线圈 203t 位于印刷电路板 203p 的中央, 而聚焦线圈 203fl 以及 203fr 位于上、下两段内, 且相对于活动部件的物镜光轴方向的重心位置, 它们位于该重心的右侧和左侧, 其中, 所述活动部件包括支承物镜 202 的透镜支架 201,

这就是说，聚焦线圈 203fl 和 203fr 位于跟踪线圈 203t 的右侧和左侧。聚焦线圈 203fl 的数目以及聚焦线圈 203fr 的数目可以分别为一个。因此，由于电流是分别提供给左和右聚焦线圈 203fl 和 203fr 的，所以左和右聚焦线圈 203fl 和 203fr 不是串联连接的，而且是彼此独立的。

前述说明涉及这样一种结构，其中，左和右聚焦线圈 203fl、203fr 以及跟踪线圈 203t 位于同一印刷电路板 203p 上。但是，作为对第三实施例的修改，可以分别将左和右聚焦线圈 203fl、203fr 以及跟踪线圈 203t 放置在两个印刷电路板上。同样，在这个实施例中，将要设置在印刷电路板上的聚焦线圈的数目为偶数，将要设置在印刷电路板上的跟踪线圈的数目为一。

线圈单元 203 被插入并被联结到透镜支架 201 的四口部件 201a 上，从而被固定到透镜支架 201 上。在线圈单元 203 的（在跟踪方向 T 上的）两端，形成了六个 V 槽 203v，而六个导电弹性部件 204 的一个侧端被焊料 203h 分别固定在六个 V 槽 203v 上。被用作引线的导电弹性部件 203 是由用于聚焦线圈驱动的两个部件 204（2x2）以及用于跟踪线圈驱动的两个部件 204 构成的，即总共是由六个部件 204 构成的。

顺便提一句，四个导电部件 204 足以弹性支承用作活动部件的透镜支架 201，因此，在采用四个导电弹性部件 204 来支承透镜支架 201 的情况下，引线（未示出）连接到剩余线圈上。

当前实施例中所采用的磁路与如图 6 所示的第一实施例中采用的磁路相似。此外，如图 9 和 10 所示，磁路可以包含一个磁铁。在此情况下，N 和 S 极之间的边界线位于沿跟踪方向 T 的磁铁 5 的中心。由于此缘故，整个物镜驱动装置可以制得紧凑些。磁铁 205 的宽度 W 是这样确定的，使得，在活动部件的可移动的中间位置处，其中由导电弹性部件 204 以悬臂方式来可移动地支承活动部件，这就是说，如图 19 所示，在活动部件在聚焦方向 F 上的自重位置处，当线圈单元 203 位于磁隙 205g 内时，在两个上、下段的左聚焦线圈 203fl 的垂直侧 a 和 c 的（沿平行于聚焦方向 F 的）右和左外部垂直侧 c 和 a，同时还有位于两个上、下段的右聚焦线圈 203fr，都可以分别位于磁隙 205（它指出了存在于相互面对的磁铁 205 的宽度 W 之内的一个空

隙)内。同样,磁铁 205 的高度 H 是这样确定的,如图 19 所示,上段聚焦线圈 203fl 和 203fr 的(沿垂直于聚焦方向 F 延伸的)水平侧 b 和 d 的底侧 b,下段聚焦线圈 203fl 和 203fr 的(沿垂直于聚焦方向 F 延伸的)的顶侧 d,以及跟踪线圈 203t 的(沿垂直于聚焦方向 F 延伸的)水平侧 B 和 D,都可以分别安装在磁隙 205g(它指出了存在于相互面对的磁铁 205 的高度 W 内的一个空隙)内。

如图 19 所示,磁铁 205 的 N 和 S 极之间的边界线 205b 不仅被设置在跟踪线圈 203t 的(沿平行于聚焦方向 F 延伸的)垂直侧 A 和 C 之间的中部,而且还被设置在左聚焦线圈 203fl 的(沿平行于聚焦方向 F 延伸的)垂直侧 a、c 的右侧与右聚焦线圈 203fr 的(沿平行于聚焦方向 F 延伸的)垂直侧 a、c 的左侧 c 之间的中部。磁铁 205 的中心实质上与线圈单元 203 的中心一致。

线圈单元 203 分别位于磁隙 205g 内,导电弹性部件 204 的另一个侧端分别穿过引线底座 208,通过焊接而被固定在底板 209 上。如此,安装在线圈单元 203 上的聚焦线圈 203fl、203fr 以及跟踪线圈 203t 都位于磁隙 205g 内,同时,以悬臂方式,对包含支承物镜 202 的透镜支架 201 的活动部件进行支承,使得,其相对于包含磁铁 205、轭底座 206、轭 207、引线底座 208 以及底板 209 的固定部件,可以活动。

可以使用单独准备的倾角检测器,也可以利用光拾取器所给的再现信号,来检测光盘的倾角。

利用倾角检测器或是利用光拾取器的再现信号而得到的倾斜误差信号以及聚焦误差信号,被输入到图 20 所示的一个控制电路;以及,控制电路计算最佳电流 I_l 以及 I_r ,其中所述电流能促使图 19 所示的聚焦线圈 203fl 以及 203fr,使其能同时校正聚焦误差和倾斜误差,此后,控制电路将所计算的电流 I_l 和 I_r 输出。作为受控目标的物镜驱动装置,不仅执行聚焦驱动操作,同时还在聚焦方向 F 上移动,而且还执行倾斜驱动操作,其中,聚焦驱动操作的执行,是由于响应了图 21A 所示的电流 I_l 和 I_r ,而产生了作为驱动力 F_l 和 F_r 的总和的一个力;而倾斜驱动操作的执行,是由于围绕透镜支架 201 的重心 G 产生了力矩 $M = F_l \times d - F_r \times d$,这种力矩是由于驱动力 F_l 和 F_r 之间的差产生的。这里, d 表示透镜支架 201 的重心 G 与聚焦

线圈 203fl、203fr 之间的距离。

现在，图 21B 显示了与图 21A 不同的一种情况，所产生的驱动力 F_l 和 F_r 在相反的两个方向上。在这种情况下，将要在聚集方向 F 上移动的一个力是 $F_l + (-F_r)$ ，而倾斜力矩为 $F_l \times d - (-F_r \times d)$ 。

- 5 无论如何，物镜驱动装置利用函数 $(F_l + F_r)$ 执行一个聚焦驱动操作，利用函数 $(F_l - F_r)$ 执行一个倾斜驱动操作。

- 10 左和右聚焦线圈 203fl 以及 203fr 不仅可以执行聚焦伺服，还能调节物镜 102 的倾角。因此，消除了这样一种需要，即，提供专用于调节物镜 202 的倾角的一个线圈以及一个磁铁。这可以减少部件数目，可以以低成本来调节物镜 202 的倾角，还可减少整个物镜驱动装置的尺寸。

- 15 在跟踪线圈 203 被推动的情况下，由于（由图 19 中的箭头所表示的）电流流入了跟踪线圈 203t 的（在平行于聚焦方向 F 上延伸的）垂直侧 A 和 C ，因而在跟踪方向 T 上，产生了相同方向的驱动力，这样，依据记录媒体的离心率，可以在跟踪方向 T 上移动物镜 202。

在线圈单元 203 被插入并被联结到透镜支架 201 的凹口部件 201a 的情况下，磁隙 205g 的数目可以减小到一。这还可以减小部件的数目，可以以低成本调节物镜 202 的倾角，还可减小整个物镜驱动装置的尺寸。

- 20 在上述实施例中，利用左和右聚焦线圈 203fl 和 203fr，不仅可以实现聚焦伺服，还可以实现对物镜 202 的倾角的调节。但是，在以下结构中，也可提供相似的效果：即，如图 22 所示，一个线圈单元 203 包括所需数目的印刷电路板 203p，这些电路板一个位于另一个的顶部，这些电路板 203p 中的每一个都包括一个聚焦线圈 203f 以及四个跟踪线圈 203t；聚焦线圈 203f 位于每一个印刷电路板 203p 的中央；跟踪线圈 203tu 和 203td 分别位于活动部件的中心上沿物镜光轴方向的上部和下部，所述活动部件包括支承物镜 202 的一个透镜支架 201，这就是说，跟踪线圈 203tu 以及 203td 位于沿聚焦线圈 203f 分别向上和向下延伸的两个右行和左行内；以及按照磁铁 205 的 N 和 S 极之间的边界线 205b，在聚焦方向上，对磁铁 205 进行两极磁化。
- 30 在这种结构中，磁路与图 2 所示的第一实施例中采用的磁路相似。顺便提一句，如图 9 所示，磁路可以包括一个磁铁 5'，并且该线圈单

元也可以设置在磁隙 5g' 中。磁路如图 10 所示, 可以获得和线圈在磁路包含了如上所述的两个磁铁和磁隙的情况下的操作相似的操作。

5 这里, 另一种可替换的方案是, 跟踪线圈 203tu 和 203td 在数目上分别也可以是一个。由于电流是单独提供给上、下跟踪线圈 203tu 和 203td 的, 因而它们没有串联连接, 但它们是独立连接的。

在这种结构中, 聚焦线圈 203f 以及跟踪线圈 203tu、203td 位于同一个印刷电路板 203p 上。但是, 聚焦线圈 203f 以及跟踪线圈 203tu、203td 也可以分别位于两个不同的印刷电路板上。在这种情况下, 同样, 印刷电路板上的聚焦线圈以及跟踪线圈的数目也分别是一以及偶数。

15 磁铁 205 的宽度 W 是这样确定的, 在活动部件的可移动的中间位置处, 其中, 由导电弹性部件 204 以悬臂方式对活动部件进行可活动的支承, 这就是说, 在聚焦方向 F 上的活动部件的自重位置处, 如图 23 所示, 当线圈单元 203 位于磁隙 205g 内时, 两个上段的右和左跟踪线圈 203tu 的 (沿平行于聚焦方向延伸的) 垂直侧 A 和 C 的右和左内部垂直侧 C 和 A, 同时还有两个下段的右和左跟踪线圈 203td, 都可以分别位于磁隙 205g (它指出了存在于相互面对的磁铁 205 的宽度 W 内的一个空隙) 内。同样, 可以这样确定磁铁 205 的高度, 如图 20 23 所示, 不仅是位于印刷电路板 203p 中心处的聚焦线圈 203f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b 和 d, 同时还有上段跟踪线圈 203tu 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的顶侧 D, 以及下段跟踪线圈 203td 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B, 都可以分别安装在磁隙 205g (它指出了存在于相互面对的磁铁 205 的高度 W 内的一个空隙) 内。

25 如图 23 所示, 磁铁 205 的 N 和 S 极之间的边界线 205b, 不仅位于聚焦线圈 203f 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 b 和 d 的顶侧 b 和底侧 d 之间的中部, 而且还位于上段跟踪线圈 203tu 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的底侧 B 以及下段跟踪线圈 203td 的 (沿垂直于聚焦方向 F 延伸的) 水平侧 B 和 D 的顶侧 D 之间的中部。这样, 磁铁 205 的中心实质上与线圈单元 203 的中心一致。

利用倾斜检测器或利用光拾取器的再现信号所得到的一个倾斜误差信号以及跟踪误差信号,被输入到一个校正电路,该电路与图 20 所示的控制电路相似;以及,控制电路计算最佳电流 I_u 以及 I_d , 如图 23 所示,上述电流能促进跟踪线圈 203tu 以及 203td,使得能同时校正跟踪误差以及倾斜误差,之后,控制电路输出所得到的电流 I_u 和 I_d . 作为受控目标的物镜驱动装置,不仅执行跟踪驱动操作,同时还在聚焦方向 F 上移动,而且还执行一个倾斜驱动操作,其中,聚焦驱动操作的执行,是由于响应了电流 I_l 和 I_r ,而产生了作为驱动力(未示出)的总和的一个力;而倾斜驱动操作的执行,是由于围绕透镜支架 201 的重心产生了力矩,这种力矩是由于驱动力之间的差产生的。

在聚焦线圈 203f 被驱动的情况下,由于(由图 18 中的箭头所标记的)电流流入图 18 的聚焦线圈 203f 的沿着与垂直于聚焦方向 F 的水平侧 b 和 d,因而,在聚焦方向 F 上,产生了相同方向的驱动力,这样,物镜 202 可以依据记录媒体表面的振动而在聚焦方向 F 上移动。

此外,在第三实施例中可以由具有聚焦线圈和跟踪线圈的控制单元的倾斜驱动的系统可以应用于根据图 11 和 12 所示的第二实施例的物镜驱动装置。

正如此前所说明的那样,依据本发明的第一方面,提供了一种物镜驱动装置,其中将一个其上安装有聚焦线圈、跟踪线圈以及倾斜线圈的线圈单元放置在磁路的同一个磁隙内,所述磁路至少包括一个磁铁。在本物镜驱动装置中,可以利用用于聚焦和跟踪驱动的磁铁,对物镜的倾角进行调节,这样作,消除了一种需要,即必须提供专用于调节物镜倾角的一个磁铁。因此,依据本发明的第一方面,有可能防止由于对物镜的倾角进行调节所引起的成本的增加,以及物镜驱动装置的尺寸的增加。

同样,依据本发明的第二方面,提供了一种物镜驱动装置,其中,有两个完整的磁路,每个磁路都至少包括被两极磁化的一个磁铁,并且,在两个磁路中每个磁路的磁隙内,都安装有一个线圈单元,其上安装有一个聚焦线圈、一个跟踪线圈以及一个倾斜线圈。在当前的物镜驱动装置中,可以利用用于聚焦以及跟踪驱动的磁铁,对物镜的倾

角进行调节，这样做会消除提供专用于调节物镜倾角的一个磁铁的需要。因此，依据本发明的第二方面，有可能防止由对物镜倾角的调节而引起的物镜驱动装置的成本的增加，以及其尺寸的增加。

- 另外，依据本发明的第三方面，提供了一种物镜驱动装置，其中，
- 5 其上安装有若干聚焦线圈以及一个跟踪线圈的一个线圈单元位于磁路的同一个磁隙内，所述磁路至少包括一个两极磁化的磁铁，电流是被分别提供给包含在线圈单元内的若干聚焦线圈的，因而能依据响应所提供的电流而产生的驱动力的和来执行聚焦伺服，以及，由于驱动力之间的差而产生了围绕活动部件重心的一个力矩，从而可以在执行
 - 10 聚焦伺服的同时，对物镜的倾角进行调节。在本物镜驱动装置中，利用右和左聚焦线圈，不仅可以实现聚焦伺服，还能对物镜的倾角进行调节，这样会消除提供专用于调节物镜倾角的一个线圈和一个磁铁的需要。因此，依据本发明的第三方面，有可能防止由对物镜倾角的调节而引起的物镜驱动装置的成本的增加，以及其尺寸的增加。

说明书附图

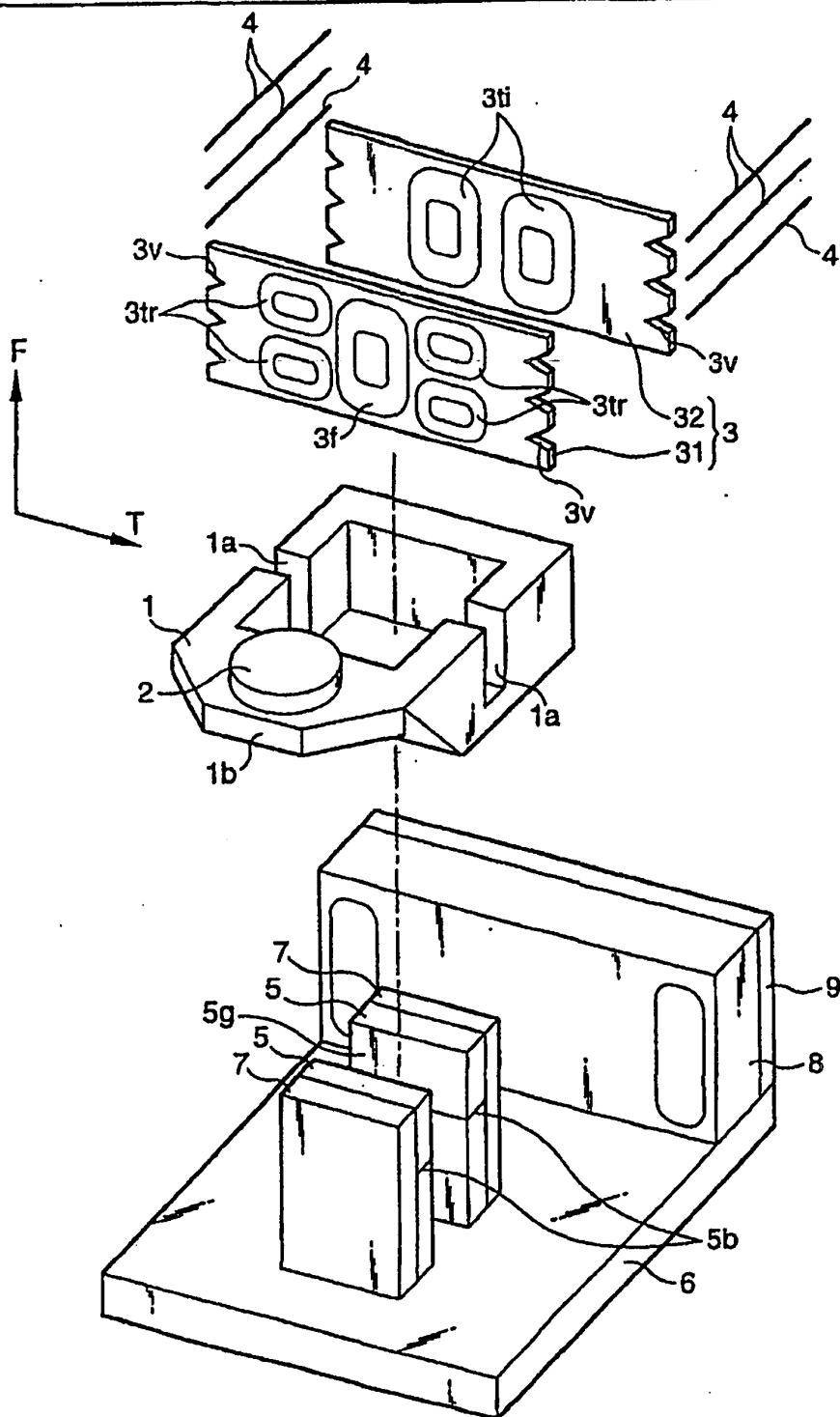


图 1
1

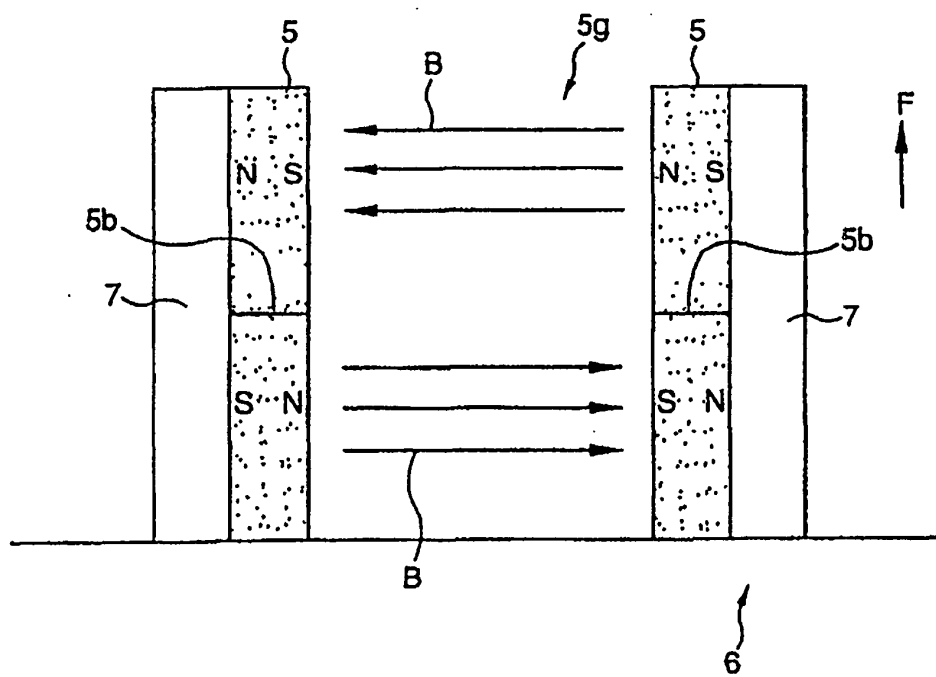


图 2

01.07.18

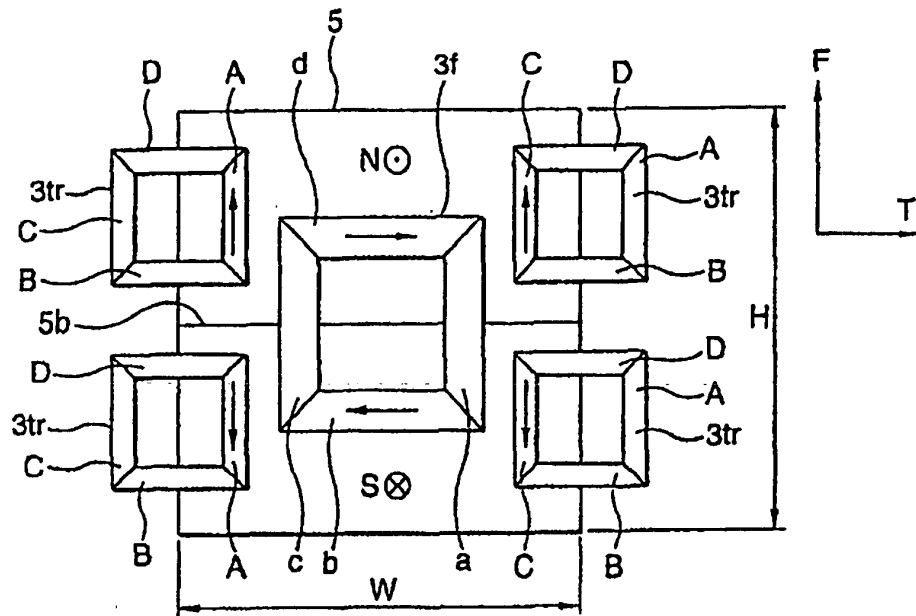


图 3

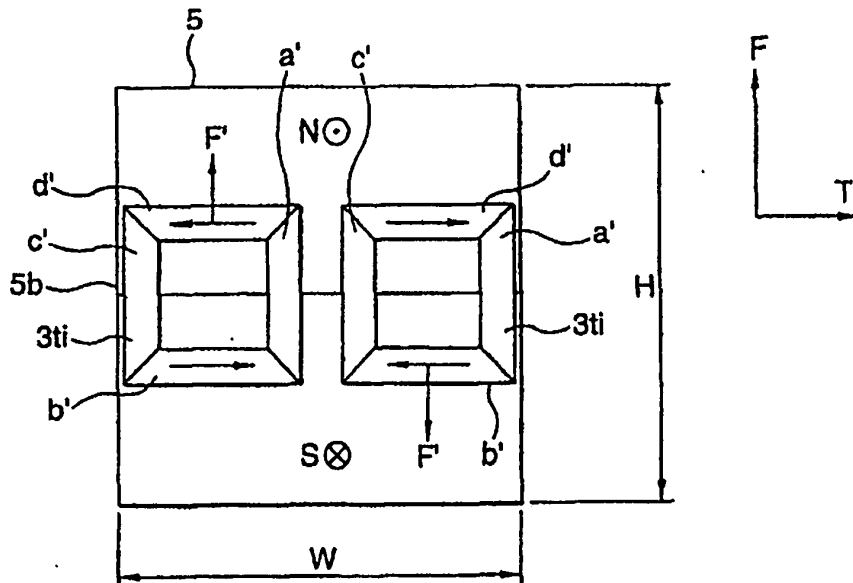


图 4

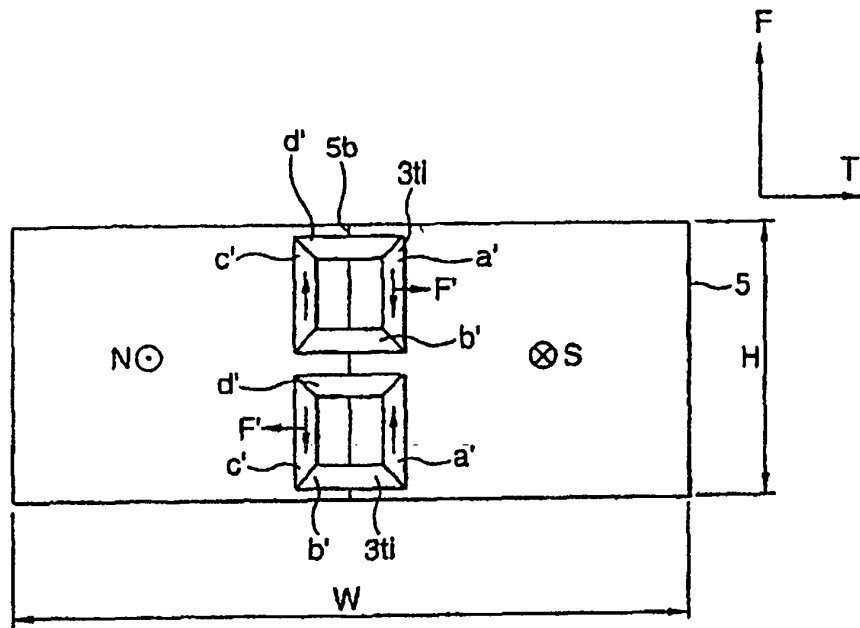


图 5

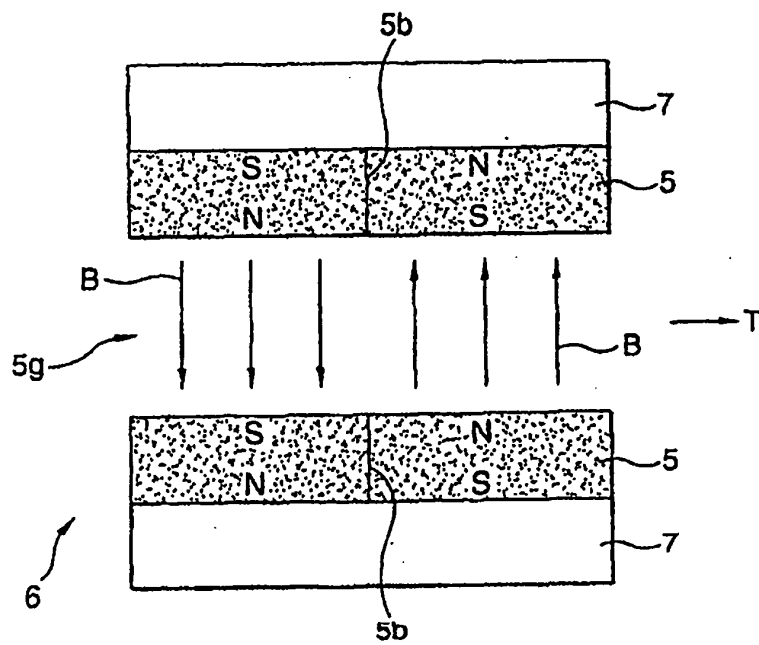


图 6

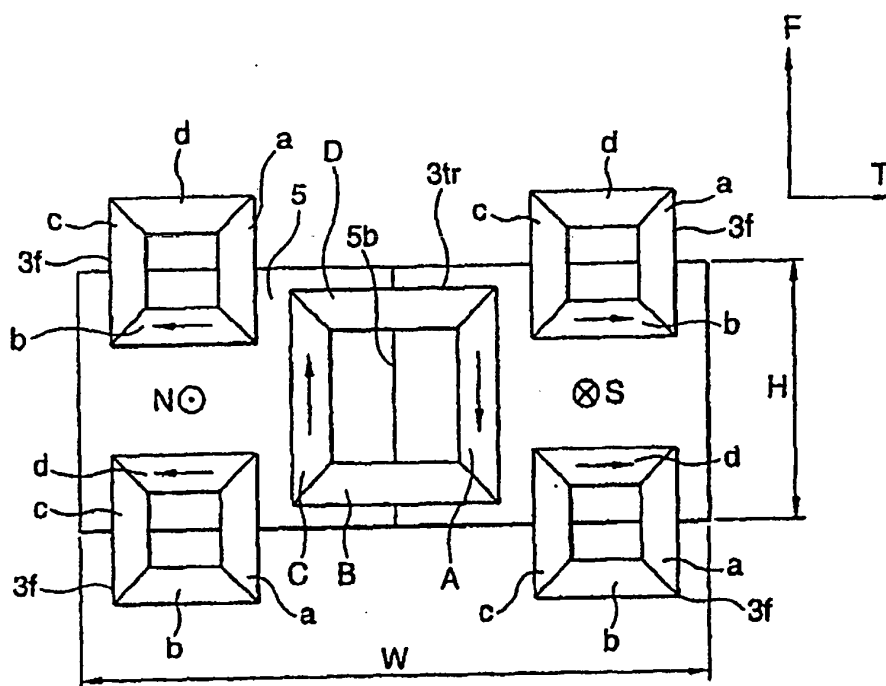


图 7

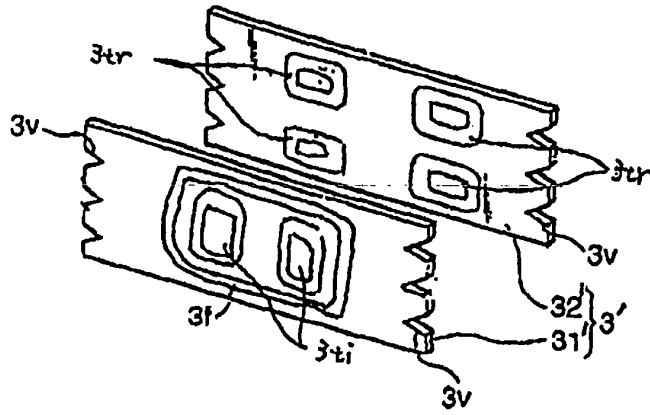


图 8

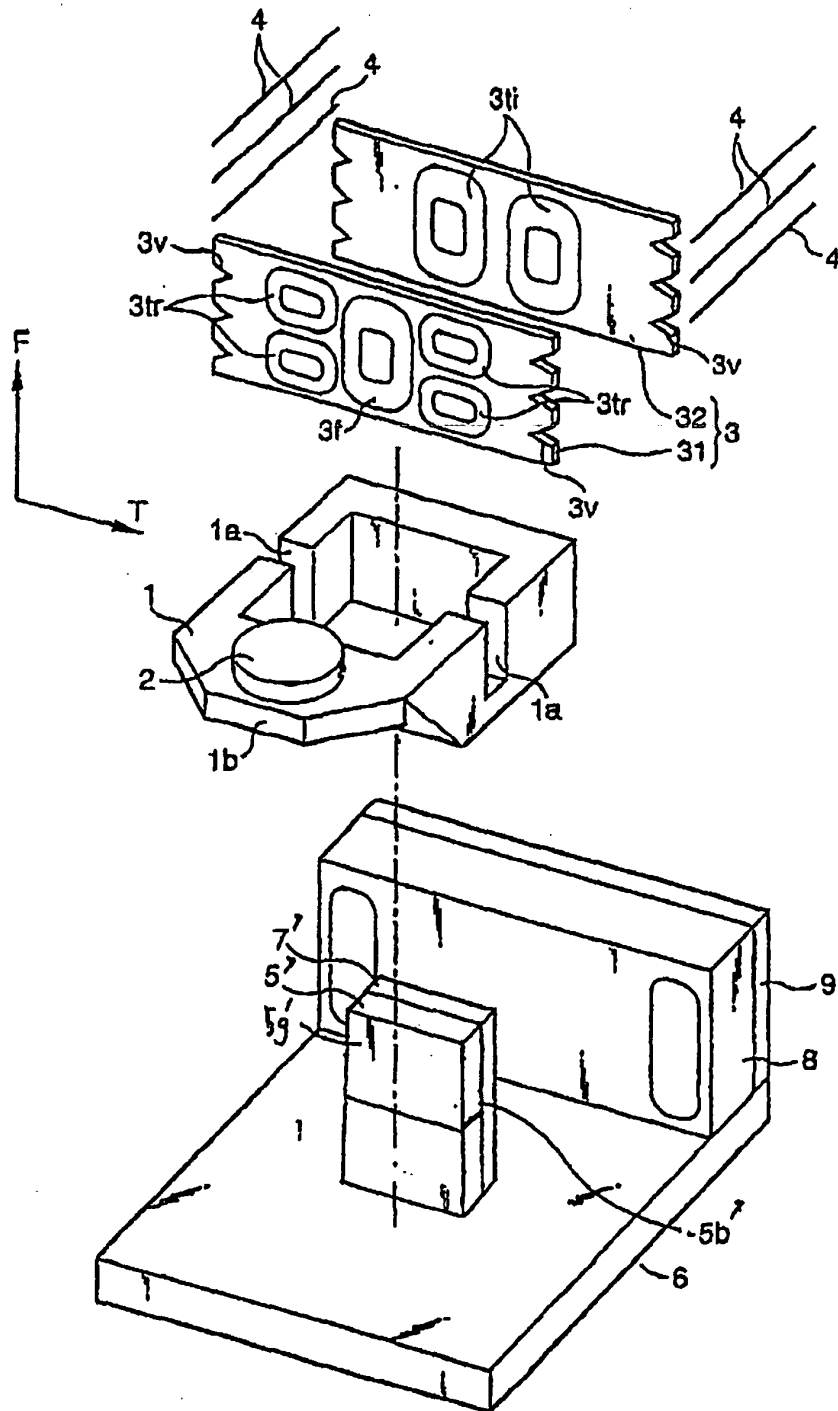


图 9

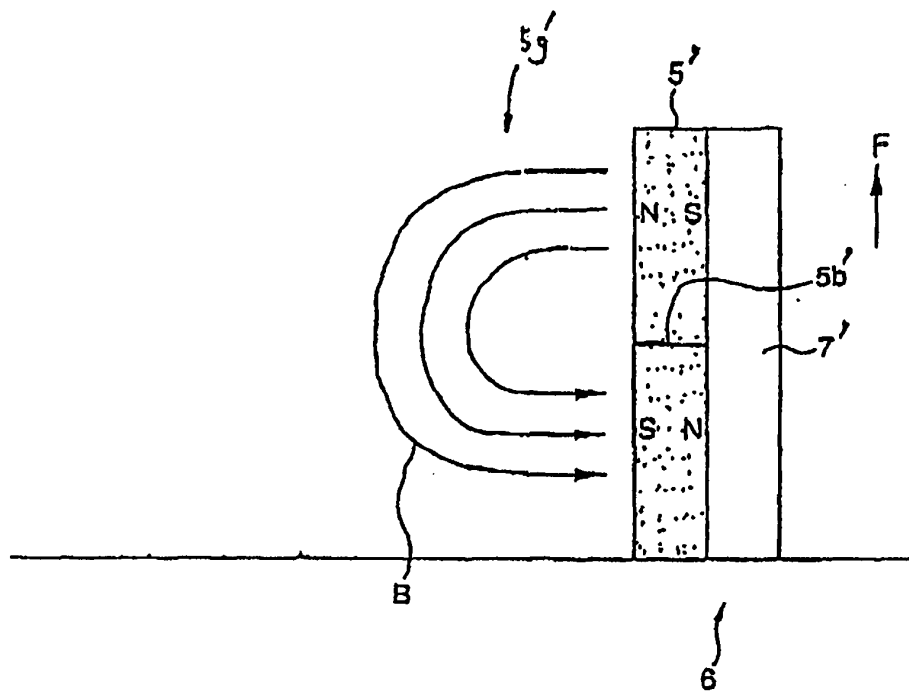


图 10

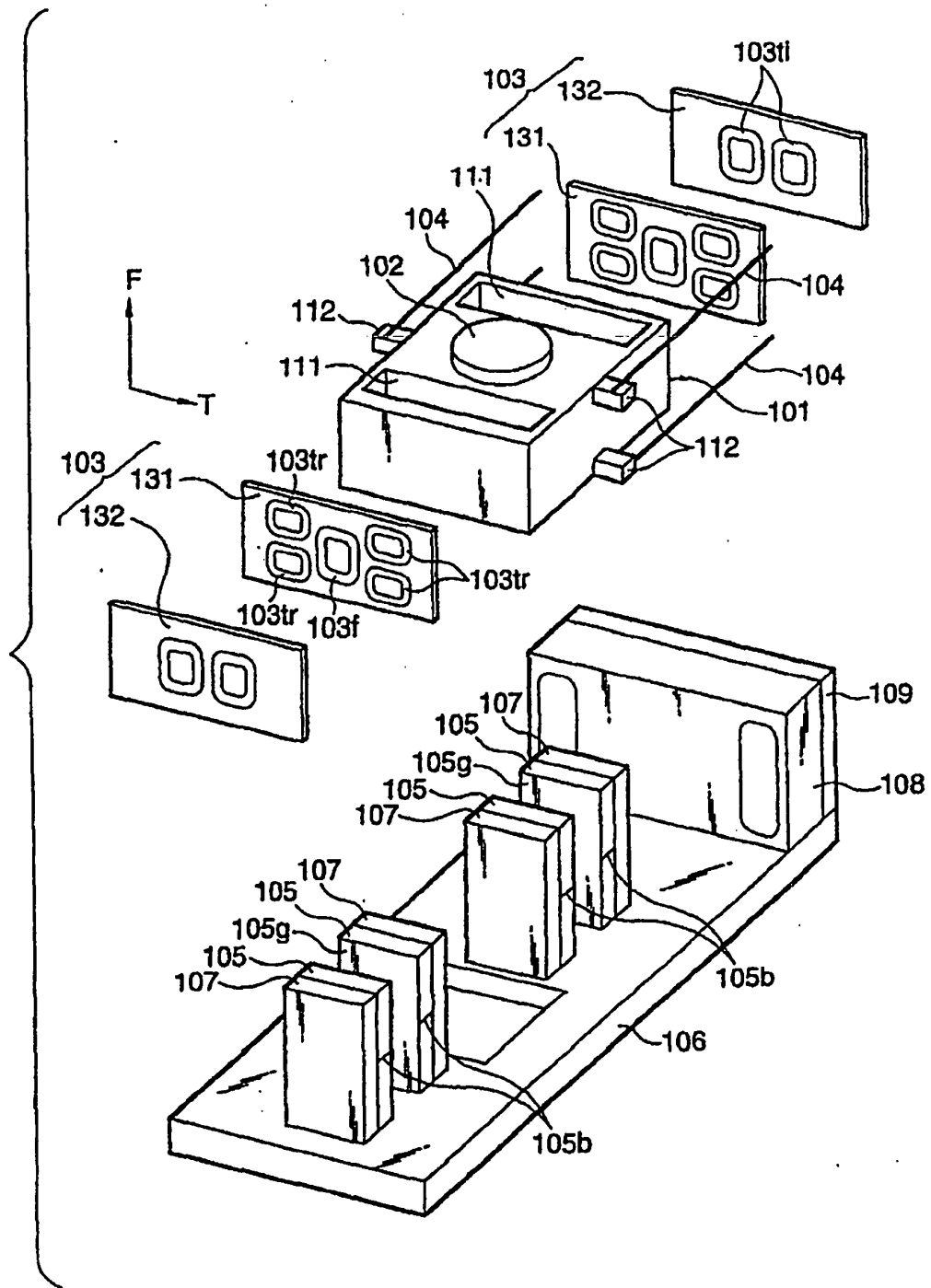


图 11

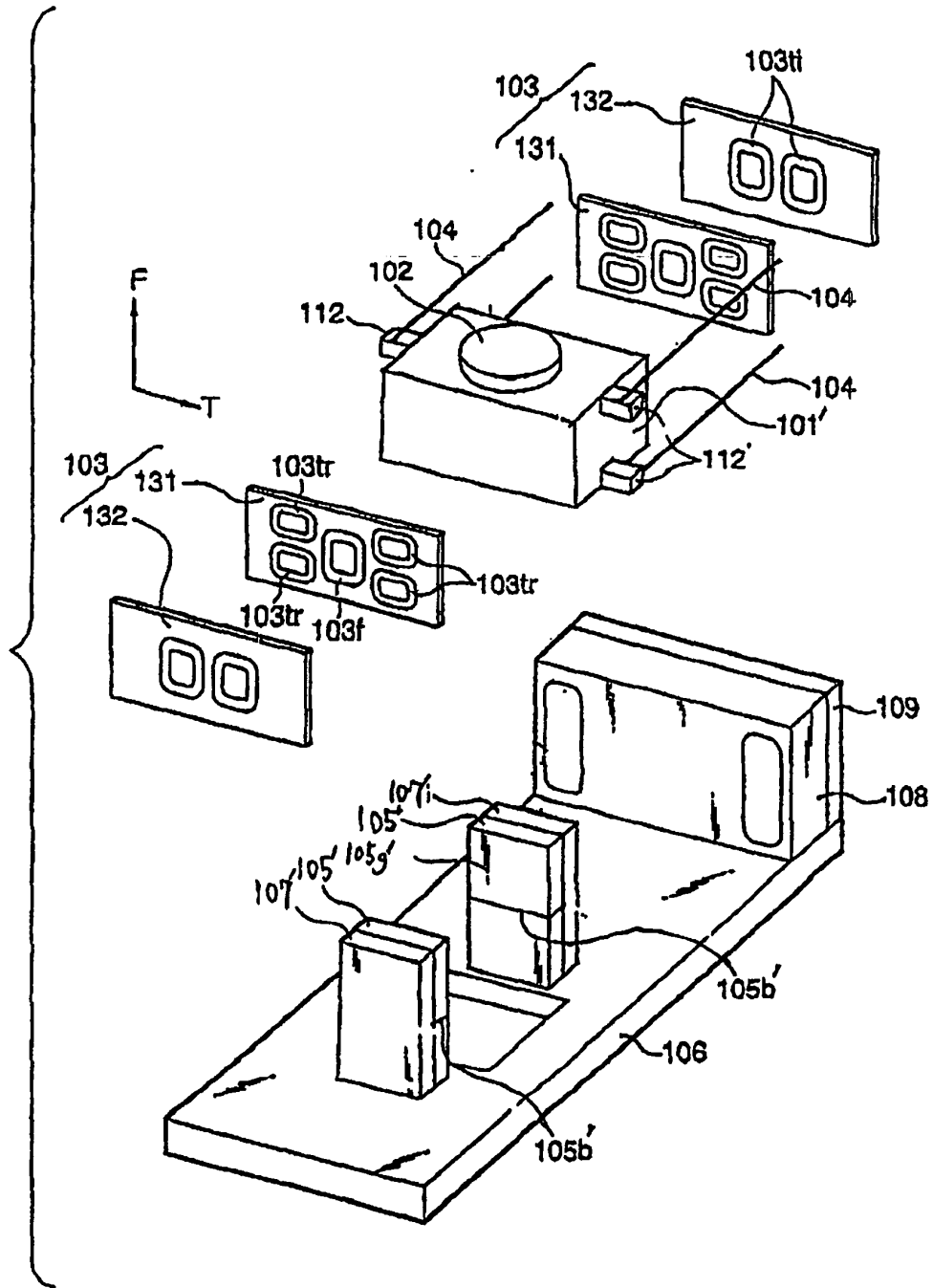


图 12
10

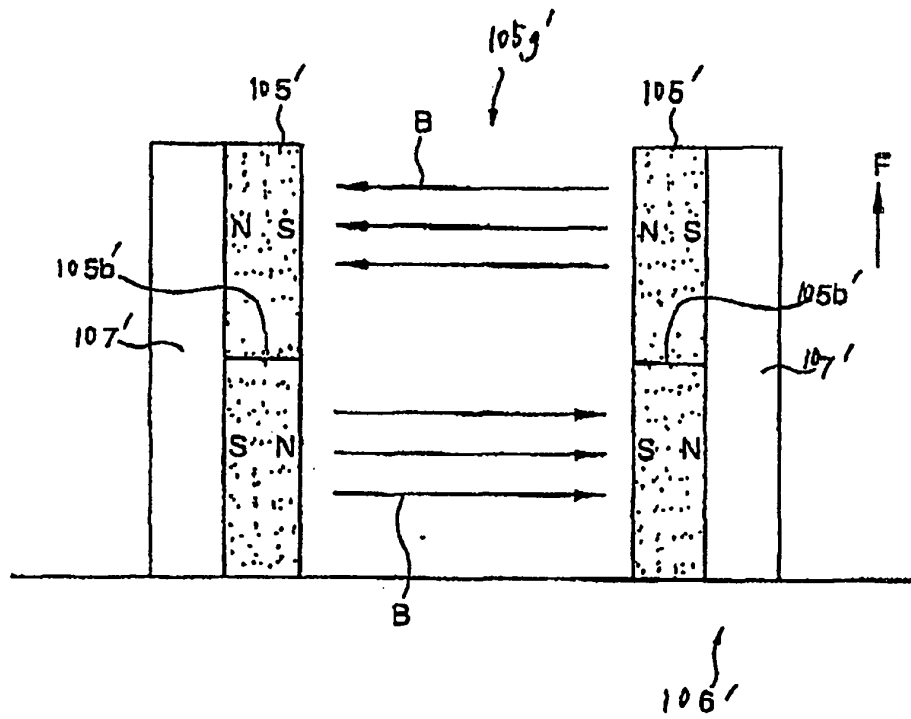


图 13A

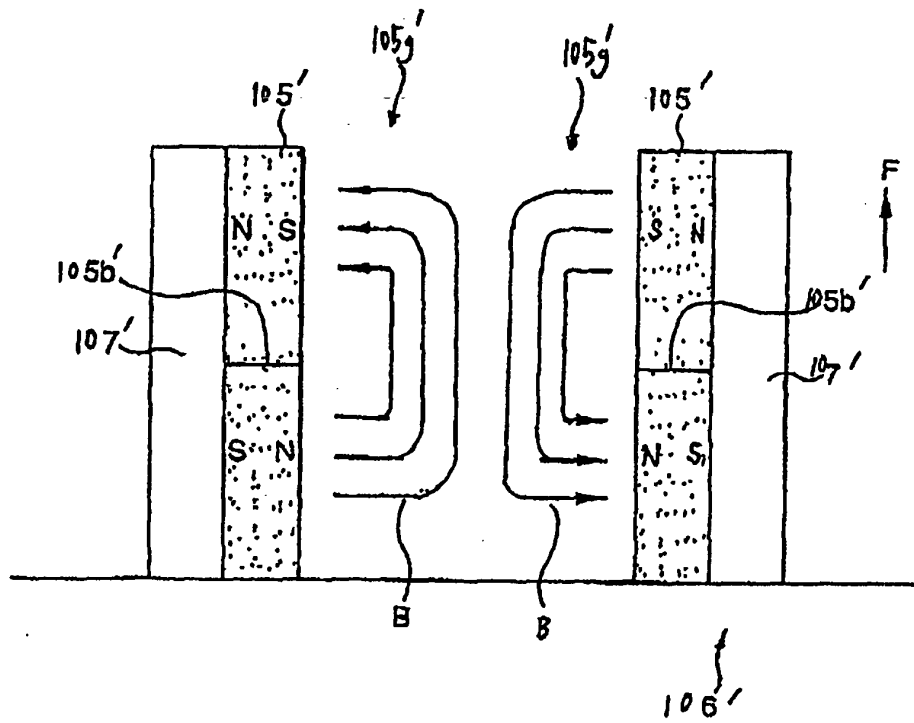


图 13B

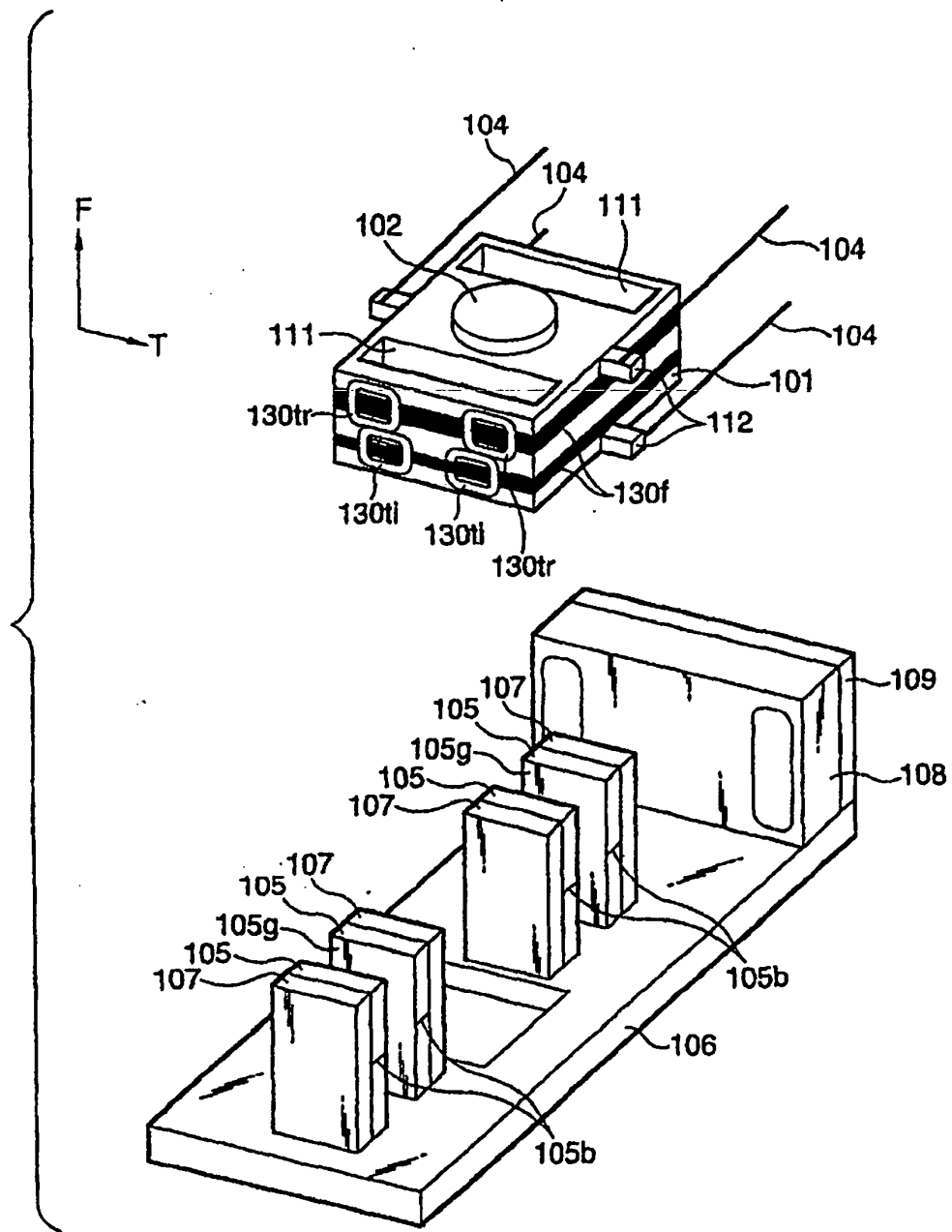


图 14

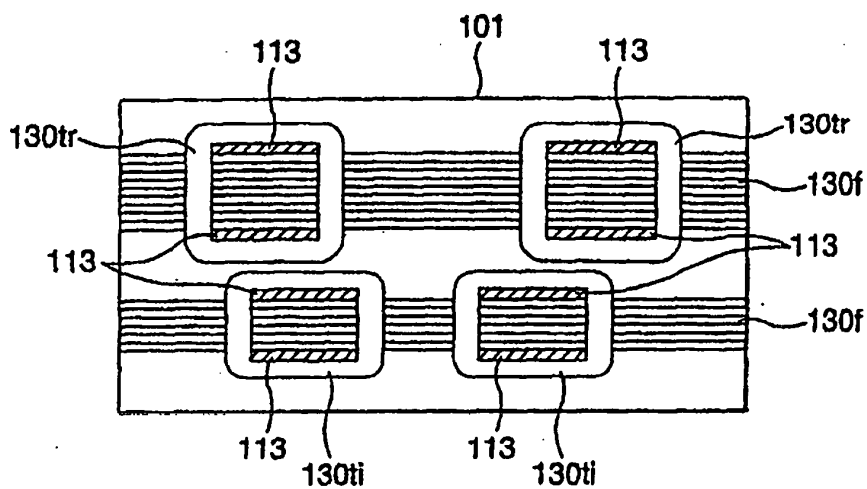


图 15

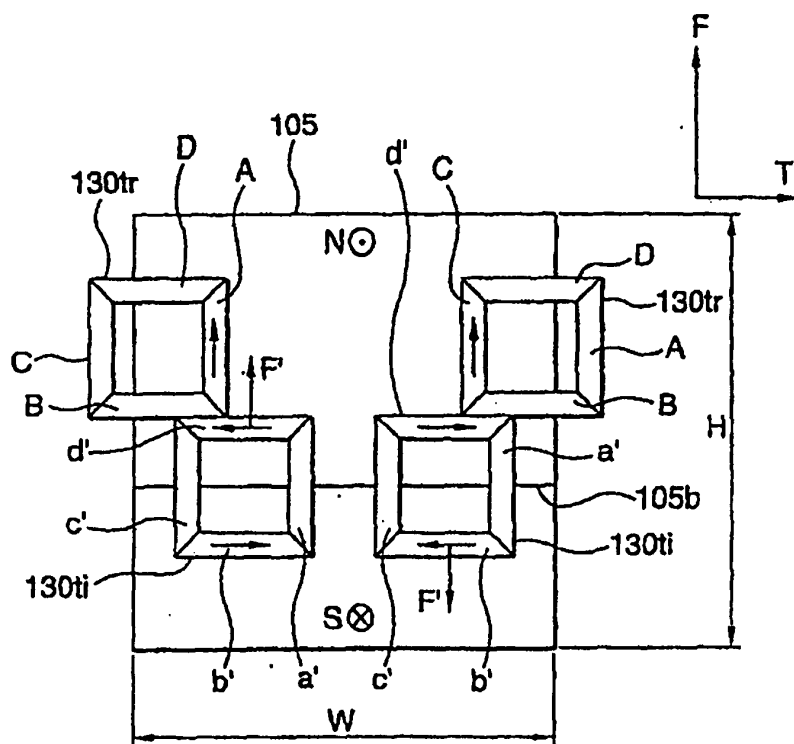


图 16

01.04.18

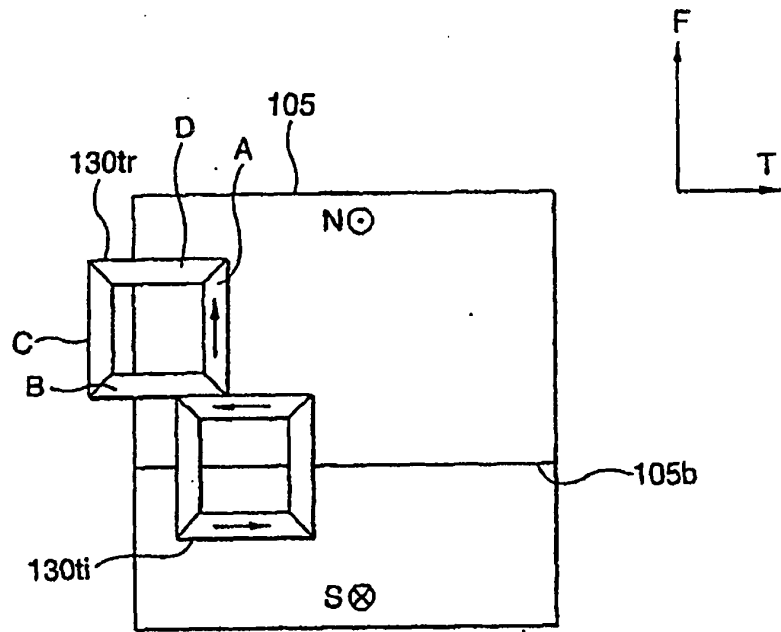


图 17

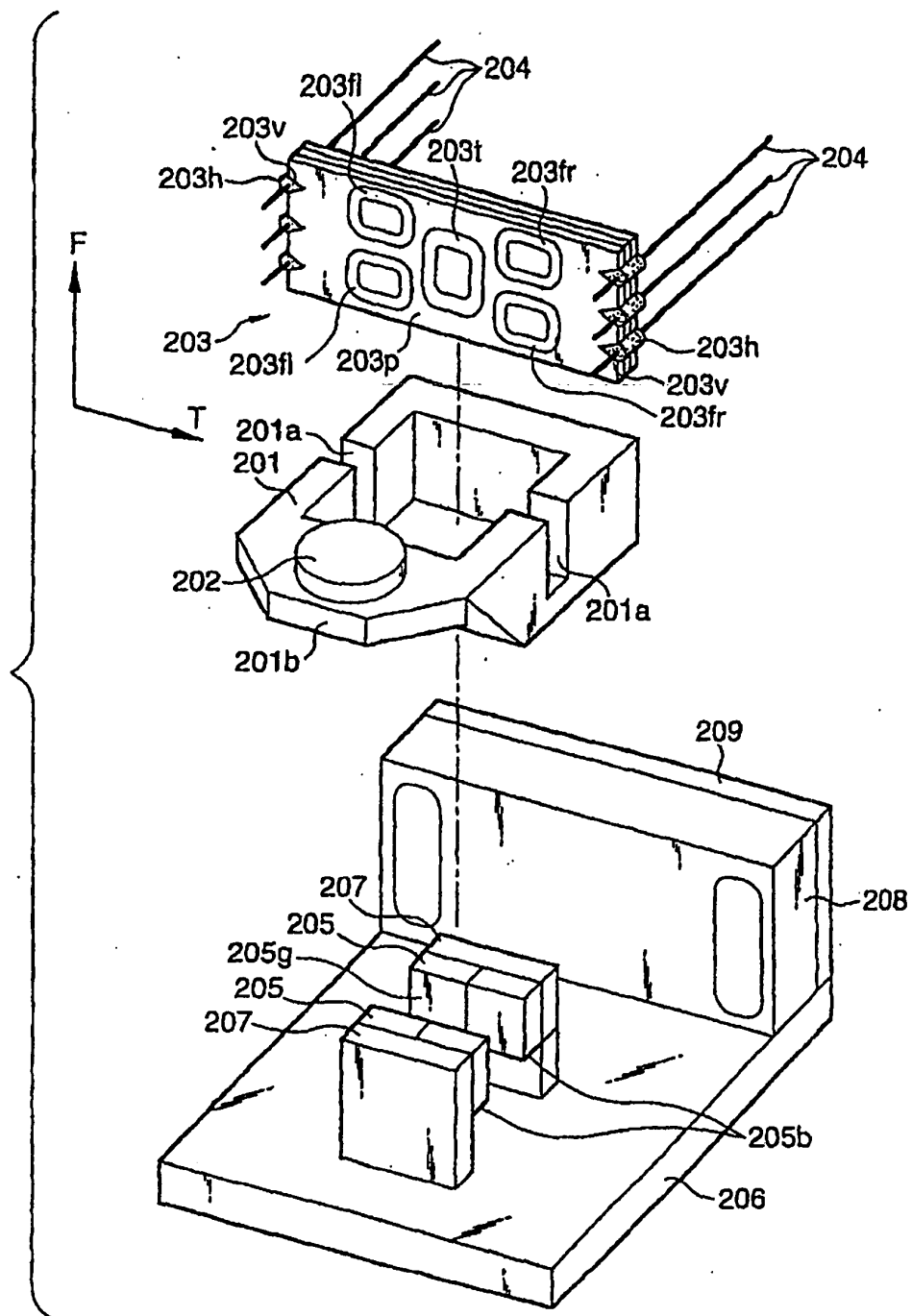


图 18

16

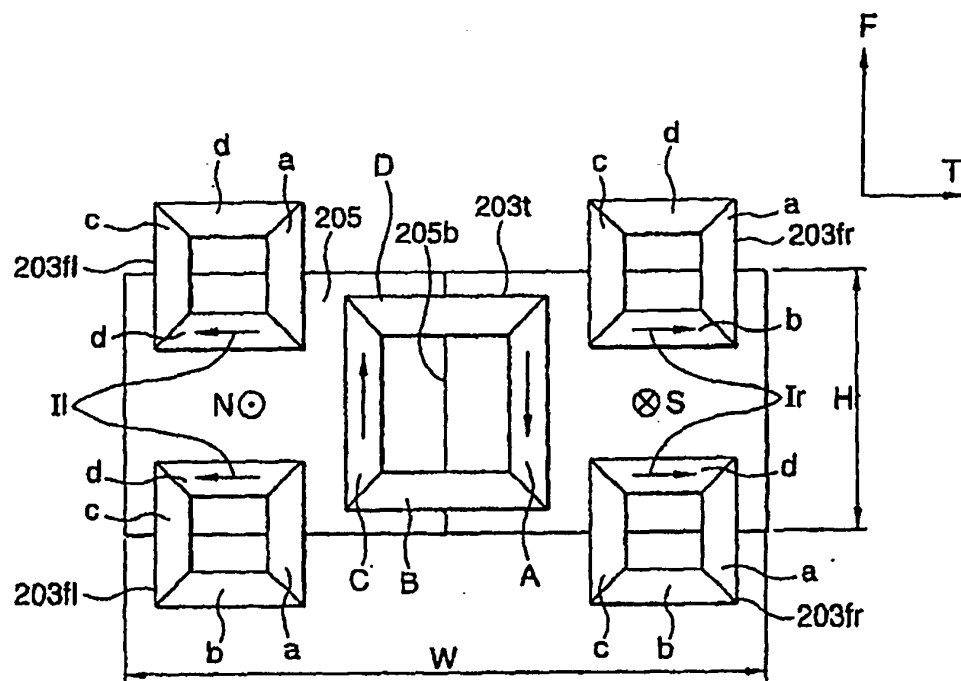


图 19

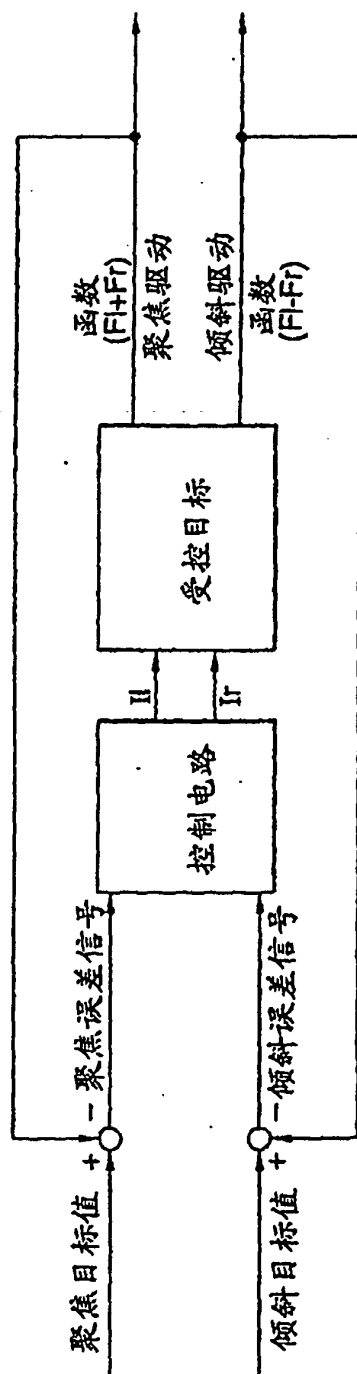


图 20

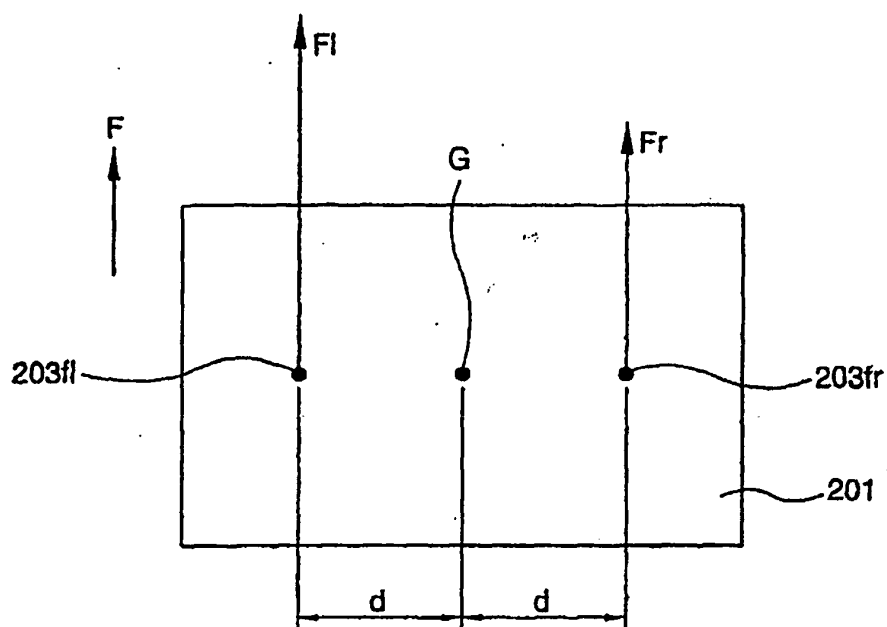


图 21A

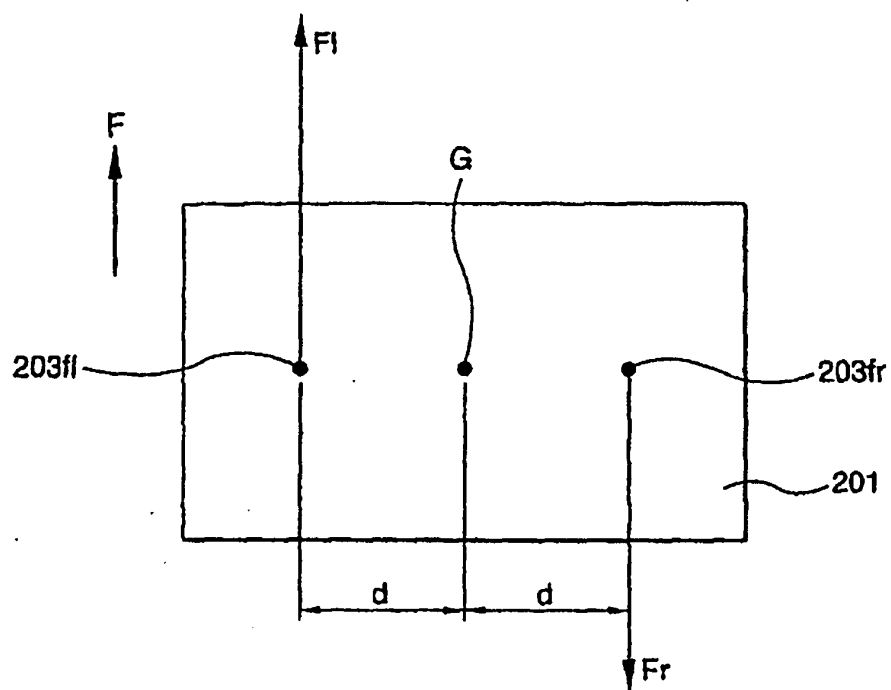


图 21B

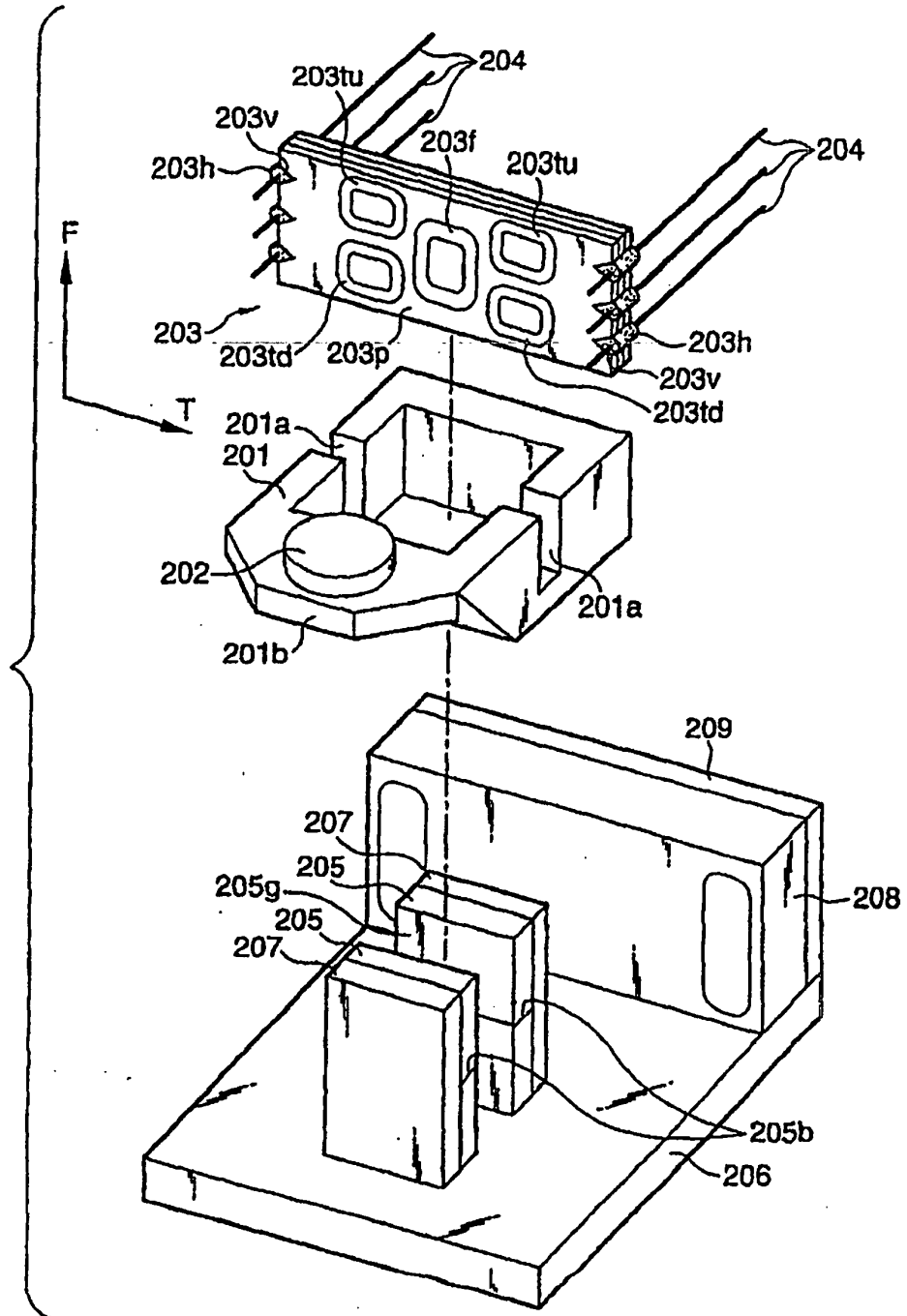


图 22

20

21

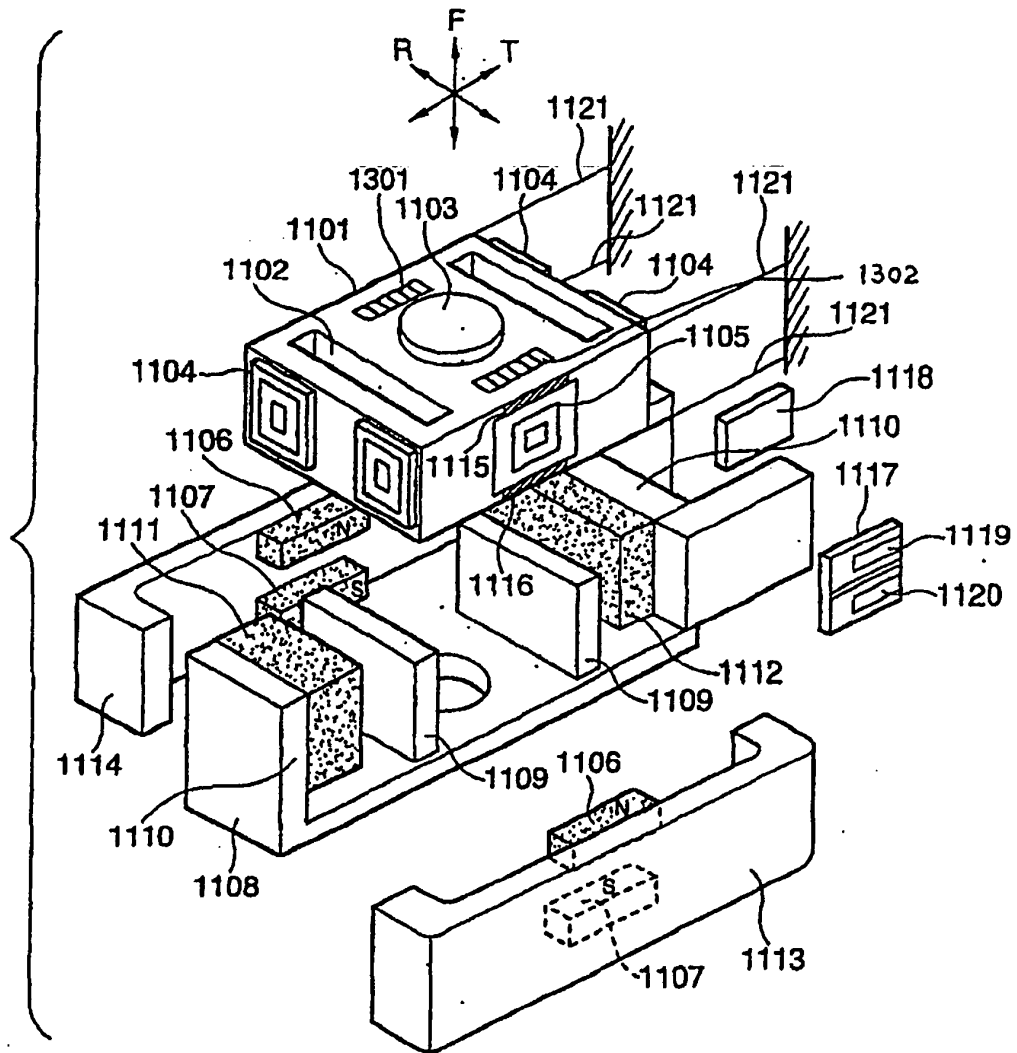


图 24

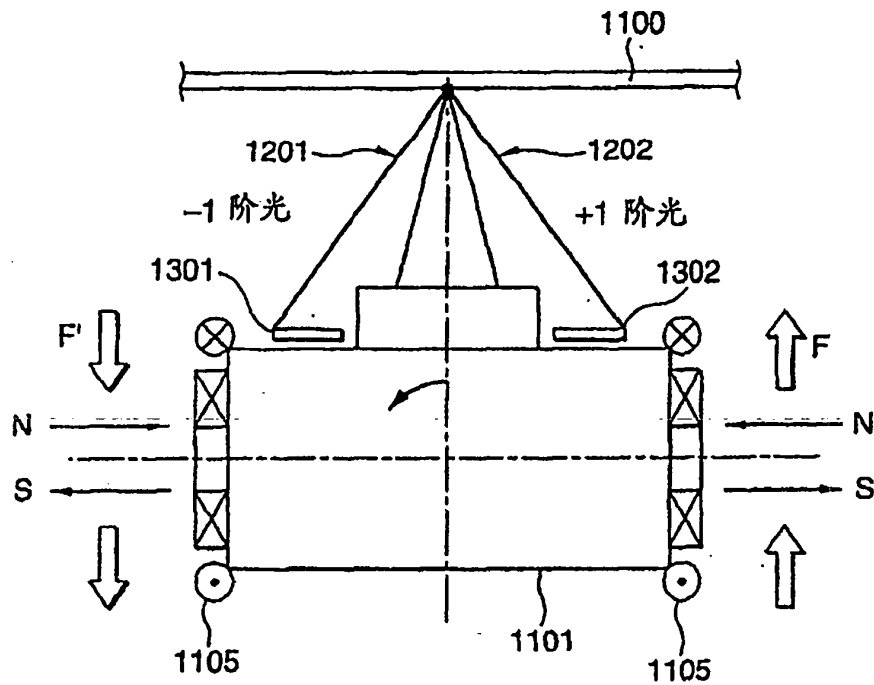


图 25

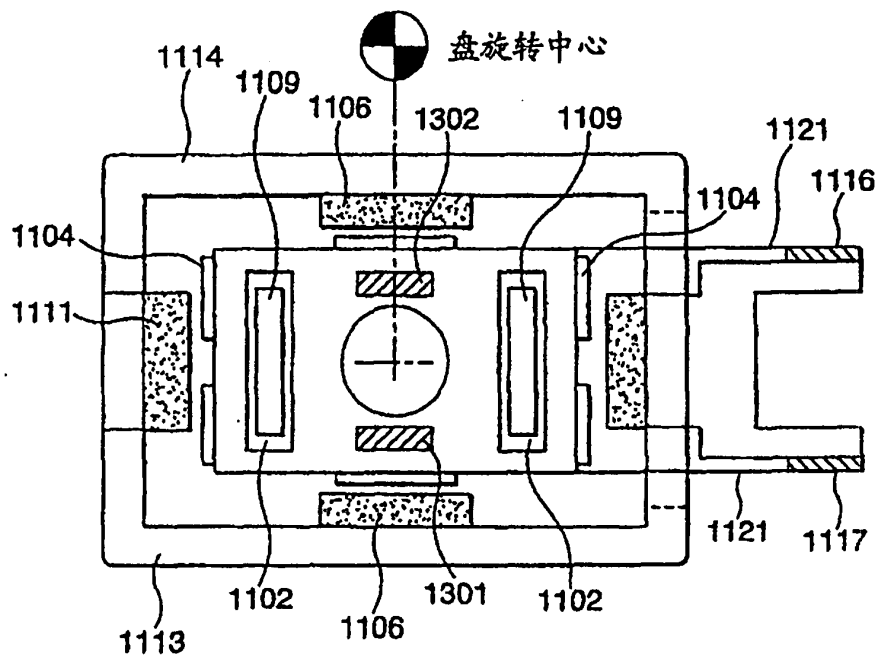


图 26

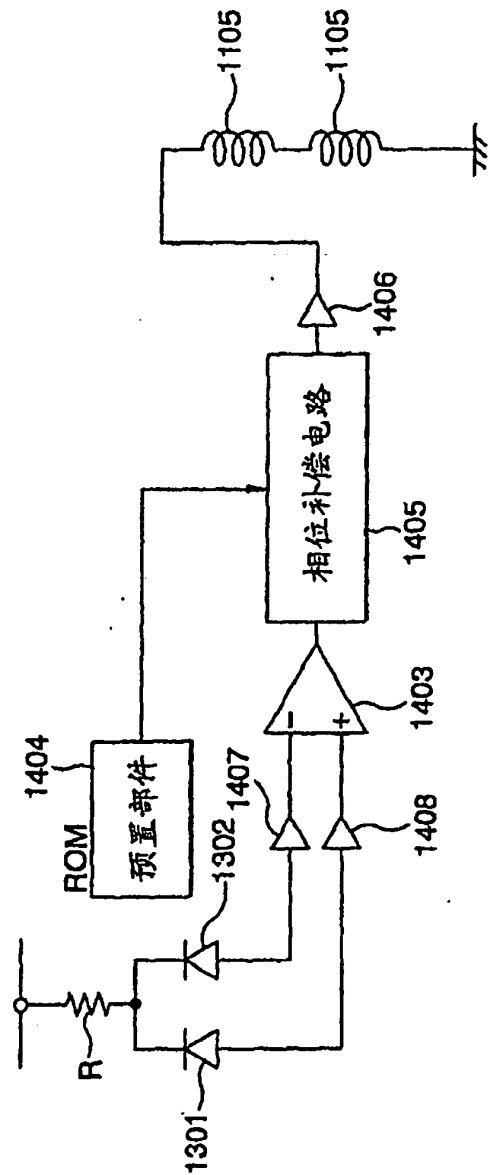


图 27



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HINDI, NABIL Z

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TITLE OF INVENTION: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$0	\$1700	07/27/2007

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS** FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21171 7590 04/27/2007

STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296

TITLE OF INVENTION: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1400	\$300	\$0	\$1700	07/27/2007

EXAMINER	ART UNIT	CLASS-SUBCLASS
HINDI, NABIL Z	2627	369-044140

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
 (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
 (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
 1 _____
 2 _____
 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296
21171	7590	04/27/2007	EXAMINER	
STAAS & HALSEY LLP SUITE 700 1201 NEW YORK AVENUE, N.W. WASHINGTON, DC 20005			HINDI, NABIL Z	
			ART UNIT	PAPER NUMBER
			2627	
DATE MAILED: 04/27/2007				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 534 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 534 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/849,190	CHO ET AL.	
	Examiner	Art Unit	
	NABIL Z. HINDI	2627	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment dated April 05, 2004.
2. ☒ The allowed claim(s) is/are 1, 3-11 and 13-47 renumbered as claims 1-45.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. ☐ Notice of References Cited (PTO-892) 2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 3. ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____ 4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material | <ol style="list-style-type: none"> 5. ☐ Notice of Informal Patent Application 6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____ 7. ☐ Examiner's Amendment/Comment 8. ☐ Examiner's Statement of Reasons for Allowance 9. ☐ Other _____ |
|---|---|


 NABIL Z. HINDI
 PRIMARY EXAMINER
 GROUP 2627
 2627

☐ Claims renumbered in the same order as presented by applicant				☐ CPA				☐ T.D.				☐ R.1.47			
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original		
1	1	29	31		61		91		121		151		181		
X	2	30	32		62		92		122		152		182		
2	3	31	33		63		93		123		153		183		
3	4	32	34		64		94		124		154		184		
4	5	33	35		65		95		125		155		185		
5	6	34	36		66		96		126		156		186		
6	7	35	37		67		97		127		157		187		
7	8	36	38		68		98		128		158		188		
8	9	37	39		69		99		129		159		189		
9	10	38	40		70		100		130		160		190		
10	11	39	41		71		101		131		161		191		
X	12	40	42		72		102		132		162		192		
11	13	41	43		73		103		133		163		193		
12	14	42	44		74		104		134		164		194		
13	15	43	45		75		105		135		165		195		
14	16	44	46		76		106		136		166		196		
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22	24		54		84		114		144		174		204		
23	25		55		85		115		145		175		205		
24	26		56		86		116		146		176		206		
25	27		57		87		117		147		177		207		
26	28		58		88		118		148		178		208		
27	29		59		89		119		149		179		209		
28	30		60		90		120		150		180		210		

Search Notes

Application/Control No.

10/849,190

Examiner

NABIL Z. HINDI

Applicant(s)/Patent under
Reexamination

CHO ET AL.

Art Unit

2627

SEARCHED

Class	Subclass	Date	Examiner
369	44.14	4/9/07	N/H
	44.15		
	44.11		
	44.16		
	44.20		
	44.21	4/9/07	N/H

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner
369	44.14	4/9/07	N/H

**SEARCH NOTES
(INCLUDING SEARCH STRATEGY)**

	DATE	EXMR
West Coast	4/9/07	N/H

Index of Claims



Application/Control No.

10/849,190

Examiner

NABIL Z. HINDI

Applicant(s)/Patent under Reexamination

CHO ET AL.

Art Unit

2627

✓	Rejected
=	Allowed

—	(Through numeral) Cancelled
÷	Restricted

N	Non-Elected
I	Interference

A	Appeal
O	Objected

Claim	Date
Final	Original
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Bib Data Sheet

CONFIRMATION NO. 7296

SERIAL NUMBER 10/849 190	FILING OR 371(c) DATE 05/20/2004 RULE	CLASS 369	GROUP ART UNIT 2627	ATTORNEY DOCKET NO. 1793.1290	
APPLICANTS Won-ik Cho, Seoul, KOREA, REPUBLIC OF; Byung-ryul Ryoo, Suwon-si, KOREA, REPUBLIC OF; Young-pil Park, Seoul, KOREA, REPUBLIC OF; No-cheol Park, Seoul, KOREA, REPUBLIC OF;					
CONTINUING DATA ** *****					
FOREIGN APPLICATIONS ***** REPUBLIC OF KOREA 2003-35305 06/02/2003					
IS REQUIRED, FOREIGN FILING LICENSE GRANTED ** 07/16/2004					
Foreign Priority Claimed ☒ yes ☐ no 35 USC 119 (a)-(d) conditions ☒ yes ☐ no ☐ Met after met ☒ Allowance Verified and Acknowledged ☒ Examiner's Signature Initials		STATE OR COUNTRY KOREA, REPUBLIC OF	SHEETS DRAWING 7	TOTAL CLAIMS 47	INDEPENDENT CLAIMS 8
ADDRESS 21171					
TITLE Optical pickup actuator and optical disk drive using the same and method					
FILING FEE RECEIVED 1686	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

<http://neo:8000/PrexServlet/PrexAction?serviceName=BibDataSheet&Action=display&brows...> 1/3/07

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a), (b), or (d))		
SEARCH FEE (37 CFR 1.16(k), (l), or (m))		
EXAMINATION FEE (37 CFR 1.16(c), (p), or (q))		
TOTAL CLAIMS (37 CFR 1.16(i))		
INDEPENDENT CLAIMS (37 CFR 1.16(i))		
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).	

SMALL ENTITY	
RATE (\$)	FEE (\$)
X 25 =	
X 100 =	
180	
TOTAL	

OTHER THAN SMALL ENTITY	
RATE (\$)	FEE (\$)
X 50 =	
X 200 =	
360	
TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED - PART II

4-5-07

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT	(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total (37 CFR 1.16(i))	45	27	
Independent (37 CFR 1.16(i))	8	8	
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

SMALL ENTITY	
RATE (\$)	ADDITIONAL FEE (\$)
X 25 =	
X 100 =	
180	
TOTAL ADD'L FEE	

OTHER THAN SMALL ENTITY	
RATE (\$)	ADDITIONAL FEE (\$)
X 50 =	
X 200 =	
360	
TOTAL ADD'L FEE	

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT	(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total (37 CFR 1.16(i))			
Independent (37 CFR 1.16(i))			
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

SMALL ENTITY	
RATE (\$)	ADDITIONAL FEE (\$)
X =	
X =	
TOTAL ADD'L FEE	

OTHER THAN SMALL ENTITY	
RATE (\$)	ADDITIONAL FEE (\$)
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X =	
TOTAL ADD'L FEE	

- * If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
- ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
- *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.
 This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9198 and select option 2.

CLAIMS ONLY							Application Number 10/849190		Filing Date	
							Applicant(s)			
* May be used for additional claims or amendments										
CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT					
	Indep	Depend	Indep	Depend	Indep	Depend	Indep	Depend	Indep	Depend
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Won-ik CHO, et al.

Serial No. 10/849,190

Group Art Unit: 2627

Confirmation No. 7296

Filed: May 20, 2004

Examiner: Hindi, Nabil Z.

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME
AND METHOD

AMENDMENT

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

This is in response to the Office Action mailed January 5, 2007, and having a period for response set to expire on April 5, 2007.

The following amendments and remarks are respectfully submitted. Reconsideration of the claims is respectfully requested.

IN THE CLAIMS:

The text of all pending claims (including withdrawn claims) is set forth below. Cancelled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~striketrough~~. The status of each claim is indicated with one of (original), (currently amended), (cancelled), (withdrawn), (new), (previously presented), or (not entered).

Please CANCEL 2 and 12 without prejudice or disclaimer, and AMEND claims 1, 4, 11, 14, and 26 in accordance with the following:

1. (currently amended) An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;

a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;

a magnetic element positioned on the base; and

a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing and/or tilting direction through an interaction with the magnetic element,

wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and

wherein the coil comprises a pair of first coils positioned on the blade in a first direction and facing each other with respect to the objective lens.

2. (canceled)

3. (original) The optical pickup actuator according to claim 1, wherein the coil comprises a coil surrounding an outer surface of the blade.

4. (currently amended) The optical pickup actuator according to claim ~~2~~1, further comprising a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.

5. (original) The optical pickup actuator according to claim 4, wherein the second coil is positioned on both sides of the blade.

6. (original) The optical pickup actuator according to claim 4, further comprising an inner yoke positioned on the base and positioned within a cavity defined by walls of the first coil, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

7. (original) The optical pickup actuator according claim 5, further comprising an inner yoke positioned on the base and positioned within a cavity defined by walls of the first coil, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

8. (original) The optical pickup actuator according to claim 1, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade and have the same polarity.

9. (original) The optical pickup actuator according to claim 4, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.

10. (original) The optical pickup actuator according to claim 1, further comprising three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

11. (currently amended) An optical disc drive for a disc that is a recording medium, comprising:

a spindle motor for rotating the disc;

an optical pickup for recording and/or reproducing information by emitting light onto the disc through an objective lens; and

an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:
a blade holding the objective lens,

a plurality of suspension wires supporting the blade on a base so that the blade is elastically movable,

a magnetic element positioned on the base, and

a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element,

wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and

wherein the coil comprises a pair of first coils positioned on the blade in a first direction so as to face each other with respect to the objective lens.

12. (canceled)

13. (original) The optical disc drive according to claim 11, wherein the coil comprises a coil positioned on the blade so as to surround an outer surface of the blade.

14. (currently amended) The optical disc drive according to claim ~~42~~11, wherein the optical pickup actuator further comprises a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.

15. (original) The optical disc drive according to claim 14, wherein the second coil is positioned on both sides of the blade.

16. (original) The optical disc drive according to claim 14, wherein the optical pickup actuator further comprises an inner yoke positioned on the base and placed inside the first coil, and

wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

17. (original) The optical disc drive according to claim 14, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.

18. (original) The optical disc drive according to claim 11, wherein the optical pickup actuator further comprises three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

19. (original) An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;

a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;

a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction;

a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction; and

an inner yoke positioned on the base, the inner yoke positioned inside a cavity defined by each of the first coils,

wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

20. (original) The optical pickup actuator according to claim 19, wherein each of the first coils is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction.

21. (original) The optical pickup actuator according to claim 19, further comprising a third coil positioned so as to surround the sides of the blade.

22. (original) The optical pickup actuator according to claim 21, wherein the third coil is divided into a plurality of subcoils that are vertically separated from one another.

23. (original) The optical pickup actuator according to claim 19, further comprising a pair of unipolar magnets disposed opposite each to other with respect to the blade in the second direction and have the same polarity.

24. (original) The optical pickup actuator according to claim 19, further comprising three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

25. (original) The optical pickup actuator according to claim 19, wherein the second coil is positioned vertically on both sides of the blade in the second.

26. (currently amended) An optical disc drive for a disc that is a recording medium, comprising:

- a spindle motor for rotating the disc-;

- an optical pickup for recording and/or reproducing information by emitting light focuses onto the disc through an objective lens-; and

- an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:

- a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable,

- a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction,

- a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction, and

- an inner yoke positioned on the base, the inner yoke positioned inside a cavity formed by walls of each of the first coils,

- wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

27. (original) The optical disc drive according to claim 26, wherein each of the first coils is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in the vertical direction.

28. (original) The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises a third coil positioned to surround the sides of the blade.

29. (original) The optical disc drive according to claim 28, wherein the third coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in the vertical direction.

30. (original) The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises a pair of unipolar magnets disposed opposite to each other with respect to the blade in the second direction and have the same polarity.

31. (original) The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

32. (original) An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;

a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable; and

three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

33. (original) The optical pickup actuator according to claim 32, wherein the stoppers are positioned on the blade.

34. (original) The optical pickup actuator according to claim 32, wherein the stoppers are positioned on the base.

35. (original) An optical disc drive for a disc that is a recording medium, comprising:
a spindle motor for rotating the disc ;

an optical pickup for recording and/or reproducing information by emitting light focused onto the disc through an objective lens ; and

an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:

a blade holding the objective lens;
a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable; and
three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

36. (original) The optical disc drive according to claim 35, wherein the stoppers are positioned on the blade.

37. (original) The optical disc drive according to claim 35, wherein the stoppers are positioned on the base.

38. (original) An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;
a plurality of suspension wires movingly supporting the blade on the base;
a pair of unipolar magnets positioned on the base; and
a plurality of coils positioned on the blade and interacting with the unipolar magnets to create an electromagnet force to move the blade; and
an inner yoke positioned inside a cavity defined by the walls of a coil, wherein the yoke comprises three sections with each of the three sections of the yoke being parallel to a different wall of the cavity to increase an effective area facing the magnets.

39. (original) The optical pickup actuator according to claim 38, wherein one of the coils is divided into a plurality of subcoils that are separated from one another.

40. (original) The optical pickup actuator according to claim 38, wherein one of the coils is positioned to surround the sides of the blade.

41. (original) The optical pickup actuator according to claim 38, wherein the base has only a single pair of unipolar magnets

42. (original) An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;
a plurality of suspension wires movingly supporting the blade on the base;
a plurality of hinges each of coupled to an end of a suspension wire;
a pair of unipolar magnets positioned on the base; and
a plurality of coils connected to an electric circuit and interacting with the unipolar magnets to create an electromagnet force to move the blade; and
wherein at least one of the plurality of coils is divided into subcoils and a hinge coupled to each of the plurality of suspension wires is between an adjacent pair of subcoils.

43. (original) The optical pickup actuator according to claim 42, wherein the plurality of suspension wires are at least six suspension wires and the coil is divided into three or more subcoils.

44. (original) The optical pickup actuator according to claim 42, wherein a first hinge and a second hinge are positioned on each of a top and a bottom of one of the coils, respectively, and a third hinge is positioned between two of the subcoils.

45. (original) The optical pickup actuator according to claim 42, wherein the coils are focus and tracking coils and the electric circuit supplies current to the coils in the same direction.

46. (original) The optical pickup actuator according to claim 42, wherein the coils are focus and tracking coils, of which the focus coil also serves as a tilt coil and the electric circuit supplies current separately to each of the coils.

47. (original) The optical pickup actuator according to claim 42, wherein the coils are focus, tracking, and tilt coils and the circuit supplies current to the coils in opposite directions.

REMARKS**INTRODUCTION:**

In accordance with the foregoing, claims 2 and 12 have been cancelled without prejudice or disclaimer, and claims 1, 4, 11, 14 and 26 have been amended. No new matter is being presented, and approval and entry are respectfully requested.

Claims 1, 3-11, and 13-47 are pending and under consideration.

REJECTION UNDER 35 U.S.C. §102:

In the Office Action, at page 2, claims 1-7, 11-16, 19, 20, and 25-27 were rejected under 35 U.S.C. §102(b) as being anticipated by Korean Patent 2002-140828 (This is believed to be a typographical error - it should read Japanese Patent 2002-140828 in accordance with Form 1449 and FIG. 21 of same. Hence, the response is directed to rejection of claims 1-7, 11-16, 19, 20, and 25-27 under 35 U.S.C. §102(b) as being anticipated by Japanese Patent 2002-140828.) This rejection is traversed and reconsideration is requested.

Claim 1 has been amended to include the features of claim 2. Claim 2 has been canceled without prejudice or disclaimer. Claim 4 has been amended to update antecedent basis.

Claim 11 has been amended to include the features of claim 12. Claim 12 has been canceled without prejudice or disclaimer. Claim 14 has been amended to update antecedent basis.

Claim 26 has been corrected to remove spaces from immediately before two semicolons.

It is respectfully submitted that Japanese Patent 2002-140828 teaches that coils 30f are separated from each other in a vertical direction (see FIG. 21). However, coils 30f are not facing each other with respect to the objective lens 2. In contrast, amended independent claim 1 of the present invention recites that the coil comprises a pair of first coils positioned on the blade in a first direction and facing each other with respect to the objective lens (see FIGs. 4 and 8), which is not taught or suggested by Japanese Patent 2002-140828. Amended independent claim 11, and independent claims 19 and 26 of the present invention, recite the positioning of the pair of first coils in similar fashion.

In order for a reference to anticipate a claim, the reference must teach each and every element of the claim (MPEP 2131). It is respectfully submitted that the court has held that an

anticipating reference "must disclose every element of the challenged claim and enable one skilled in the art to make the anticipating subject matter." PPG Industries, Inc. v. Guardian Industries Corp., 75 F.3d 1558, 1566, 37 USPQ2d 1618, 1624 (Fed. Cir. 1996).

Anticipation requires a lack of novelty of the invention as claimed. The invention must have been known to the art in the detail of the claim; that is, all of the elements and limitations of the claim must be shown in a single prior reference, arranged as in the claim. See C.R. Bard, Inc. v. M3 Systems, Inc., 157 F.3d 1340, 1349, 48 USPQ2d 1225, 1229-30 (Fed. Cir. 1998); Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Hence, it is respectfully submitted that independent claims 1, 11, 19 and 26 are not anticipated under 35 U.S.C. §102(b) as being anticipated by Japanese Patent 2002-140828. Since claims 2-7, 12-16, 20, 25, and 27 depend from independent claims 1, 11, 19 and 26, respectively, claims 2-7, 12-16, 20, 25, and 27 are not anticipated by Japanese Patent 2002-140828 for at least the reasons independent claims 1, 11, 19, and 26 are not anticipated by Japanese Patent 2002-140828.

ALLOWABLE SUBJECT MATTER:

A. In the Office Action, at page 3, claims 8-10 17, 18, 21-24, and 28-31 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants thank the Examiner for his careful review of the claims. However, in view of the above amendments and arguments, claims 8-10 17, 18, 21-24, and 28-31, which depend from independent claims 1, 11, 19 and 26, respectfully, are submitted to be allowable for at least the reasons independent claims 1, 11, 19 and 26 are allowable.

B. In the Office Action, at page 3, claims 32-47 were allowed.

Applicants thank the Examiner for his careful review and acknowledgement that claims 32-47 are allowed.

CONCLUSIONS:

In accordance with the foregoing, Applicants respectfully submit that all outstanding objections and rejections have been overcome and/or rendered moot, and further, that all pending claims patentably distinguish over the cited art. Thus, there being no further outstanding objections or rejections, the application is submitted as being in condition for allowance which action is earnestly solicited.

Serial No. 10/849,190

Docket No. 1793.1290

If the Examiner has any remaining issues to be addressed, it is believed that prosecution can be expedited by the Examiner contacting the undersigned attorney for a telephone interview to discuss resolution of such issues.

If there are any underpayments or overpayments of fees associated with the filing of this Amendment, please charge and/or credit the same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: April 5, 2007

By: Darleen J. Stockley
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Electronic Acknowledgement Receipt

EFS ID:	1656116
Application Number:	10849190
International Application Number:	
Confirmation Number:	7296
Title of Invention:	Optical pickup actuator and optical disk drive using the same and method
First Named Inventor/Applicant Name:	Won-ik Cho
Customer Number:	21171
Filer:	Darleen J. Stockley/Brian Formagus
Filer Authorized By:	Darleen J. Stockley
Attorney Docket Number:	1793.1290
Receipt Date:	05-APR-2007
Filing Date:	20-MAY-2004
Time Stamp:	10:56:09
Application Type:	Utility

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)	Multi Part /.zip	Pages (if appl.)
1		040507Amendment.pdf	487073	yes	13

Multipart Description/PDF files in .zip description			
Document Description		Start	End
Fee Worksheet (PTO-06)		1	1
Amendment - After Non-Final Rejection		2	2
Claims		3	10
Applicant Arguments/Remarks Made in an Amendment		11	13

Warnings:

Information:

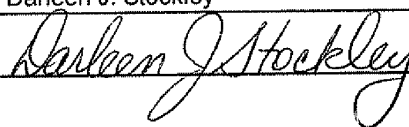
Total Files Size (in bytes):	487073
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

REPLY/AMENDMENT FEE TRANSMITTAL		Attorney Docket No.	1793.1290		
		Application Number	10/849,190		
		Filing Date	May 20, 2004		
		First Named Inventor	Won-ik CHO, et al.		
		Group Art Unit	2655		
AMOUNT ENCLOSED	0.00	Examiner Name	HINDI, Nabil Z.		
FEE CALCULATION (fees effective 12/08/04)					
CLAIMS AS AMENDED	Claims Remaining After Amendment	Highest Number Previously Paid For	Number Extra	Rate	Calculations
TOTAL CLAIMS	45	- 47 =	0	X \$ 50.00 =	\$ 0.00
INDEPENDENT CLAIMS	8	- 8 =	0	X \$ 200.00 =	0.00
Since an Official Action set an <u>original</u> due date of <u>April 5, 2007</u> , petition is hereby made for an extension to cover the date this reply is filed for which the requisite fee is enclosed (1 month (\$120)); (2 months (\$450)); (3 months (\$1,020)); (4 months (\$1,590)); (5 months (\$2,160)).					
If Notice of Appeal is enclosed, add (\$500.00)					
If Statutory Disclaimer under Rule 20(d) is enclosed, add fee (\$130.00)					
Information Disclosure Statement (Rule 1.17(p)) (\$180.00)					
Total of above Calculations =					\$ 0.00
Reduction by 50% for filing by small entity (37 CFR 1.9, 1.27 & 1.28)					
TOTAL FEES DUE =					\$ 0.00
(1) If entry (1) is less than entry (2), entry (3) is "0". (2) If entry (2) is less than 20, change entry (2) to "20". (4) If entry (4) is less than entry (5), entry (6) is "0". (6) If entry (5) is less than 3, change entry (5) to "3".					
METHOD OF PAYMENT					
☐ Check enclosed as payment. ☐ Charge "TOTAL FEES DUE" to the Deposit Account No. below. ☒ No payment is enclosed.					
GENERAL AUTHORIZATION					
☒ If the above-noted "AMOUNT ENCLOSED" is not correct, the Commissioner is hereby authorized to credit any overpayment or charge any additional fees necessary to: Deposit Account No. <u>19-3935</u> Deposit Account Name <u>STAAS & HALSEY LLP</u>					
☒ The Commissioner is also authorized to credit any overpayments or charge any additional fees required under 37 CFR 1.16 (filing fees) or 37 CFR 1.17 (processing fees) during the prosecution of this application, including any related application(s) claiming benefit hereof pursuant to 35 USC § 120 (e.g., continuations/divisionals/CIPs under 37 CFR 1.53(b) and/or continuations/divisionals/CPAs under 37 CFR 1.53(d)) to maintain pendency hereof or of any such related application.					
SUBMITTED BY: STAAS & HALSEY LLP					
Typed Name	Darleen J. Stockley		Reg. No.	34,257	
Signature			Date	April 5, 2007	

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,190	05/20/2004	Won-ik Cho	1793.1290	7296

21171 7590 01/05/2007
STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER

HINDI, NABIL Z

ART UNIT	PAPER NUMBER
----------	--------------

2627

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/05/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/849,190	Applicant(s) CHO ET AL.	
	Examiner NABIL Z. HINDI	Art Unit 2627	
	-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --		

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on ____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-47 is/are pending in this application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5) ☒ Claim(s) 32-47 is/are allowed.

6) ☒ Claim(s) 1-7, 11-16, 19, 20 and 25-27 is/are rejected.

7) ☒ Claim(s) 8-10, 17, 18, 21-24 and 28-31 is/are objected to.

8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☒ All b) ☐ Some * c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. ____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB-080).
 Paper No(s)/Mail Date ____.

4) ☐ Interview Summary (PTO-413)
 Paper No(s)/Mail Date ____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: ____.

In response to applicant's filing dated May 20, 2004. The following action is taken:

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-7, 11-16, 19, 20, and 25-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Korean Patent 2002-140828.

The reference shows an optical head structure comprising: an objective lens 2 on a blade 1, a plurality of suspension wires 4, a magnetic circuit positioned on a head base 5-7, a coil positioned horizontally and divided in a vertical direction 30f.

With respect to the limitations of claims 2 and 12 see fig 21 having the coils 30f divided in a vertical direction corresponding to coil 150 of the claimed invention.

With respect to the limitations of claims 3 and 13 see fig 21 having the coil surrounding the lens holder.

With respect to the limitations of claims 4, 5, 14 and 15 see elements 30ti.

With respect to the limitations of claims 6, 7 and 16 see element 5 and 7.

With respect to the limitation of claims 20, 25 and 27 see elements 30f.

Claims 8-10, 17, 18, 21-24, 28-31 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

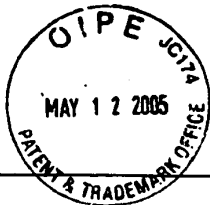
None of the cited prior art shows or teaches a pair of uni-polar magnets disposed opposite to each other with respect to the blade and have the same polarity nor the use of a three stoppers as structurally claimed.

Claims 32-47 are allowed.

None of the cited prior art shows or teaches the three stoppers, the hinge 162 between the sub coils 151, 152 nor the use of a yoke having three sections as claimed.

Any inquiry concerning this communication should be directed to NABIL Z. HINDI at telephone number (571) 272-7618.


NABIL HINDI
PRIMARY EXAMINER
GROUP 2627
2627



ATTACHMENT 1(g)

LIST OF ADDITIONAL SUBMITTED DOCUMENTS	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2007	2655-2627

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialing same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE
	AA						
	AB						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION YES NO	
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

			TRANSLATION YES NO	
	AE	Office Action issued by the Korean Patent Office on 24 February 2005 (including English translation).	✓	

EXAMINER		DATE CONSIDERED	1/30/07
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.			



FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	ATTORNEY DOCKET NO. 1793.1290	Sheet 1 of 1 APPLICATION NO. 10/849,190
	FIRST NAMED INVENTOR Won-ik CHO, et al.	
	FILING DATE May 20, 2004	GROUP ART UNIT 2655-2627

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO		ABSTRACT
	AG	2000-39836	7/2000	Korea	☒	☐	✓
	AH	2002-140828	5/2002	Japan	☒	☐	✓
	AI						
	AJ						
	AK						
	AL						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

			TRANSLATION YES NO	
	AM			

EXAMINER 	DATE CONSIDERED 1/3/07
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
 United States Patent and Trademark Office
 Address: COMMISSIONER FOR PATENTS
 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov



Bib Data Sheet

CONFIRMATION NO. 7296

SERIAL NUMBER 10/849 190	FILING OR 371(c) DATE 05/20/2004 RULE	CLASS 369	GROUP ART UNIT 2627	ATTORNEY DOCKET NO. 1793.1290
APPLICANTS Won-ik Cho, Seoul, KOREA, REPUBLIC OF; Byung-ryul Ryoo, Suwon-si, KOREA, REPUBLIC OF; Young-pil Park, Seoul, KOREA, REPUBLIC OF; No-cheol Park, Seoul, KOREA, REPUBLIC OF;				
** CONTINUING DATA ** *****				
** FOREIGN APPLICATIONS ***** REPUBLIC OF KOREA 2003-35005 06/02/2003				
IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 07/16/2004				
Foreign Priority claimed ☒ yes ☐ no 35 USC 119 (a)-(d) conditions ☒ yes ☐ no ☐ Met after met Verified and Acknowledged ☒ Allowance Examiner's Signature _____ Initials _____	STATE OR COUNTRY KOREA, REPUBLIC OF	SHEETS DRAWING 7	TOTAL CLAIMS 47	INDEPENDENT CLAIMS 8
ADDRESS 21171				
TITLE Optical pickup actuator and optical disk drive using the same and method				
FILING FEE RECEIVED 1686	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit	

Index of Claims 		Application/Control No. 10/849,190 Examiner NABIL Z. HINDI		Applicant(s)/Patent under Reexamination CHO ET AL. Art Unit 2627	
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Rejected = Allowed	(Through numeral) Cancelled + Restricted	N Non-Elected I Interference	A Appeal O Objected
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Claim		Date			
Final	Original				
1	✓				
2	✓				
3	✓				
4	✓				
5	✓				
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8	0				
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Search Notes



Application/Control No.

10/849,190

Examiner

NABIL Z. HINDI

Applicant(s)/Patent under Reexamination

CHO ET AL.

Art Unit

2627

SEARCHED

Class	Subclass	Date	Examiner
369	44.11	1/3/07	U/H
	44.14		
	44.15		
	44.16		
	44.20		
	44.21	1/3/07	U/H

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)

	DATE	EXMR
West Coast	1/3/07	U/H

JPW



Attorney Docket No. 1793.1290

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re Patent Application of:

Won-ik CHO, et al.

Application No. 10/849,190

Group Art Unit: 2655

Filed: May 20, 2004

Examiner:

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING
THE SAME AND METHOD

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the duty of disclosure provisions of 37 CFR § 1.56, there is hereby provided certain information which the Examiner may consider material to the examination of the subject U.S. patent application. It is requested that the Examiner make this information of record if it is deemed material to the examination of the subject application.

1. Enclosures accompanying this Information Disclosure Statement are:

- 1a. ☒ Form PTO-1449.
- 1b. ☐ Copy(ies) of IDS citation(s), except for U.S. Patents and U.S. Patent Application publications.
- 1c. ☒ English language copy of a communication(s) from a foreign Patent Office or a PCT International Search Report.
- 1d. ☒ English language translation (complete, Abstract or relevant portion(s)) attached to non-English language publications as indicated on the attached Form PTO-1449.
- 1e. ☐ Explanations of Relevancy of References (ATTACHMENT 1(e), hereto) for providing a concise explanation of non-English publications.
- 1f. ☐ List of Copending Applications (ATTACHMENT 1(f), hereto).
- 1g. ☒ List of Additional Submitted Documents (ATTACHMENT 1(g), hereto).

2. ☒ This Information Disclosure Statement is filed under 37 CFR § 1.97(b):

(Check either Item 2a or 2b or 2c or 2d)

- 2a. ☐ Within three months of the filing date of a national application;
- 2b. ☐ Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application.
- 2c. ☒ Before the mailing of a first Office Action on the merits; or
- 2d. ☐ Before the mailing of a first Office Action after the filing of a Request for Continued Examination under § 1.114.

3. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(c) after the period specified in paragraph 2 above but before the mailing date of any of a Final Office Action under § 1.113, a Notice of Allowance under § 1.311 or an action that otherwise closes prosecution in the application, AND
- (Check either Item 3a or 3b; Item 3b to be checked if any reference known for more than 3 months)*
- 3a. ☐ The § 1.97(e) Statement in Item 5 below is applicable; OR
- 3b. ☐ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
- ☐ enclosed.
- ☐ to be charged to Deposit Account No. 19-3935.
4. ☐ This Information Disclosure Statement is filed under 37 CFR § 1.97(d) after the period specified in paragraph 3 above, but on or before payment of the Issue Fee, AND
- 4a. ☐ The § 1.97(e) Statement in Item 5 below is applicable; AND
- 4b. ☐ The \$180.00 fee set forth in 37 CFR § 1.17(p) is:
- ☐ enclosed.
- ☐ to be charged to Deposit Account No. 19-3935.
5. ☐ Statement under § 1.97(e) (*applicable if Item 3a or Item 4a is checked*)
- (Check either Item 5a or 5b)*
- 5a. ☐ In accordance with 37 CFR § 1.97(e)(1), it is stated that each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.
- 5b. ☐ In accordance with 37 CFR § 1.97(e)(2), it is stated that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known by any individual designated in § 1.56(c) more than three months prior to the filing of this Information Disclosure Statement.
6. ☐ This is a continuation/divisional/continuation-in-part application under 37 CFR § 1.53(b).
- (Check appropriate Items 6a and/or 6b)*
- 6a. ☐ Copies of the publications listed on the attached Form PTO-1449 which were previously cited in prior application Serial No. __, filed on __, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, have been omitted pursuant to 37 CFR § 1.98(d).
- 6b. ☐ Copies of the publications listed on the attached Form PTO-1449 which were not previously cited in prior application Serial No. __, filed on __, and which is relied on for an earlier effective filing date for the subject application under 35 U.S.C. § 120, are provided herewith.

7. ☐ This is a Request for Continued Examination under 37 CFR § 1.114.
(Check either Item 7a or 7b)
- 7a. ☐ The Issue Fee has not been paid.
- 7b. ☐ A Petition to Withdraw from issue under 37 CFR § 1.313(c) is filed concurrently herewith or has been granted. A Request for Continued Examination under 37 CFR § 1.114, after payment of the Issue Fee, is proper in accordance with 37 CFR § 1.114(a), respectively.
8. ☐ This is a Supplemental Information Disclosure Statement.
(Check either Item 8a or 8b)
- 8a. ☐ This Supplemental Information Disclosure Statement under 37 CFR § 1.97(f) supplements the Information Disclosure Statement filed on _____. A bona fide attempt was made to comply with 37 CFR § 1.98, but inadvertent omissions were made. These omissions have been corrected herein. Accordingly, additional time is requested so that this Supplemental IDS can be considered as if properly filed on _____.
- 8b. ☐ This Supplemental Information Disclosure Statement is timely filed within one (1) month of the Notice under 37 CFR §§ 1.97 and 1.98, mailed _____.
9. ☐ In accordance with 37 CFR § 1.98, a concise explanation of what is presently understood to be the relevance of each non-English language publication is:
(Check appropriate Items 9a, 9b, 9c and/or 9d)
- 9a. ☐ satisfied for the non-English language publication(s) cited on the enclosed "English language version of the search report or action which indicates the degree of relevance found by the foreign office". (See MPEP § 609, Minimum Requirements for an Information Disclosure Statement, Part A(3): Concise Explanation of Relevance, 8th Ed., Rev. 2)
- 9b. ☐ set forth in the application.
- 9c. ☐ satisfied for the non-English language publication(s) indicated on the attached Form PTO-1449 as having an English language translation (complete or relevant portion(s)) attached thereto.
- 9d. ☐ enclosed as Attachment 1(e), hereto.
10. No admission is made that the information cited in this Statement is, or is considered to be, material to patentability nor a representation that a search has been made (other than search report(s) from a counterpart foreign application or a PCT International Search Report, if submitted herewith). 37 CFR §§ 1.97(g) and (h).

11. The Commissioner is authorized to credit any overpayment or charge any additional fee required under 37 CFR § 1.17 for this Information Disclosure Statement to Deposit Account No. 19-3935.

Respectfully submitted,

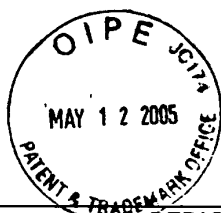
STAAS & HALSEY LLP

Dated: May 12, 2005

By: 

Gene M. Garner, II
Registration No. 34,172

1201 New York Ave., N.W., 7th Floor
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501



Sheet 1 of 1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2004	2655

U.S. PATENT DOCUMENTS

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FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	TRANSLATION YES NO		ABSTRACT
	AG	2000-39836	7/2000	Korea			√
	AH	2002-140828	5/2002	Japan			√
	AI						
	AJ						
	AK						
	AL						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

TRANSLATION
YES NO

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EXAMINER	DATE CONSIDERED
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	



ATTACHMENT 1(g)

LIST OF ADDITIONAL SUBMITTED DOCUMENTS	ATTORNEY DOCKET NO.	APPLICATION NO.
	1793.1290	10/849,190
	FIRST NAMED INVENTOR	
	Won-ik CHO, et al.	
	FILING DATE	GROUP ART UNIT
	May 20, 2004	2655

The following document(s) is/are listed in accordance with the duty of disclosure provisions of 37 CFR § 1.56, so that the Examiner may consider same should he deem any thereof to be material to examination of the subject application.

It is requested that the Examiner acknowledge his consideration of document(s) below-listed by initialing same in the space provided adjacent each such application and that the Examiner sign and date this form at the bottom thereof to confirm such consideration having been given.

This submission in no way represents an admission that any of the information listed herein constitutes prior art with respect to the subject application; and unless and until such prior art status is established, this submission is not a request that the information presented herein be printed on the face of any patent issuing from the subject application in which this information is being filed.

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE
	AA						
	AB						

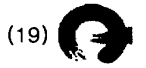
FOREIGN PATENT DOCUMENTS

		DOCUMENT NO.	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION	
							YES	NO
	AC							
	AD							

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

			TRANSLATION	
			YES	NO
	AE	Office Action issued by the Korean Patent Office on 24 February 2005 (including English translation).	√	

EXAMINER	DATE CONSIDERED
*EXAMINER: Initial if document considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	



KOREAN INTELLECTUAL PROPERTY OFFICE

KOREAN PATENT ABSTRACTS

(11)Publication number: 1020000039836 A
(43)Date of publication of application: 05.07.2000

(21)Application number: 1019980055298
(22)Date of filing: 16.12.1998

(71)Applicant: DAEWOO ELECTRONICS CO., LTD.
(72)Inventor: PARK, JAE GYU

(51)Int. Cl G11B 7/08

(54) STRUCTURE FOR CONTROLLING SKEW OF OPTICAL PICKUP ACTUATOR

(57) Abstract:

PURPOSE: A controlling structure of skew for an optical pickup actuator is provided to improve the assembling productivity with eliminating a separated controlling structure of skew by controlling the skew of lens holder supported in a suspension wire by itself.

CONSTITUTION: By generating a skew in all direction, a voltage is fed to a direction generated an electric force downward into a left first controlling coil of skew(40) and a third controlling coil of skew(44) in inclining a lens holder(30) rightward. The voltage is fed to the direction generated the electric force upward into a right second controlling coil of skew(42) and a fourth controlling coil of skew(46). Therefore, the skew in all direction is controlled because the lens holder(30) receives a rotated talk twisted anti-clockwise. When the lens holder(30) is inclined leftward, the voltage is fed in the direction generated the electric force upward into the left controlling coil of skew(40). The third controlling coil of skew(44) and the voltage is fed in the direction generated an electric force downward into the right second controlling coil of skew(42) and the fourth controlling coil of skew(46). Therefore, the skew in all direction is controlled because the lens holder(30) receives the rotated talk twisted clockwise.

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Legal Status

Date of final disposal of an application (20001031)

Patent registration number (1002873230000)

Date of registration (20010126)

공개특허 제2000-39836호(2000.07.05) 1부.

[첨부그림 1]

특 2000-0039836

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(51) Int. Cl. ⁸ G11B 7/08	(11) 공개번호 (43) 공개일자	특2000-0039836 2000년 07월 05일
(21) 출원번호 (22) 출원일자	10-1998-0055298 1998년 12월 16일	
(71) 출원인	대우전자 주식회사 전주법 서울시 중구 남대문로5가 541	
(72) 발명자	박재규 경기도 고양시 덕양구 관산동 새서울아파트 5동 110호	
(74) 대리인	남상선	
심사권구 : 있음		
(54) 광픽업 액츄에이터의 스큐 조정구조		

요약

본 발명은 서스펜션 와이어에 지지되는 광픽업 액츄에이터의 렌즈 홀더의 스큐가 자체로 조정되도록 하기 위한 것이다.

이러한 본 발명은 광픽업 액츄에이터의 각각의 트레이킹 코일(38) 및 포커싱 코일(36)과 렌즈 홀더(30)의 사이에 요크(10)와 일체로 돌출 형성되는 제 1 내지 제 4홀(20, 22, 24, 26)과, 제 1 내지 제 4홀(20, 22, 24, 26)을 각각 어워싸도록 권선되며 상기 렌즈 홀더(30)에 고정되는 제 1 내지 제 4스큐 조정 코일(40, 42, 44, 46)로 구성되는 스큐 조정구조로서, 스큐를 보상하기 위한 전압값을 제어부에 입력하여 홀로그래프 소자의 구동과 동시에 미리 입력된 전압을 제 1 내지 제 4스큐 조정코일(40, 42, 44, 46)에 각각 인가하여 렌즈 홀더(30)의 스큐를 자체로 조정함으로써, 별도의 스큐조정을 위한 구조 및 공정을 생략하여 조립생산성을 향상시킬 수 있다.

도면도

도 2

발명서

도면의 간단한 설명

- 도 1은 일반적인 광픽업 액츄에이터의 스큐 조정구조를 도시한 사시도.
도 2는 본 발명에 따른 광픽업 액츄에이터의 분해 사시도.
도 3은 본 발명에 따른 광픽업 액츄에이터의 결합 상태를 도시한 평면도.
도 4a, 4b는 본 발명에 따른 스큐 조정작용을 도시한 확대면도.
도 5a, 5b는 본 발명에 따른 스큐 조정작용을 도시한 정단면도.

<도면의 주요부분에 대한 부호의 설명>

- | | |
|----------------|----------------|
| 10: 요크 | 12: 마그네트 |
| 20: 제 1홀 | 22: 제 2홀 |
| 24: 제 3홀 | 26: 제 4홀 |
| 30: 렌즈 홀더 | 32: 대물렌즈 |
| 34: 서스펜션 와이어 | 36: 포커싱 코일 |
| 38: 트레이킹 코일 | 40: 제 1스큐 조정코일 |
| 42: 제 2스큐 조정코일 | 44: 제 3스큐 조정코일 |
| 46: 제 4스큐 조정코일 | |

발명의 상세한 설명

발명의 목적

본 발명이 속하는 기술 및 그 분야의 종래기술

7-1

7-1

본 발명은 광픽업 액츄에이터의 스큐(skew) 조정구조에 관한 것으로서, 특히 서스펜션 와이어에 지지되는 렌즈 홀더의 스큐가 자체로 조정되도록 함으로써, 별도의 스큐 조정구조를 생략하여 조립생산성을 향상시키기 위한 광픽업 액츄에이터의 스큐 조정구조에 관한 것이다.

일반적으로 광픽업 장치는 써디 플레이어에 설치되어 디스크에 레이저 광을 조사하고 디스크로부터 반사되는 광을 받아들여 디스크의 기록 내용을 재생하는 장치로서, 레이저를 조사하고 반사된 빛을 전기신호로 바꾸는 홀로그래프 소자가 고정되는 픽업 베이스와, 홀로그래프 소자로부터 조사된 레이저 광을 디스크 면상에 집속시키는 대물렌즈를 구동시키기 위한 광픽업 액츄에이터로 구성되어 있다.

이러한 광픽업 장치 중 와이어 구동방식 광픽업 액츄에이터를 구비한 제품의 한 예는 도 1에 도시한 바와 같이, 대물렌즈(110)가 장착된 렌즈 홀더(112)를 서스펜션 와이어(114)로 포커싱 방향 및 트래킹 방향으로 유동 가능하게 요크(116)에 지지시키고, 이 요크(116)을 홀로그래프 소자가 설치된 픽업 베이스(130) 상에 안착시킨 구조로 되어 있다.

한편 상기의 대물렌즈(110)는 디스크의 평면에 대해 정확히 수평이 되게 설치된 상태 즉, 렌즈 홀더(112)가 포커싱하기 위하여 상하로 구동할 때 정확히 광축을 따라 이동할 수 있도록 설치되어야만 대물렌즈(110)에서 형성한 레이저 광의 초점이 디스크의 기록 피트 상의 트랙에서 이탈되지 않은 상태로 스코의 크기가 조절될 수 있다.

만일 대물렌즈(110)가 렌즈 홀더(112)에 잘못 장착되어 기울어져 수평이 되지 않은 경우에는, 렌즈 홀더(112)가 포커싱하기 위하여 상하로 구동할 때 대물렌즈(110)가 광축으로부터 벗어나거나, 광의 초점이 원하는 대로 트래킹 방향으로 이동하게 되므로 재차 트래킹 에러를 보정하여야 한다.

이에 따라 종래에는 렌즈 홀더(112) 및 서스펜션 와이어(114)를 요크(116)에 조립하는 공정을 마치고 요크(116)을 픽업 베이스(130)에 조립할 때, 최종적으로 요크(116)의 높이 밸런스를 픽업 베이스(130) 상에서 조절하여 대물렌즈(110)가 디스크 면에 대해 정확히 수평이 되게 하였다.

이러한 고정 작업을 위하여 요크(116)의 일측에 관통공(118)을 형성하고, 이 관통공(118)에 압축 스프링(122)을 끼운 고정나사(120)를 삽입시키고 픽업 베이스(130) 상에 형성되는 나사공(미도시)에 체결함으로써, 요크(116)의 일측을 압축 스프링(122)의 탄성으로 픽업 베이스(130) 상에서 탄성을 가지면서 고정되도록 하였다.

그리고 요크(116)의 타측 가로 방향 및 세로 방향 높이 밸런스를 조절하기 위하여 픽업 베이스(130)에 형성한 관통공(118)으로부터 가로 및 세로 방향의 픽업 베이스(130)에 각각 관통공(136)을 형성하고, 각각의 관통공(136)에 각각의 조정나사(138)를 삽입시켜 요크(116)에 형성되는 나사공(미도시)에 각각 체결한 다음, 각각의 조정나사(138)의 조임 정도를 조절하여 요크(116)의 가로 및 세로의 높이 밸런스를 조절함으로써, 대물렌즈(110)가 수평이 되게하여 대물렌즈(110)를 투과한 레이저 광의 축방향이 디스크에 대해 수직이 되게 하였다.

여기서 가로 방향과 세로 방향은, 디스크의 기록피트에 대해 대물렌즈(110)에서 형성하는 레이저 광의 초점이 이동하는 방향에 따른 것으로서, 방사(radial) 방향 및 접선(tangential) 방향을 의미한다.

따라서 검사장비로 요크(116)의 수평도를 검사하며 두 개의 조정나사(138)로 요크(116)의 높이 밸런스를 조절함으로써, 대물렌즈(110)의 방사 스큐 및 접선 스큐를 조정하였던 것이다.

이와 같이 종래의 광픽업 액츄에이터에 있어서는, 대물렌즈(110)의 스큐를 조정하기 위하여 요크(112)의 일측을 픽업 베이스(130)에 탄성을 갖도록 압축 스프링(122)을 끼운 고정나사(120)로 체결하고, 요크(116)의 높이 밸런스를 조절하기 위하여 두 개의 조정나사(138)로 요크(116)을 방사 방향 및 접선 방향으로 기울였다. 또한 요크(112) 및 픽업 베이스(130)에는 서로 맞닿는 구면을 형성하여 요크(112)가 구면을 따라 기울어지도록 하였다.

따라서 종래의 광픽업 액츄에이터는 대물렌즈(110)의 스큐 조정을 위한 구조 및 조정 공정이 복잡하였으므로, 부품수 및 공정수가 증가되어 광픽업 액츄에이터의 조립생산성이 저하되는 문제점이 있었다.

발명이 이루고자 하는 기술적 과제

본 발명은 종래의 문제점을 개선하기 위하여 안출한 것으로, 본 발명의 목적은 서스펜션 와이어에 지지되는 렌즈 홀더의 스큐가 자체로 조정되도록 함으로써, 별도의 스큐 조정구조를 생략하여 조립생산성을 향상시키기 위한 것이다.

발명의 구성 및 작용

상기의 목적을 달성하기 위한 본 발명은, 포커싱 코일이 물레에 권선되고 트래킹 코일이 대향되는 위치에 고정되는 렌즈 홀더와, 상기 렌즈 홀더를 서스펜션 와이어로 지지시키는 요크와, 상기 요크의 대향되는 위치에 한 쌍이 고정되어 상기 트래킹 코일 및 포커싱 코일에 자속을 공급하는 마그네트가 구비된 광픽업 액츄에이터에 있어서, 각각의 상기 트래킹 코일 및 포커싱 코일과 상기 렌즈 홀더의 사이에 상기 요크와 일체로 돌출 형성되는 제 1 내지 제 4플과, 상기 제 1 내지 제 4플을 각각 에워싸도록 권선되어 상기 렌즈 홀더에 고정되는 스큐 조정코일로 구성되는 것을 특징으로 한다.

이러한 스큐 조정구조는 각각의 스큐 조정코일에 전류가 인가되면, 마그네트의 자속이 미치는 부분에서 렌즈 홀더를 광축 방향으로 이동시키는 전자력이 발생하므로, 각각의 스큐 조정 코일의 전자력의 방향을 조절함으로써 렌즈 홀더를 방사 방향 및 접선 방향으로 기울일 수 있다.

따라서 렌즈 홀더의 스큐를 자체로 스큐가 조정하여 별도의 스큐조정을 위한 구조 및 공정을 생략함으로써, 조립생산성을 향상시킬 수 있다.

이하에서는 본 발명에 따른 양호한 실시예를 설명하여 본 발명의 실시를 용이하게 한다.

본 실시예는 포커싱 코일이 둘레에 권선되고 트래킹 코일이 대향되는 위치에 고정되는 렌즈 홀더와, 상기 렌즈 홀더를 서스펜션 와이어로 지지시키는 요크와, 상기 요크의 대향되는 위치에 한 쌍이 고정되어 상기 트래킹 코일 및 포커싱 코일에 자속을 공급하는 마그네트가 구비된 와이어 구동방식 광픽업 액츄에이터에 적용된다.

여기서 도 2에 도시한 바와 같이, 각각의 트래킹 코일(38) 및 포커싱 코일(36)과 렌즈 홀더(30)의 사이에 요크(10)와 일체로 돌출 형성되는 제 1 내지 제 4홀(20, 22, 24, 26)과, 각각의 제 1 내지 제 4홀(20, 22, 24, 26)을 에워싸도록 권선되어 상기 렌즈 홀더(30)에 고정되는 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)이 구비된다. 이러한 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)은 별도의 경로로 제어부에 접속시켜, 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에 인가되는 전류의 방향 및 전압의 세기를 조절할 수 있도록 한다.

이러한 광픽업 액츄에이터가 조립된 상태는 도 3과 같으며, 대물렌즈(32)가 고정된 렌즈 홀더(30)는 서스펜션 와이어(34)에 의해 요크(10)에 부속되어 지지되고, 렌즈 홀더(30)의 둘레에 권선된 포커싱 코일(36) 및 렌즈 홀더(30)의 양측에 부착된 트래킹 코일(38)의 외측에 위치하도록 한 쌍의 마그네트(12)가 요크(10)에 고정된다.

또 요크(10)에 형성한 제 1 내지 제 4홀(20, 22, 24, 26)은 트래킹 코일 및 포커싱 코일(36)의 내측에 위치하고, 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)은 제 1 내지 제 4홀(20, 22, 24, 26)을 각각 에워싸며 렌즈 홀더(30)에 고정된다.

한편, 스퀴를 보상하기 위한 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)의 전압값은 미리 실험을 통하여 측정하여 제어부에 입력하고, 홀로그래프 소자의 구동과 동시에 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에도 동시에 입력된 전압값이 인가되도록 프로그래밍시킴으로써, 렌즈 홀더(30)의 구동작동과 스퀴의 조정 및 동시에 이루어지도록 한다.

이하에서는 상기와 같은 구성으로 된 광픽업 액츄에이터의 스퀴 조정작용을 설명한다.

우선 렌즈 홀더(30)가 기울어진 스퀴값을 알기 위하여 검사장비로 렌즈 홀더(30)의 스퀴값을 측정하면서, 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에 전류를 인가하여 스퀴를 조정하고, 스퀴가 조정된 상태에서 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에 인가된 전압값을 제어부에 입력하여 둔다.

여기서 렌즈 홀더(30)의 스퀴가 조정되는 작용을 설명한다.

먼저 방사 방향의 스퀴가 발생한 경우에서, 도 4a와 같이 렌즈 홀더(30)가 도면을 기준으로 우측으로 기울어진 경우에는 좌측의 제 1스프링 조정코일(40)과 제 3스프링 조정코일(44)에 하방으로 전압이 발생되는 방향으로 전압을 인가하고, 우측의 제 2스프링 조정코일(42)과 제 4스프링 조정코일(46)에 상방으로 전압이 발생되는 방향으로 전압을 인가한다. 따라서 렌즈 홀더(30)는 반시계 방향으로 비틀리는 회전토크를 받게 되어 방사 방향의 스퀴가 조정된다.

또한 도 4b와 같이 렌즈 홀더(30)가 도면을 기준으로 좌측으로 기울어진 경우에는 좌측의 제 1스프링 조정코일(40)과 제 3스프링 조정코일(44)에 상방으로 전압이 발생되는 방향으로 전압을 인가하고, 우측의 제 2스프링 조정코일(42)과 제 4스프링 조정코일(46)에 하방으로 전압이 발생되는 방향으로 전압을 인가한다. 따라서 렌즈 홀더(30)는 시계 방향으로 비틀리는 회전토크를 받게 되어 방사 방향의 스퀴가 조정된다.

한편, 렌즈 홀더(30)가 집선 방향으로 스퀴가 발생한 경우에서, 도 5a와 같이 렌즈 홀더(30)가 우측으로 기울어진 경우에는 좌측의 제 1스프링 조정코일(40)과 제 2스프링 조정코일(42)에 하방으로 전압이 발생되는 방향으로 전압을 인가하고, 우측의 제 3스프링 조정코일(44)과 제 4스프링 조정코일(46)에 상방으로 전압이 발생되는 방향으로 전압을 인가한다. 따라서 렌즈 홀더(30)는 반시계 방향으로 비틀리는 회전토크를 받게 되어 집선 방향의 스퀴가 조정되는 것이다.

또한 도 5b와 같이 렌즈 홀더(30)가 좌측으로 기울어진 경우에는 좌측의 제 1스프링 조정코일(40)과 제 2스프링 조정코일(42)에 상방으로 전압이 발생되는 방향으로 전압을 인가하고, 우측의 제 3스프링 조정코일(44)과 제 4스프링 조정코일(46)에 하방으로 전압이 발생되는 방향으로 전압을 인가한다. 따라서 렌즈 홀더(30)는 시계 방향으로 비틀리는 회전토크를 받게 되어 집선 방향의 스퀴가 조정되는 것이다.

따라서 본 실시예의 광픽업 액츄에이터는 디스크의 기록을 재생하기 위하여 홀로그래프 소자에서 대물렌즈(32)로 레이저 광이 조사되고, 이 대물렌즈(32)에서 디스크에 레이저 광의 초점을 형성함과 동시에, 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에 각각 전압이 인가되어 렌즈 홀더(30)의 스퀴가 조정된다.

이와 같이 렌즈 홀더(30)는 홀로그래프 소자의 구동과 동시에 스퀴가 조정된 상태가 되고, 트래킹 코일(38) 및 포커싱 코일(36)에 전류가 인가되면, 렌즈 홀더(30)가 구동하여 레이저 광의 초점에 발생된 트래킹 에러 및 포커싱 에러를 보정한다.

따라서 본 실시예의 광픽업 액츄에이터는 렌즈 홀더(30)의 스퀴가 자체에서 조정되므로, 별도의 스퀴조정을 위한 구조 및 공정을 생략할 수 있다.

발명의 효과

상기의 실시예에서 설명한 바와 같이, 본 발명은 광픽업 액츄에이터의 각각의 트래킹 코일(38) 및 포커싱 코일(36)과 렌즈 홀더(30)의 사이에 요크(10)와 일체로 돌출 형성되는 제 1 내지 제 4홀(20, 22, 24, 26)과, 각각의 제 1 내지 제 4홀(20, 22, 24, 26)을 에워싸도록 권선되어 상기 렌즈 홀더(30)에 고정되는 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)로 구성되는 스퀴 조정구조로서, 스퀴를 보상하기 위한 전압값을 제어부에 입력하여 홀로그래프 소자의 구동과 동시에 미리 입력된 전압값을 제 1 내지 제 4스프링 조정코일(40, 42, 44, 46)에 인가하여 렌즈 홀더(30)의 스퀴를 자체로 조정함으로써, 별도의 스퀴조정을 위한 구조 및 공정을 생략하여 조립생산성을 향상시킬 수 있는 효과가 있다.

(57) 청구의 범위

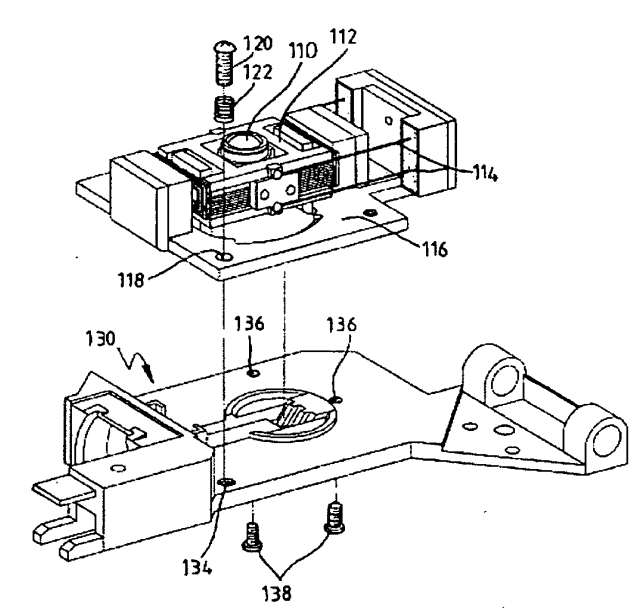
청구항 1. 포커싱 코일(36)이 둘레에 권선되고 트래킹 코일(38)이 대향되는 위치에 고정되는 렌즈 홀더(30)와, 상기 렌즈 홀더(30)를 서스펜션 와이어(34)로 지지시키는 요크(10)와, 상기 요크(10)의 대향되는 위치에 한 쌍이 고정되어 상기 트래킹 코일(38) 및 포커싱 코일(36)에 자속을 공급하는 마그네트(12)가 구비된 광픽업 액츄에이터에 있어서,

각각의 상기 트래킹 코일(38) 및 포커싱 코일(36)과 상기 렌즈 홀더(30)의 사이에 상기 요크(10)와 일체로 돌출 형성되는 제 1 내지 제 4홀(20, 22, 24, 26)과,

상기 제 1 내지 제 4홀(20, 22, 24, 26)을 각각 여워싸도록 권선되어 상기 렌즈 홀더(30)에 고정되는 제 1 내지 제 4스큐 조정코일(40, 42, 44, 46)로 구성되는 것을 특징으로 하는 광픽업 액츄에이터의 스큐 조정구조.

도면

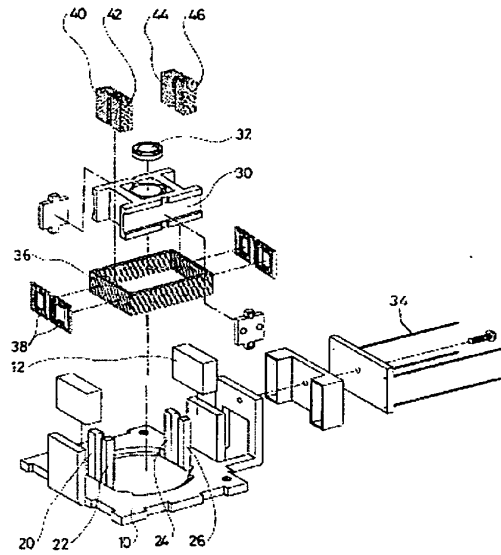
도면1



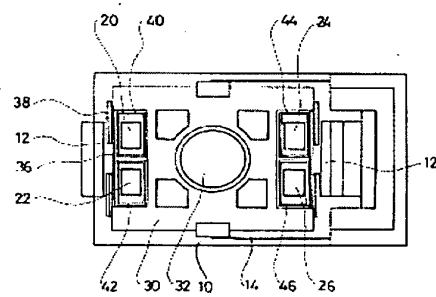
[첨부그림 5]

특 2000-0039836

도 B2



도 B3



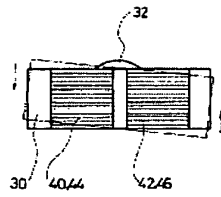
7-5

7-5

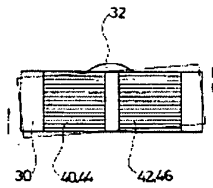
[첨부그림 6]

특 2000-0039836

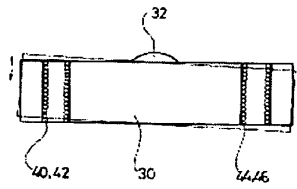
도 B4a



도 B4b



도 B5a



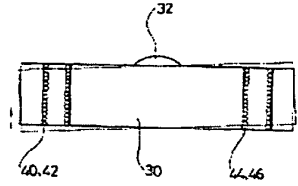
7-6

7-6

[첨부그림 7]

특 2000-0039836

도 5b



7-7

7-7

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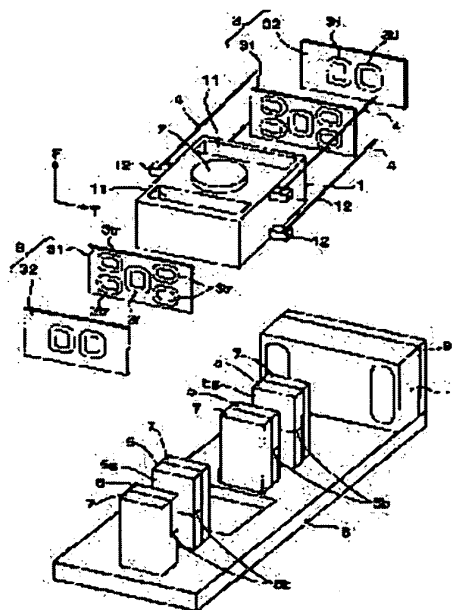
Priority country : JP

(54) DRIVING DEVICE FOR OBJECTIVE OF OPTICAL PICKUP

(57)Abstract:

PROBLEM TO BE SOLVED: To make a magnet unnecessary for the adjustment of inclination of an objective in a driving device for the objective of an optical pickup.

SOLUTION: Two magnetic circuits each including at least one magnet 5 magnetized into multipolar are formed, and a coil unit 3 mounting a focus coil 3f, tracking coil 3tr and tilt coil 3ti is disposed in the magnetic gap 5g of the magnetic circuit. Inclination of the objective is adjusted by the magnet 5 magnetized into multipolar.



LEGAL STATUS

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10.11.2004

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[첨부그림 1]

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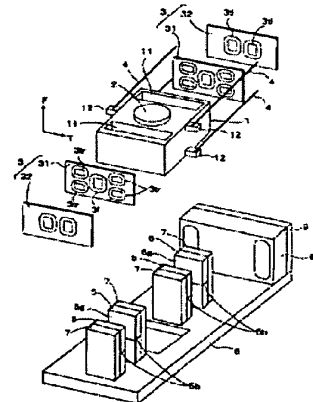
(21)出願番号	特願2001-245212(P2001-245212)	(71)出願人	000003067 ティーディーケー株式会社 東京都中央区日本橋1丁目13番1号
(22)出願日	平成13年8月13日(2001.8.13)	(72)発明者	河野 紀行 東京都中央区日本橋一丁目13番1号 ティーディーケー株式会社内
(31)優先権主張番号	特願2000-250465(P2000-250465)	(74)代理人	100082706 弁理士 三木 晃
(32)優先日	平成12年8月22日(2000.8.22)	Fターム(参考)	5D118 A401 A403 B401 D403 E411 E426 F405 F408
(33)優先権主張国	日本(JP)		

(54)【発明の名称】 光ピックアップの対物レンズ駆動装置

(57)【要約】

【課題】 光ピックアップの対物レンズ駆動装置において、対物レンズの傾きを調整するためのマグネットを不要にする。

【解決手段】 少なくとも1つの、多極に誘磁されているマグネット5を含む磁気回路を2個、形成し、該磁気回路の磁気ギャップ5a内に、フォーカスコイル3f、トラッキングコイル3t及びチルトコイル3iが装着されたコイルユニット3を配置し、多極に誘磁されているマグネット5によって、対物レンズの傾きをも調整する。



[첨부그림 2]

【특許請求의範圍】

【請求項 1】 少なくとも 1つの, 多極に巻回されているマグネットを含む磁気回路を 2個, 形成し, 該磁気回路의磁氣갭內に, 포어카스코일, 트래킹코일及びチルトコイルが装着されたコイルユニットを配置した光ビックアップ의對物렌즈駆動裝置
 【請求項 2】 マグネットが 2極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 3】 マグネットが 4極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 4】 マグネットが 3極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 5】 포어카스코일이 1個, 트래킹コ일이 偶數個, チルトコ일이 2個であるとともに, マグネットが 포어카스方向に 2極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 6】 포어카스コ일이 偶數個, 트래킹コ일이 1個, チルトコ일이 2個であるとともに, マグネットが 트래킹方向に 2極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 7】 포어카스コ일이 2個, 트래킹コ일이 2個, チルトコ일이 2個であるとともに, マグネットが 트래킹方向に 2極に巻回されたものが 포어카스方向上下 2段に配列されて 4極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 8】 포어카스コ일이 4個, 트래킹コ일이 2個, チルトコ일이 4個であるとともに, マグネットが 1極を正形状 1字形とし, 正形状四邊形の 2個の他極を 1極の空間に挿入して全体として正形状四邊形として 3極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 9】 포어카스コ일이 2個, 트래킹コ일이 4個, チルトコ일이 4個であるとともに, マグネットが 1極を正形状 H字形とし, 正形状四邊形の 2個の他極を 1極の空間に挿入して全体として正形状四邊形として 3極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 10】 포어카스コ일이 2個, 트래킹コ일이 2個, チルトコ일이 4個であるとともに, マグネットが 1極を正形状 T字形とし, 正形状四邊形の 2個の他極を 1極の空間に挿入して全体として正形状四邊形として 3極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 11】 포어카스コ일이 2個, 트래킹コ일이 2個, チルトコ일이 4個であるとともに, マグネットが 1極を正形状 U字形とし, 正形状四邊形の 1個の他極を 1極の空間に挿入して全体として正形状四邊形として 2極に巻回されている請求項 1의光ビックアップ의對物렌즈駆動裝置
 【請求項 12】 코일ユニットは, 포어카스コ

일, 트래킹コ일及びチルトコ일이 個別に装着されたプリント基板が堆敷, 積層されて形成されている請求項 1乃至請求項 11의いずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 13】 코일ユニットは, 포어카스コ일及び트래킹コ일이装着されたプリント基板とチルトコ일이装着されたプリント基板が堆敷, 積層されて形成されている請求項 1乃至請求項 11의いずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 14】 코일ユニットは, 포어카스コ일及びチルトコ일이装着されたプリント基板と트래킹コ일이装着されたプリント基板が堆敷, 積層されて形成されている請求項 1乃至請求項 11의いずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 15】 코일ユニットは, 트래킹方向と平行する, 렌즈ホルダ의兩側面に固定されている請求項 1乃至請求項 14의いずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 16】 少なくとも 1つの, 포어카스方向に 2極に巻回されているマグネットを含む磁気回路を 2個, 形成し, 該磁気回路의磁氣갭內に, 렌즈ホルダ의側面に巻回されている포어카스コ일と, 트래킹方向と平行する, 렌즈ホルダ의兩側面に装着されている트래킹コ일及びチルトコ일とを配置した光ビックアップ의對物렌즈駆動裝置
 【請求項 17】 렌즈ホルダ의一側面に装着されている트래킹コ일及びチルトコ일의數がそれぞれ 2個である請求項 16의光ビックアップ의對物렌즈駆動裝置
 【請求項 18】 렌즈ホルダ의一側面に装着されている트래킹コ일及びチルトコ일의數がそれぞれ 1個である請求項 16의光ビックアップ의對物렌즈駆動裝置
 【請求項 19】 렌즈ホルダ의一側面に装着されている트래킹コ일의數が 1個で, チルトコ일의數が 2個である請求項 16의光ビックアップ의對物렌즈駆動裝置
 【請求項 20】 렌즈ホルダ의一側面に装着されている트래킹コ일의數が 2個で, チルトコ일의數が 1個である請求項 16의光ビックアップ의對物렌즈駆動裝置
 【請求項 21】 트래킹コ일及びチルトコ일이 共に, 포어카스コ일에重巻されている請求項 16乃至請求項 20의いずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 22】 트래킹コ일及びチルトコ일이 共に, 렌즈ホルダ의側面に突設されたコ일卷き棒に巻回されている請求項 16乃至請求項 20のいずれかに記載의光ビックアップ의對物렌즈駆動裝置
 【請求項 23】 트래킹コ일이 렌즈ホルダ의

側面に突設されたコイル巻き棒に巻回されているとともに、チルトコイルがフォーカスコイルに重畳されている請求項 15乃至請求項 20のいずれかに記載の光ピックアップの対物レンズ駆動装置

【請求項 24】 トラッキングコイルがフォーカスコイルに重畳されているとともに、チルトコイルがレンズホルダの側面に突設されたコイル巻き棒に巻回されている請求項 15乃至請求項 20のいずれかに記載の光ピックアップの対物レンズ駆動装置

【発明の詳細な説明】

【0001】

【発明が属する技術分野】この発明は、ディスク上の記録媒体に光スポットを投射して光学的に情報を読み取ることができる光ディスク装置を構成する光ピックアップの対物レンズ駆動装置に関するものである。

【0002】

【従来の技術】光ディスク装置を構成する光ピックアップは、一般に、対物レンズを備えた対物レンズ駆動装置と、対物レンズに光の透射を行う光学系とから構成され、光学系ブロックの取付台上に対物レンズ駆動装置を配置した構造となっている。対物レンズ駆動装置は、対物レンズ、フォーカスコイル、トラッキングコイルを備えた可動部と磁気回路を備えた固定部とから構成され、可動部は、一部分が弾性材などの弾性のあるダンパ付で包囲・保持されている4本のワイヤで固定部より支持されている。

【0003】対物レンズをフォーカス方向、トラッキング方向に駆動させるだけでなく、ディスク上に結像されたスポットのコマ収差、非点収差を補正する対物レンズ駆動装置としては、特開9-231595に記載のものが知られている。この従来技術は、図25、26、27に示すように、レンズホルダ101の、光ディスク対向面上に、対物レンズ103の光ディスク半径方向又は接線方向に、少なくとも一対の光センサ301、302を備え、さらに、レンズホルダ101の光ディスク半径方向の一側面又は両側面に、傾き補正を行うためのコイル105を備え、レンズホルダ101の側面に対向するヨーク113、114に傾き補正を行うためにコイル105の配置に対応させて一対の逆極のマグネット部材106、107を備え、光センサ301、302の出力に基づき光ディスク100との傾き検出を行い、この傾き検出角度と、コリメータ光軸と対物レンズ光軸とのズレの算出値に基づき、傾き補正を行うためのコイル105を電流駆動し、逆極のマグネット部材106、107との電磁相互作用によりレンズホルダ101の側面を駆動し、傾き自在に、サーボ制御することとを特徴とするものである。

【0004】一対の光センサ301、302は、レンズホルダ101の対物レンズ103の両側に取り付けられていて、図26に示すように、光ヘッドから射出し、光

ディスク溝によって屈折した、±1次光201、202を受光する。光センサ301、302からの電気信号は、図28に示すように、増幅器407、408で増幅されて、差動増幅器403に差動入力する。差動増幅器403の出力から光ディスク100とレンズホルダ101との傾きを算出する。

【0005】図28に示すように、この傾き角度と、対物レンズ光軸とコリメータ光軸のズレから、好ましくはROM(読み出し専用メモリ)に設定されたプリセット部404により、レンズ駆動傾きを求め、両者の演算結果をもとに、サーボを印加するための、位相補償回路405と差動増幅器405とを介して、傾き補正コイル105を駆動する。

【0006】レンズホルダ101は、その平面には、ヨーク部材109を通すスリット102が2個設けられ、中心には、対物レンズ103が装着されているとともに、対向する一対の側面には、トラッキング駆動のための角形偏平コイル104がそれぞれ2個ずつ計4個設けられている。また、光ディスク半径方向(R)の対向する側面には、傾き補正を行うコイル105として、角形偏平コイルが一対設けられているとともに、傾き補正を行うコイル105の上下に銅箔部分115、116を介して支持された、不図示のプリント基板が張り付けられている。

【0007】アクチュエータベース108には、ヨーク部分109、110が突設され、マグネット111、112を介して、フォーカス方向とトラッキング方向の駆動用の確閉磁路を構成している。また、アクチュエータベース108の両側面には、平面形状がコの字形とされた、レンズホルダ傾き調整駆動用のサイドヨーク113、114が設けられている。そして、サイドヨーク113、114には、傾き補正を行うコイル105の上下の辺に対応して、互いに逆極の長尺のマグネット106及び107が設けられている。

【0008】また、アクチュエータベース108には、角形のプリント基板117、118が、同様に、銅箔部分119、120を介して張り付けられる。そして、りん青銅のパネワイヤ121を、このパネワイヤ121の両端に配置されたプリント基板で固定して4本中2本の両端に配置されたプリント基板で固定して4本中2本の固定については図27の平面図参照。

【0009】なお、図25において、Fは対物レンズアクチュエータの移動系のフォーカス軸、Rはトラッキング軸、Tは光ディスク傾き軸を示す。

【0010】次に、図26を参照して、従来技術におけるレンズホルダ101の傾き駆動を説明すると、レンズホルダ101の光ディスク半径方向の両側面に設けられた、左右の傾き補正を行うコイル105の電流方向を同一にし、傾き補正を行うコイル105の上下の辺に対応して設けられた、左右のマグネット106及び107の磁界方向を左右対称としたとき、両者のコイルの電磁駆

動は、フレミングの左手の法則により、左右で電磁駆動力の方向が異なる(圖中矢印F、F' 参照)。これによって、レンズホルダ101の、重心もしくは支持中心は、ほぼ同一点であるが、この点を中心に回転し、光ディスク100に対して傾き補正が可能となる。

【0011】

【発明が解決しようとする課題】 しかしながら、この従来技術には、対物レンズの傾きを補正するために、トラッキングサーボ及びフォーカスサーボ用のコイルとマグネットとは別個に、新たに傾き補正を行うコイル105及びマグネット106、107を設置しなければならないため、コストアップになっているという課題があった。また、この従来技術には、対物レンズ103を保持するレンズホルダ101の光ディスク100の半径方向の側面に傾き補正を行うコイル105及びマグネット106、107を配置しなければならないため、対物レンズ駆動装置の幅幅及び重量が大きくなってしまおうという課題があった。

【0012】 この発明は、このような従来技術の課題を解決する目的でなされたものである。

【0013】

【課題を解決するための手段】 上記課題を解決するための手段を、実施の一形態に対応する図1を用いて以下、説明する。この発明は、少なくとも1つの、多極に巻磁されているマグネット5を含む磁気回路を2個、形成し、該磁気回路の磁気ギャップ5a内に、フォーカスコイル3f、トラッキングコイル3tr及びチルトコイル3tiが装着されたコイルユニット3を配置したものである。

【0014】 このように構成されたものにおいては、多極に巻磁されているマグネット5は、傾き補正をも行うので、傾き補正を行う専用のマグネットは不要である。

【0015】

【発明の実施の形態】 図1は、この発明の実施の一形態を示す斜視図である。図1において、1はレンズホルダ、2は対物レンズ、3はコイルユニット、3fはフォーカスコイル、3trはトラッキングコイル、3tiはチルトコイル、5はマグネット、5aは磁気ギャップである。

【0016】 レンズホルダ1は、曲げ弾性率の高い軽金属、例えばマグネシウム合金、又はカーボン繊維入りの樹脂から形成されている。かかる材料の使用によって、レンズホルダ1自体は、曲げ弾性率が高くなって、高次共振周波数が高くなる。これにより、光ディスク装置の高速化に対応できる。

【0017】 レンズホルダ1には、その平面に、後述するマグネット5、ヨーク7を這すスリット11が2個、穿設され、その中心に、対物レンズ2が装着され、トラッキング方向Tに直交する、一対の側面に、後述する導電性弾性体4の一端が固定される支持片12が上下に2

個、突設されているとともに、トラッキング方向Tに平行する、一対の側面に、後述するコイルユニット3が装着、固定されている。

【0018】 トラッキング方向Tに平行する、一対の側面は、その表面に補強用の絶縁保護膜(図示せず)が形成されている。これは、レンズホルダ1に使用される曲げ弾性率の高い軽金属、例えばマグネシウム合金、又はカーボン繊維入りの樹脂は、導電率が高いため、レンズホルダ1に装着されるコイルユニット3の絶縁性を確保するためである。なお、レンズホルダ1のトラッキング方向Tに平行する、一対の側面の表面に補強用の絶縁保護膜が形成されていないときは、レンズホルダ1に装着されるコイルユニット3の部分に補強用の絶縁保護膜(図示せず)を形成して、コイルユニット3の絶縁性を確保する。

【0019】 コイルユニット3は、1個のフォーカスコイル3f及び4個のトラッキングコイル3trが形成されたプリント基板31と、2個のチルトコイル3tiが形成されたプリント基板32とが所要数、積層されて形成されている。1個のフォーカスコイル3fは、プリント基板31の中心に配置され、4個のトラッキングコイル3trは、対物レンズ2を保持するレンズホルダ1を含む可動部の対物レンズ光軸方向の重心位置を境にして左右(トラッキング方向T)に、すなわち、1個のフォーカスコイル3fの左右に上下2段に配置されている。4個のトラッキングコイル3trは、直列に接続されている。なお、トラッキングコイル3trは、2個で構成してもよい。2個のチルトコイル3tiは、プリント基板32の中心から左右(トラッキング方向T)1列に配置されている。2個のチルトコイル3tiは、直列に接続されている。

【0020】 プリント基板31、プリント基板32の積層は、トラッキング方向Tから見てレンズホルダ1のトラッキング方向Tに平行する、一対の側面において左右対称に、例えば、プリント基板31は対物レンズ2側の内側に、プリント基板32は外側に配置する。このようにすると、各方向の駆動点が一致し、駆動点不一致による共振(ピッチング共振、ヨーイング共振)を回避することができる。

【0021】 以上は、プリント基板31に1個のフォーカスコイル3f及び4個のトラッキングコイル3trを形成した場合であるが、2枚のプリント基板に個別に1個のフォーカスコイル3f、4個のトラッキングコイル3trを形成してもよい。この場合にも、プリント基板は、トラッキング方向Tから見て左右対称に積層する。

【0022】 コイルユニット3が固定されたレンズホルダ1の支持片12には、4本の導電性弾性体4の一端が半田(図示せず)により固定されている。可動部であるレンズホルダ1を弾性支持するには、導電性弾性体4は4本で十分であるので、リード線でもある導電性弾性体

4は、フォーカスコイル駆動用に2本、トラッキングコイル駆動用に2本、チルトコイル駆動用に2本の、いずれが4本に使用され、他のコイルには、図示しないリード線を接続する。

【0023】マグネット5は、フォーカス方向FにN極とS極の境界線5bにより2極に分割されていて、ヨークベース6上のヨーク7に接合されている。図2に示すように、N極とS極の境界線5bは、マグネット5のフォーカス方向Fの中心に位置し、2個のマグネット5の対向によって磁気ギャップ5eが形成されて、磁気ギャップ5eのフォーカス方向Fにおいて、磁力線Bの方向が逆になっている。

【0024】この場合、マグネット5の幅Wは、導電性弾性体4によって移動可能に片持ち式に支持されている可動部の可動中立位置、すなわち、フォーカス方向Fの自重位置において、図3に示すように、コイルユニット3を磁気ギャップ5eに配置したとき、左右に上下2段に配置された4個のトラッキングコイル3tのフォーカス方向Fと平行な垂直面A、Cが、図4に示すように、左右1列に配置された2個のチルトコイル3tiのフォーカス方向Fと平行な垂直面D、Eが、図4に示すように、左右1列に配置された2個のチルトコイル3tiのフォーカス方向Fと垂直な水平面B、Dが、図4に示すように、チルトコイル3tiのフォーカス方向Fと垂直な水平面B'、D'が、磁気ギャップ5e内(対向するマグネット5の幅W以内の空間を指す)に配置されるように、定められている。また、マグネット5の高さHは、図3に示すように、プリント基板31の中心に配置された1個のフォーカスコイル3fiのフォーカス方向Fと垂直な水平面b、dが、及びトラッキングコイル3tのフォーカス方向Fと垂直な水平面b'、d'が、磁気ギャップ5e内(対向するマグネット5の高さH以内の空間を指す)に配置されるように、定められている。

【0025】マグネット5のN極とS極の境界線5bは、図3に示すように、フォーカスコイル3fiのフォーカス方向Fと垂直な水平面b、dの下辺bと上辺dの中心に、上段のトラッキングコイル3tのフォーカス方向Fと垂直な水平面B、Dの下辺Bと上辺Dの中心に、及び図4に示すように、チルトコイル3tiのフォーカス方向Fと垂直な水平面b'、d'の下辺b'と上辺d'の中心に、位置している。マグネット5の中心は、コイルユニット3の中心と略一致している。

【0026】2個のコイルユニット3は、2個の磁気ギャップ5eに配置され、導電性弾性体4の他端は、ワイヤベース8を通過してベース基板9に半田により固定されている。これにより、コイルユニット3に装着されたフォーカスコイル3fi、トラッキングコイル3t及びチルトコイル3tiを、磁気ギャップ5e内に配置してい

るとともに、対物レンズ2を保持するレンズホルダ1を含む可動部を、マグネット5、ヨークベース6、ヨーク7、ワイヤベース8、ベース基板9により構成されている固定部に対して、移動可能に片持ち式に支持している。

【0027】図3において、トラッキングコイル3tに電流を流すと、トラッキングコイル3tのフォーカス方向Fと平行な垂直面A、Cに流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、4個のトラッキングコイル3tにトラッキング方向Tに同じ向きの駆動力が生じ、また、フォーカスコイル3fiに電流を流すと、フォーカスコイル3fiのフォーカス方向Fと垂直な水平面b、dに流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、フォーカスコイル3fiにフォーカス方向Fに駆動力が生じる。

【0028】さらに、図4において、チルトコイル3tiに電流を流すと、チルトコイル3tiのフォーカス方向Fと垂直な水平面b'、d'に流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、2個のチルトコイル3tiにフォーカス方向Fに互いに逆向きの駆動力F'が生じる。この逆向きの駆動力F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ1、ひいては対物レンズ2の傾きを調整する。

【0029】このように、少なくとも1つの、2極に分割されているマグネット5を含む磁気回路を2個、形成し、該磁気回路の磁気ギャップ5e内に、フォーカスコイル3fi、トラッキングコイル3tのみならず、チルトコイル3tiを配置すると、フォーカスサーボ、トラッキングサーボのみならず、チルトサーボ(対物レンズ2の傾き調整)をも行うことができる。それゆえ、対物レンズ2の傾きを調整するためのマグネットは、不要である。したがって、部品点数が少なく、安価に対物レンズ2の傾き調整ができ、また、対物レンズ駆動装置全体を小型にすることができる。

【0030】以上は、プリント基板31に1個のフォーカスコイル3fi及び4個のトラッキングコイル3t、プリント基板32に2個のチルトコイル3tiを形成した場合であるが、プリント基板31に4個のトラッキングコイル3tを形成し、プリント基板32に1個のフォーカスコイル3fi及び2個のチルトコイル3tiを形成してもよい。2個のチルトコイル3tiは、プリント基板32の中心から左右(トラッキング方向T)に配置されている。2個のチルトコイル3tiは、直列に接続されている。1個のフォーカスコイル3fiは、2個のチルトコイル3tiの外側に配置されている。4個のトラッキングコイル3tは、対物レンズ2を保持するレンズホルダ1を含む可動部の対物レンズ光軸方向の重心位置を境にして左右に上下2段に配置されている。4個のトラッキングコイル3tは、直列に接続されている。なお、トラッキングコイル3tは、2個で構成しても

よい。

【0031】この場合、マグネット5の幅Wは、導電性弾性体4によって移動可能に片持ち式に支持されている可動部の可動中立位置、すなわち、フォーカス方向Fの自重位置において、図5に示すように、コイルユニット3を磁気ギャップ5eに配置したとき、左右に上下2段に配置された4個のトラッキングコイル3t rのフォーカス方向Fと平行な垂直辺のうち、左右内側の垂直辺A、Cが、図6に示すように、1個のフォーカスコイル3fのフォーカス方向Fと平行な垂直辺a、cが、磁気ギャップ5e内（対向するマグネット5の幅W以内の空隙を指す）に配置されるように、定められている。

【0032】また、マグネット5の高さHは、図5に示すように、トラッキングコイル3t rのフォーカス方向Fと垂直な水平辺のうち、上下外側の水平辺B、Dが、図6に示すように、フォーカスコイル3fのフォーカス方向Fと垂直な水平辺b、dが、磁気ギャップ5e内（対向するマグネット5の高さH以内の空隙を指す）に配置されるように、定められている。

【0033】マグネット5のN極とS極の境界線5bは、図5に示すように、上段のトラッキングコイル3t rのフォーカス方向Fと垂直な水平辺B、Dの下辺Bと下段のトラッキングコイル3t rのフォーカス方向Fと垂直な水平辺B、Dの上辺Dの中心に、及び図6に示すように、フォーカスコイル3fのフォーカス方向Fと垂直な水平辺b、dの下辺bと上辺dの中心に、チルトコイル3tiのフォーカス方向Fと垂直な水平辺b'、d'の下辺b'と上辺d'の中心に、位置している。マグネット5の中心は、コイルユニット3の中心と略一致している。

【0034】以上は、2個のチルトコイル3tiを、プリント基板32の中心から左右（トラッキング方向T）に配置した場合であるが、図7に示すように、2個のチルトコイル3tiを、プリント基板32の中心から上下（フォーカス方向F）に配置しても、同様に効果が得られる。

【0035】この場合、コイルユニット3は、図8に示すように、1個のトラッキングコイル3t r及び4個のフォーカスコイル3fが形成されたプリント基板（図示せず）と、図7に示すように、2個のチルトコイル3tiが形成されたプリント基板（図示せず）とが所冀数、積層されて形成されている。1個のトラッキングコイル3t rは、プリント基板31の中心に配置され、4個のフォーカスコイル3fは、対物レンズ2を保持するレンズホルダ1を含む可動部の対物レンズ光軸方向の重心位置を境にして左右に、すなわち、1個のトラッキングコイル3t rの左右に上下2段に配置されている。4個のフォーカスコイル3fは、直列に接続されている。なお、フォーカスコイル3fは、2個で構成してもよい。また、2個のチルトコイル3tiは、直列に接続されて

いる。

【0036】以上は、プリント基板に1個のトラッキングコイル3t r及び4個のフォーカスコイル3fを形成した場合であるが、2枚のプリント基板に個別に1個のトラッキングコイル3t r、4個のフォーカスコイル3fを形成してもよい。この場合にも、プリント基板は、トラッキング方向Tから見て左右対称に積層する。

【0037】この場合、マグネット5は、図9に示すように、トラッキング方向TにN極とS極の境界線5bにより2極に毒害されていて、ヨークベース6上のヨーク7に接合されている。N極とS極の境界線5bは、マグネット5のトラッキング方向Tの中心に位置し、2個のマグネット5の対向によって磁気ギャップ5eが形成されて、磁気ギャップ5eのトラッキング方向Tにおいて、磁力線Bの方向が逆になっている。

【0038】この場合、マグネット5の幅Wは、導電性弾性体4によって移動可能に片持ち式に支持されている可動部の可動中立位置、すなわち、フォーカス方向Fの自重位置において、図8に示すように、コイルユニット3を磁気ギャップ5eに配置したとき、左右に上下2段に配置された4個のフォーカスコイル3fのフォーカス方向Fと平行な垂直辺のうち、左右外側の垂直辺a、cが、図7に示すように、上下2段に配置された2個のチルトコイル3tiのフォーカス方向Fと平行な垂直辺e'、e'が、磁気ギャップ5e内（対向するマグネット5の幅W以内の空隙を指す）に配置されるように、定められている。また、マグネット5の高さHは、図8に示すように、フォーカスコイル3fのフォーカス方向Fと垂直な水平辺のうち、上下内側の水平辺b、dが、及びトラッキングコイル3t rのフォーカス方向Fと垂直な水平辺B、Dが、図7に示すように、チルトコイル3tiのフォーカス方向Fと垂直な水平辺のうち、上下外側の水平辺b'、d'が、磁気ギャップ5e内（対向するマグネット5の高さH以内の空隙を指す）に配置されるように、定められている。

【0039】マグネット5のN極とS極の境界線5bは、図8に示すように、右側のフォーカスコイル3fのフォーカス方向Fと平行な垂直辺a、cの左辺aと左側のフォーカスコイル3fのフォーカス方向Fと平行な垂直辺e、cの右辺eの中心に、トラッキングコイル3t rのフォーカス方向Fと平行な垂直辺A、Cの右辺Aと左辺Cの中心に、及び図7に示すように、チルトコイル3tiのフォーカス方向Fと平行な垂直辺e'、e'の右辺e'と左辺e'の中心に、位置している。マグネット5の中心は、コイルユニット3の中心と略一致している。

【0040】図8において、トラッキングコイル3t rに電流を流すと、トラッキングコイル3t rのフォーカス方向Fと平行な垂直辺A、Cに流れる電流（矢印で図示）によって、フレミングの左手の法則に基づき、トラ

트래킹코일 31r에 트래킹방향 T에駆動力が生じ、また、フォーカスコイル 31iに電流を流すと、フォーカスコイル 31iのフォーカス方向 Fと垂直な水平辺 b、dに流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、4個のフォーカスコイル 31iにフォーカス方向 Fに同じ向きの駆動力が生じる。

【0041】図7において、チルトコイル 31iに電流を流すと、チルトコイル 31iのフォーカス方向 Fと平行な垂直辺 e'、e'に流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、2個のチルトコイル 31iにトラッキング方向 Tに互いに逆向きの駆動力 F'が生じる。この逆向きの駆動力 F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ 1、ひいては対物レンズ 2の傾きを調整する。

【0042】以上は、プリント基板 31に1個のトラッキングコイル 31r及び4個のフォーカスコイル 31i、プリント基板 32に2個のチルトコイル 31iを形成した場合であるが、プリント基板 31に1個のトラッキングコイル 31rを形成し、プリント基板 32に4個のフォーカスコイル 31i及び2個のチルトコイル 31iを形成してもよい。

【0043】この場合、コイルユニット 3は、図10に示すように、1個のトラッキングコイル 31rが形成されたプリント基板(図示せず)と、図11に示すように、2個のチルトコイル 31i及び4個のフォーカスコイル 31iが形成されたプリント基板(図示せず)とが所差数、積層されて形成されている。1個のトラッキングコイル 31rは、プリント基板 31の中心に配置され、4個のフォーカスコイル 31iは、対物レンズ 2を保持するレンズホルダ 1を含む可動部の対物レンズ光軸方向の重心位置を境にして左右に、すなわち、2個のチルトコイル 31iの左右に上下2段に配置されている。4個のフォーカスコイル 31iは、直列に接続されている。なお、フォーカスコイル 31iは、2個で構成してもよい。また、2個のチルトコイル 31iは、直列に接続されている。

【0044】この場合、マグネット 5の幅 Wは、導電性弾性体 4によって移動可能に片持ち式に支持されている可動部の可動中立位置、すなわち、フォーカス方向 Fの自重位置において、図11に示すように、コイルユニット 3を磁気ギャップ 5eに配置したとき、左右に上下2段に配置された4個のフォーカスコイル 31iのフォーカス方向 Fと平行な垂直辺のうち、左右外側の垂直辺 e、eが、図10に示すように、トラッキングコイル 31rのフォーカス方向 Fと平行な垂直辺 A、Cが、磁気ギャップ 5e内(対向するマグネット 5の幅 W以内の空隙を指す)に配置されるように、定められている。また、マグネット 5の高さ Hは、図11に示すように、フォーカスコイル 31iのフォーカス方向 Fと垂直な水平辺のうち、上下内側の水平辺 b、dが、及びチルトコイル 31i

iのフォーカス方向 Fと垂直な水平辺のうち、上下外側の水平辺 b'、d'が、図10に示すように、トラッキングコイル 31rのフォーカス方向 Fと垂直な水平辺 B、Dが、磁気ギャップ 5e内(対向するマグネット 5の高さ H以内の空隙を指す)に配置されるように、定められている。

【0045】マグネット 5のN極とS極の境界線 5bは、図11に示すように、右側のフォーカスコイル 31iのフォーカス方向 Fと平行な垂直辺 e、eの左辺 eと左側のフォーカスコイル 31iのフォーカス方向 Fと平行な垂直辺 e、eの右辺 eの中心に、チルトコイル 31iのフォーカス方向 Fと平行な垂直辺 e'、e'の右辺 e'と左辺 e'の中心に、及び図10に示すように、トラッキングコイル 31rのフォーカス方向 Fと平行な垂直辺 A、Cの右辺 Aと左辺 Cの中心に、位置している。マグネット 5の中心は、コイルユニット 3の中心と略一致している。

【0046】以上は、いずれも、マグネット 5は、フォーカス方向 Fまたはトラッキング方向 Tに2極に寄集されているものであるが、図12に示すように、トラッキング方向に2極に寄集されたものがフォーカス方向上下2段に配列されて4極に寄集されているものを使用してよい。この場合、図12に示すように、2個のトラッキングコイル 31rを、上下に、すなわちマグネット 5の第1象限と第2象限に及び第3象限と第4象限に、配置して、両コイルに逆向きの電流を流すと、2個のトラッキングコイル 31rにトラッキング方向 Tに同じ向きの駆動力が生じる。また、図13に示すように、2個のフォーカスコイル 31iを、左右に、すなわちマグネット 5の第1象限と第4象限に及び第2象限と第3象限に、配置して、両コイルに逆向きの電流を流すと、2個のフォーカスコイル 31iにフォーカス方向 Fに同じ向きの駆動力が生じる。また、図14に示すように、2個のチルトコイル 31iを、左右に、すなわちマグネット 5の第1象限と第4象限に及び第2象限と第3象限に、配置して、両コイルに同じ向きの電流を流すと、2個のチルトコイル 31iにフォーカス方向 Fに互いに逆向きの駆動力 F'が生じる。この逆向きの駆動力 F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ 1、ひいては対物レンズ 2の傾きを調整する。

【0047】なお、図示しないが、2個のチルトコイル 31iを左右ではなく、2個のチルトコイル 31iを上下に、すなわちマグネット 5の第1象限と第2象限に及び第3象限と第4象限に、配置して、両コイルに同じ向きの電流を流してもよい。すると、2個のチルトコイル 31iにトラッキング方向 Tに互いに逆向きの駆動力 F'が生じる。この逆向きの駆動力 F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ 1、ひいては対物レンズ 2の傾きを調整する。

【0048】マグネット 5が4極寄集であると、2極寄

窓に比べて、コイルの数が7個から6個と減少するので、コイルを節約できる。また、2極巻磁の場合、コイルの駆動力を発生する部分に対向する部分は、磁気ギャップ5e外に配置しなければならないが、(図3-5の3t rのA辺、C辺、図8の3fのb辺、d辺)、4極巻磁の場合、磁気ギャップ5e外に配置しなければならないことはないで、コイル配置は容易である。また、コイルを磁気ギャップ5e内に配置すると、対向する2辺は常に駆動力の発生に寄与するので、コイルの利用率は向上する。

【0049】以上において、マグネット5は、2極または4極巻磁の場合であるが、図15に示すように、1極(例えばS極)を正面形状I字形とし、正面形状四辺形の2個の他極(例えばN極)を1極の空間に挿入して全体として正面形状四辺形として3極に巻磁されているものを使用してもよい。この場合、図15に示すように、2個のトラッキングコイル3t rを、左右に、すなわちI字形のウェブ部とN極に配置して、両コイルに逆向きの電流を流すと、2個のトラッキングコイル3t rにトラッキング方向Tに同じ向きの駆動力が生じる。また、図15に示すように、4個のフォーカスコイル3fを、左右上下に、すなわちI字形のフランジ部上下とN極に配置して、上段2個に同じ向き、下段2個に上段と逆の、同じ向きの電流を流すと、4個のフォーカスコイル3fにフォーカス方向Fに同じ向きの駆動力が生じる。また、図16に示すように、4個のチルトコイル3t iを、左右上下に、すなわちI字形のフランジ部上下とN極に配置して、上段2個に逆向き、下段2個に上段と逆の、逆向きの電流を流すと、左右のチルトコイル3t iにフォーカス方向Fに互いに逆向きの駆動力F'が生じる。この逆向きの駆動力F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ1、ひいては対物レンズ2の傾きを調整する。

【0050】マグネット5を3極巻磁で構成するとき、図17に示すように、1極(例えばS極)を正面形状H字形とし、正面形状四辺形の2個の他極(例えばN極)を1極の空間に挿入して全体として正面形状四辺形としてもよい。この場合、図17に示すように、4個のトラッキングコイル3t rを、左右上下に、すなわちH字形のフランジ部左右とN極に配置して、上段2個に逆向き、下段2個に上段と同じ向きの、逆向きの電流を流すと、4個のトラッキングコイル3t rにトラッキング方向Tに同じ向きの駆動力が生じる。また、図17に示すように、2個のフォーカスコイル3fを、上下に、すなわちH字形のウェブ部とN極に配置して、両コイルに逆向きの電流を流すと、2個のフォーカスコイル3fにフォーカス方向Fに同じ向きの駆動力が生じる。また、図18に示すように、4個のチルトコイル3t iを、左右上下に、すなわちH字形のフランジ部左右とN極に配置して、上段2個に逆向き、下段2個に上段と逆の、逆向

きの電流を流すと、上下のチルトコイル3t iにトラッキング方向Tに互いに逆向きの駆動力F'が生じる。この逆向きの駆動力F'によって、可動部の重心回りにモーメントを発生し、レンズホルダ1、ひいては対物レンズ2の傾きを調整する。

【0051】以上は、チルトコイル3t iを4個とし、フォーカスコイル3f及びトラッキングコイル3t rを2個または4個とするものであるが、チルトコイル3t iを2個とする場合は、図19に示すように、1極(例えばS極)を正面形状T字形とし、正面形状四辺形の2個の他極(例えばN極)を1極の空間に挿入して全体として正面形状四辺形として3極に巻磁されているものを使用する。この場合、2個のトラッキングコイル3t rは、中央部に、すなわちT字形の垂直部とN極に、2個のフォーカスコイル3f、2個のチルトコイル3t iは、左右部に、すなわちT字形の水平部とN極に配置する。

【0052】また、図20に示すように、1極(例えばS極)を正面形状U字形とし、正面形状四辺形の1個の他極(例えばN極)を1極の空間に挿入して全体として正面形状四辺形として2極に巻磁されているものを使用する。この場合、1個のフォーカスコイル3fは、中央部に、すなわちU字形の水平部とN極に、2個のトラッキングコイル3t r、2個のチルトコイル3t iは、左右部に、すなわちU字形の垂直部とN極に配置する。

【0053】3極巻磁の場合、2極巻磁の場合に比べて、4極巻磁の場合と同様に、コイル配置は容易となり、コイルの利用率は向上する。

【0054】コイルユニット3は、U字形を使用した2極巻磁、3極巻磁、4極巻磁の場合でも、2極巻磁と同様に、フォーカスコイル3f、トラッキングコイル3t r及びチルトコイル3t iが個別に巻着されたプリント基板が複数、積層されて形成されている。また、フォーカスコイル3f及びトラッキングコイル3t rが巻着されたプリント基板とチルトコイル3t iが巻着されたプリント基板が複数、積層されて形成されていてもよく、さらには、フォーカスコイル3f及びチルトコイル3t iが巻着されたプリント基板とトラッキングコイル3t rが巻着されたプリント基板が複数、積層されて形成されていてもよい。

【0055】以上は、コイルユニット3をレンズホルダ1のトラッキング方向Tに平行する、一対の側面に巻着、固定しているが、図21に示すように、少なくとも1つの、フォーカス方向Fに2極に巻着されているマグネット5を含む磁気回路を2個、形成し、該磁気回路の磁気ギャップ5e内に、レンズホルダ1の側面に巻着されているフォーカスコイル3fと、トラッキング方向Tと平行する、レンズホルダ1の両側面に巻着されているトラッキングコイル3t r及びチルトコイル3t iとを配置しても、同様の効果が得られる。

【0056】フォーカスコイル30fは、レンズホルダ1を巻棒とする、巻棒コイルで、プリント基板にパターン形成されたものに比べて製作は容易である。

【0057】トラッキングコイル30t r及びチルトコイル30t iは、フォーカスコイル30fに重巻されている空心コイルである。又は、プリント基板にパターン形成されたものでもよい。なお、トラッキングコイル30t r及びチルトコイル30t iは、図22に示すように、フォーカスコイル30fを挟む形で、トラッキング方向Tと平行する、レンズホルダ1の側面にコイル巻棒13を突設し、コイル巻棒13に巻回して形成された巻棒コイルでもよい。さらには、トラッキングコイル30t r、チルトコイル30t iのいずれかをフォーカスコイル30fに重巻し、他方をコイル巻棒13に巻回してもよい。

【0058】マグネット5は、フォーカス方向FにN極とS極の境界線5bにより2極に巻磁されており、ヨークベース6上のヨーク7に接合されている。

【0059】マグネット5の幅Wは、導電性弾性体4によって移動可能に片持ち式に支持されている可動部の可動中立位置、すなわち、フォーカス方向Fの自重位置において、図23に示すように、レンズホルダ1を磁気ギャップ5eに配置したとき、フォーカス方向Fの上段にトラッキング方向Tの左右1列に配置された2個のトラッキングコイル30t rのフォーカス方向Fと平行な垂直辺A、Cの左右内側の垂直辺Aと垂直辺Cが、及びフォーカス方向Fの下段にトラッキング方向Tの左右1列に配置された2個のチルトコイル30t iのフォーカス方向Fと平行な垂直辺a'、c'の左右外側の垂直辺a'と垂直辺c'が、磁気ギャップ5e内(対向するマグネット5の幅W以内の空隙を指す)に配置されるように、定められている。また、マグネット5の高さHは、図23に示すように、トラッキングコイル30t rのフォーカス方向Fと垂直な水平辺Bと水平辺Dが、及びチルトコイル30t iのフォーカス方向Fと垂直な水平辺b'と水平辺d'が、磁気ギャップ5e内(対向するマグネット5の高さH以内の空隙を指す)に配置されるように、定められている。

【0060】マグネット5のN極とS極の境界線5bは、図23に示すように、トラッキングコイル30t rのフォーカス方向Fと垂直な水平辺B、Dの下辺Bより下側に、及びチルトコイル30t iのフォーカス方向Fと垂直な水平辺b'、d'の下辺b'と上辺d'の中心に、位置している。マグネット5の中心は、レンズホルダ1の中心と略一致している。

【0061】フォーカスコイル30fは、N極とS極の境界線5bを境にして、上下に配置されている。上下のフォーカスコイル30fは、直列に接続され、電流の向きは逆である。なお、2個の磁気ギャップ5eにおける磁気線Bの方向は、逆になっている。

【0062】なお、図21、22において、トラッキングコイル30t r及びチルトコイル30t iの全辺がトラッキング方向Tと平行する、レンズホルダ1の側面に巻着されているが、これに限定されるものではなく、磁気ギャップ5e内に配置されて駆動力を発生する辺、例えば、トラッキングコイル30t rに電流を流すと、トラッキング方向Tに同じ向きの駆動力が生じるトラッキングコイル30t rのフォーカス方向Fと平行な垂直辺A、C(図23参照)がレンズホルダ1の側面に巻着されている場合でもよい。

【0063】レンズホルダ1は、2個の磁気ギャップ5eに配置され、導電性弾性体4の他端は、ワイヤベース8を過ってベース基板9に半田により固定されている。これにより、レンズホルダ1に巻着されたフォーカスコイル30f、トラッキングコイル30t r及びチルトコイル30t iを、磁気ギャップ5e内に配置しているとともに、対物レンズ2を保持するレンズホルダ1を含む可動部を、マグネット5、ヨークベース6、ヨーク7、ワイヤベース8、ベース基板9により構成されている固定部に対して、移動可能に片持ち式に支持している。

【0064】図21において、フォーカスコイル30fに電流を流すと、磁気ギャップ5e内を流れる電流によって、フレミングの左手の法則に基づき、フォーカスコイル30fにフォーカス方向Fに駆動力が生じる。

【0065】図23において、トラッキングコイル30t rに電流を流すと、トラッキングコイル30t rのフォーカス方向Fと平行な垂直辺A、Cに流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、2個のトラッキングコイル30t rにトラッキング方向Tに同じ向きの駆動力が生じ、また、2個のチルトコイル30t iに電流を流すと、チルトコイル30t iのフォーカス方向Fと垂直な水平辺b'、d'に流れる電流(矢印で図示)によって、フレミングの左手の法則に基づき、2個のチルトコイル30t iにフォーカス方向Fに互いに逆向きの駆動力F'が生じる。この逆向きの駆動力F'によって、可動部の重心回りにモーメントが発生し、レンズホルダ1、ひいては対物レンズ2の傾きを調整する。

【0066】以上は、2個のトラッキングコイル30t r及びチルトコイル30t iをトラッキング方向Tに左右対称に配置して、2個のトラッキングコイル30t rに同じ向きの駆動力を、2個のチルトコイル30t iに逆向きの駆動力を発生させている場合であるが、図24に示すように、1個のトラッキングコイル30t rのフォーカス方向Fと平行な垂直辺Aをマグネット5の幅Wの内に配置し、平行な垂直辺Cをマグネット5の幅Wの外に配置するとともに、1個のチルトコイル30t iをマグネット5のトラッキング方向Tの中心から外側にずらして配置してもよい。また、トラッキングコイル30t rが図23に示すように、2個で、チルトコイル30

ti가 圖24に示すように、1個であ ってもよい。さらには、トラッキングコイル30tiが 圖24に示すように、1個で、チルトコイル30tiが 圖23に示すように、2個であ ってもよい。いずれにしろ、経 緯化が図れる。

【0057】 以上において、磁気ギャップ5eは、U字形を使用した2極毒磁、3極毒磁、4極毒磁の場合を含め、圖1、2、9、19に示すように、ヨークベース6上のヨーク7に接合されている。2個のマグネット5の対向によって形成されているが、マグネット5を1個で構成して、マグネット5とヨーク7の対向によって形成してもよい。更には、対向するヨーク7も省略して、N極からS極に至る空間を磁気ギャップ5eとしてもよい。

【0058】
【発明の効果】 以上説明してきたように、この発明は、少なくとも1つの、多極に毒磁されているマグネットを含む磁気回路を2個、形成し、該磁気回路の磁気ギャップ内に、フォーカスコイル、トラッキングコイル及びチルトコイルが装荷されたコイルユニットを配置したものである。それゆえ、フォーカス・トラッキング駆動用のマグネットに対物レンズの傾き調整を行うことができ、対物レンズの傾きを調整するためのマグネットは、不要である。したがって、この発明によれば、対物レンズの傾き調整に伴うコストアップ及び大型化を回避することができるという効果が得られる。

【図面の簡単な説明】

【図1】 この発明の実施の一形態を示す分解斜視図である。

【図2】 この発明の実施の一形態におけるマグネットがフォーカス方向に2極に毒磁されている磁気回路を示す側面図である。

【図3】 この発明の実施の一形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に毒磁されているマグネットとフォーカスコイル・トラッキングコイルの位置関係を示す配置図である。

【図4】 この発明の実施の一形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に毒磁されているマグネットとチルトコイルの位置関係を示す配置図である。

【図5】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に毒磁されているマグネットとトラッキングコイルの位置関係を示す配置図である。

【図6】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に毒磁されているマグネットとフォーカスコイル・チルトコイルの位置関係を示す配置図である。

【図7】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのトラッキング方向に2極に毒

磁されているマグネットとチルトコイルの位置関係を示す配置図である。

【図8】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのトラッキング方向に2極に毒磁されているマグネットとフォーカスコイル・トラッキングコイルの位置関係を示す配置図である。

【図9】 この発明の実施の他の形態におけるマグネットがトラッキング方向に2極に毒磁されている磁気回路を示す平面図である。

【図10】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのトラッキング方向に2極に毒磁されているマグネットとトラッキングコイルの位置関係を示す配置図である。

【図11】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのトラッキング方向に2極に毒磁されているマグネットとフォーカスコイル・チルトコイルの位置関係を示す配置図である。

【図12】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての4極に毒磁されているマグネットとトラッキングコイルの位置関係を示す配置図である。

【図13】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての4極に毒磁されているマグネットとフォーカスコイルの位置関係を示す配置図である。

【図14】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての4極に毒磁されているマグネットとチルトコイルの位置関係を示す配置図である。

【図15】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての3極に毒磁されているマグネットとフォーカスコイル・トラッキングコイルの位置関係を示す配置図である。

【図16】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての3極に毒磁されているマグネットとチルトコイルの位置関係を示す配置図である。

【図17】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての3極に毒磁されているマグネットとフォーカスコイル・トラッキングコイルの位置関係を示す配置図である。

【図18】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての3極に毒磁されているマグネットとチルトコイルの位置関係を示す配置図である。

【図19】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての3極に毒磁されているマグネットとフォーカスコイル・トラッキングコイル・チルトコイルの位置関係を示す配置図である。

【図20】 この発明の実施の他の形態におけるフォーカス方向の自重位置においての2極に毒磁されているマグネットとフォーカスコイル・トラッキングコイル・チルトコイルの位置関係を示す配置図である。

【図 21】 この発明の実施の他の形態を示す分解斜視図である。

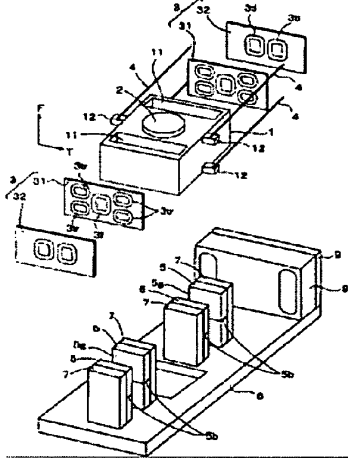
【図 22】 この発明の実施の他の形態におけるレンズホルダとフォーカスコイル・トラッキングコイル・チルトコイルの位置関係を示す配置図である。

【図 23】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に巻回されているマグネットとトラッキングコイル・チルトコイルの位置関係を示す配置図である。

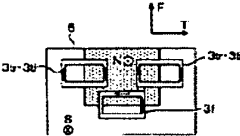
【図 24】 この発明の実施の他の形態におけるフォーカス方向の自重位置においてのフォーカス方向に2極に巻回されているマグネットとトラッキングコイル・チルトコイルの位置関係を示す配置図である。

【図 25】 従来技術の分解斜視図である。

【図 1】



【図 20】



【図 26】 従来技術における傾き補正駆動を説明図である。

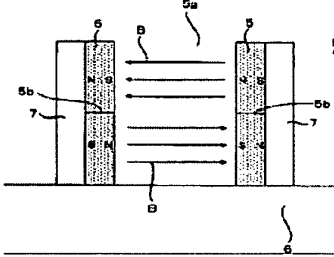
【図 27】 従来技術のアクチュエータの平面図である。

【図 28】 従来技術における傾き駆動を行う回路の構成を示すブロック図である。

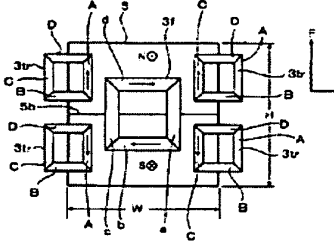
【符号の説明】

- 1 レンズホルダ
- 2 対物レンズ
- 3 コイルユニット
- 3f フォーカスコイル
- 3tr トラッキングコイル
- 3ti チルトコイル
- 5 マグネット
- 5g 磁気ギャップ

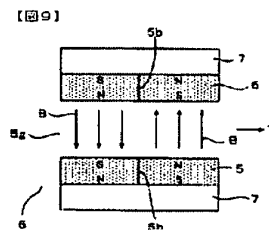
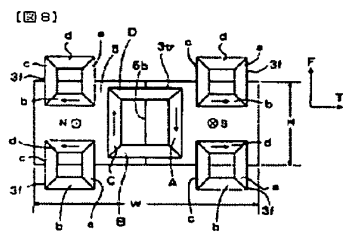
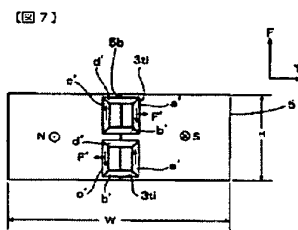
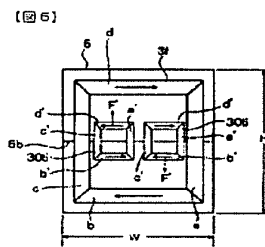
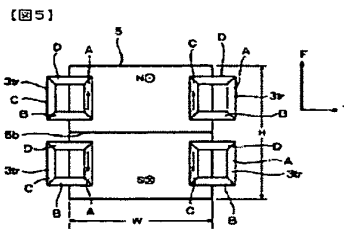
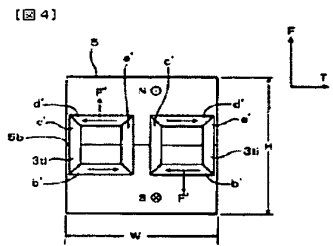
【図 2】

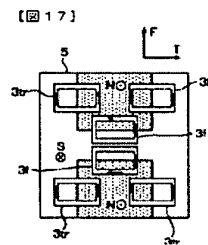
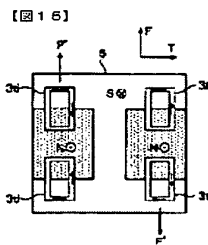
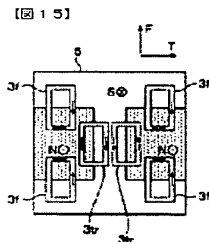
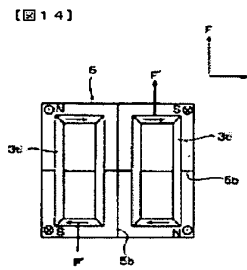
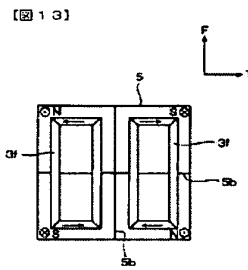
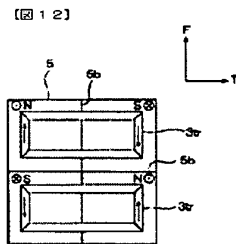
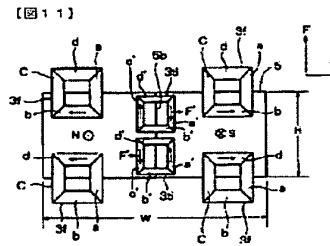
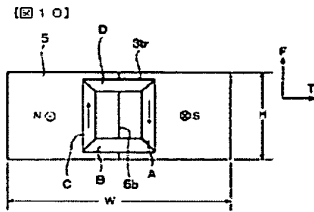


【図 3】

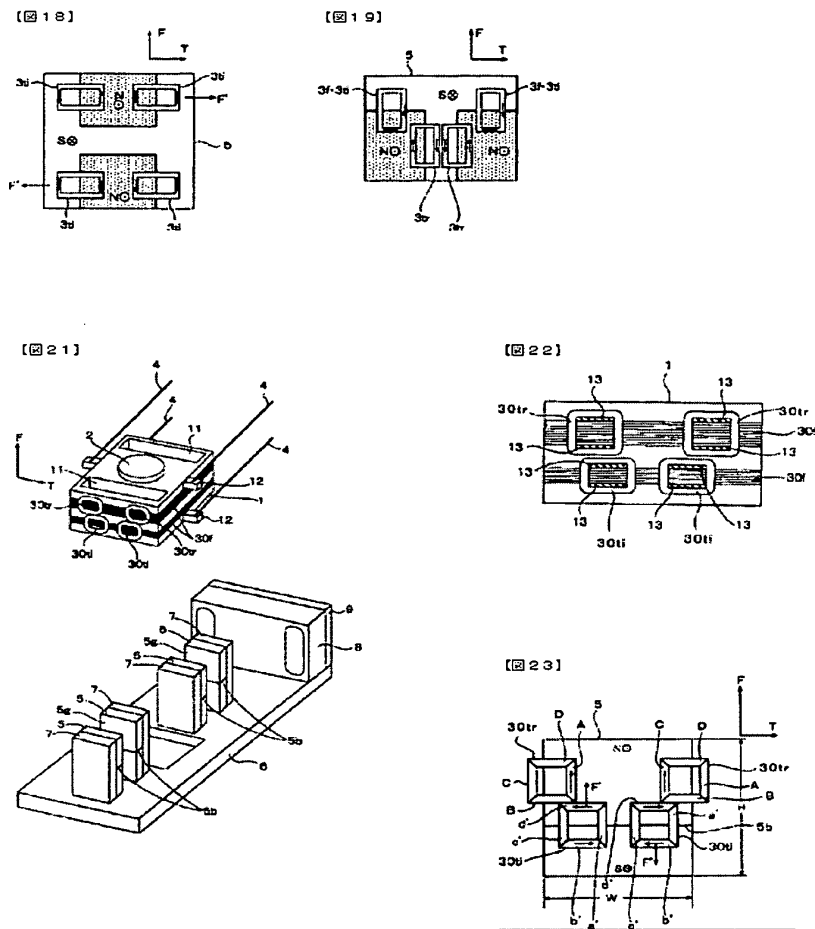


[첨부그림 12]



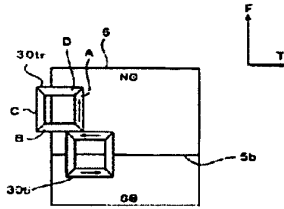


[첨부그림 14]

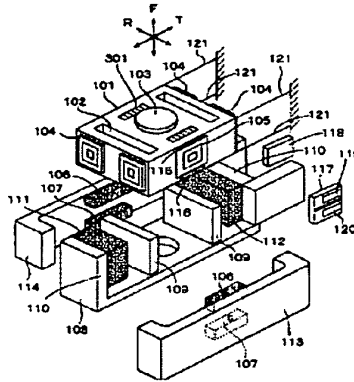


[첨부그림 15]

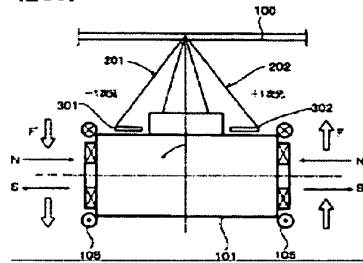
[圖 24]



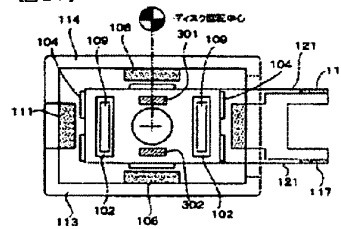
[圖 25]



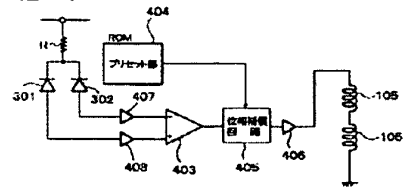
[圖 26]



[圖 27]



[圖 28]



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**UTILITY
PATENT APPLICATION****TRANSMITTAL***(Only for original applications)***APPLICATION ELEMENTS***See MPEP chapter 600 concerning utility patent
application contents.*

Attorney Docket No. 1793.1290

First Named Inventor or Application Identifier:
Won-ik CHO, et al.

Express Mail Label No.

ADDRESS TO:

**Commissioner for Patents
Box Patent Application
PO Box 1450
Alexandria, VA 22313-1450**17548 U.S. PTO
10/849190

1. ☒ Fee Transmittal Form
2. ☒ Specification, Claims & Abstract[Total Pages: 23]
3. ☒ Drawing(s) (35 USC 113)[Total Sheets: 7] [FIGS. 1, 2, 3, 4, 5, 6-7 and 8]
4. ☒ Oath or Declaration[Total Pages: 2]
- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 CFR 1.63(d))
- i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the prior application,
see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Verified Statement Claiming Small Entity Status
6. ☐ Application Data Sheet. See 37 C.F.R. 1.76
7. ☒ Applicant claims foreign priority benefit to: Korean Application 2003-35305 filed June 2, 2003
8. ☐ CD-Rom or CD-R in duplicate, large table or Computer Program (Appendix)
9. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
- a. ☐ Computer Readable Form (CRF)
- b. ☐ Specification Sequence Listing on:
- i. ☐ CD-ROM or CD-R (2 copies); or
- ii. ☐ paper
- c. ☐ Statement verifying identity of above copies
10. ☐ For publication of assignee information under 37 CFR 1.215(b), list the assignee as Samsung Electronics Co., Ltd. of Suwon-si, Republic of Korea. The Assignment papers will be filed later.

ACCOMPANYING APPLICATION PARTS

11. ☒ Assignment (cover sheet & document(s)) to Samsung Electronics Co., Ltd. of Suwon-si, Republic of Korea
☒ for publication of assignee information under 37 CFR 1.215(b)
12. ☐ 37 CFR 3.73(b) Statement (when there is an assignee) ☐ Power of Attorney
13. ☐ English Translation Document (if applicable)
14. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
15. ☐ Preliminary Amendment
16. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
17. ☒ Certified Copy of Priority Document(s) (if foreign priority is claimed)
18. ☐ Request and Certification for Nonpublication under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form
PTO/SB/35 or its equivalent
19. ☐ Other:

20. CORRESPONDENCE ADDRESS

21171

PATENT TRADEMARK OFFICE



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S&H Form (10/03)

NEW APPLICATION FEE TRANSMITTAL		Attorney Docket No. 1793.1290			
		Application Number			
		Filing Date May 20, 2004			
AMOUNT ENCLOSED \$ 1726.00		First Named Inventor Won-ik CHO, et al.			
FEE CALCULATION (fees effective 10/01/03)					
CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS	47 - 20 =	27	X \$ 18.00 =	\$ 486.00
	INDEPENDENT CLAIMS	8 - 3 =	5	X \$ 86.00 =	430.00
	MULTIPLE DEPENDENT CLAIMS (any number; if applicable)			+ \$290.00 =	
				BASIC FILING FEE	770.00
				Total of above Calculations =	\$ 1686.00
	Surcharge for late filing fee, Oath or Declaration (37 CFR 1.53(f)) (\$130.00)				
	Reduction by 50% for filing by small entity (37 CFR 1.27).				
				TOTAL FILING FEE =	\$ 1686.00
	Surcharge for filing non-English language application (\$130.00; 37 CFR 1.52(d))				
	Recordation of Assignment (\$40.00; 37 CFR 1.21(h))				
				TOTAL FEES DUE =	\$ 1726.00
METHOD OF PAYMENT					
☒ Check enclosed as payment.					
☐ Charge "TOTAL FEES DUE" to the Deposit Account No. below.					
☐ No payment is enclosed and no charges to the Deposit Account are authorized at this time (unless specifically required to obtain a filing date).					
GENERAL AUTHORIZATION					
☒ If the above-noted "AMOUNT ENCLOSED" is not correct, the Commissioner is hereby authorized to credit any overpayment or charge any additional fees necessary to:					
Deposit Account No.		19-3935			
Deposit Account Name		STAAS & HALSEY LLP			
☒ The Commissioner is also authorized to credit any overpayments or charge any additional fees required under 37 CFR 1.16 (filing fees) or 37 CFR 1.17 (processing fees) during the prosecution of this application, including any related application(s) claiming benefit hereof pursuant to 35 USC 120 (e.g., continuations/divisionals/CIPs under 37 CFR 1.53(b) and/or continuations/divisionals/CPAs under 37 CFR 1.53(d)) to maintain pendency hereof or of any such related application.					
SUBMITTED BY: STAAS & HALSEY LLP					
Typed Name		Michael D. Stein		Reg. No.	37,240
Signature				Date	May 20, 2004

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**UTILITY
PATENT APPLICATION****TRANSMITTAL**

(Only for original applications)

APPLICATION ELEMENTSSee MPEP chapter 600 concerning utility patent
application contents.

Attorney Docket No. 1793.1290

First Named Inventor or Application Identifier:
Won-ik CHO, et al.

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1. ☒ Fee Transmittal Form
2. ☒ Specification, Claims & Abstract[Total Pages: 23]
3. ☒ Drawing(s) (35 USC 113)[Total Sheets: 7] [FIGS. 1, 2, 3, 4, 5, 6-7 and 8]
4. ☒ Oath or Declaration[Total Pages: 2]
 - a. ☒ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 CFR 1.63(d))
 - i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the prior application,
see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Verified Statement Claiming Small Entity Status
6. ☐ Application Data Sheet. See 37 C.F.R. 1.76
7. ☒ Applicant claims foreign priority benefit to: Korean Application 2003-35305 filed June 2, 2003
8. ☐ CD-Rom or CD-R in duplicate, large table or Computer Program (Appendix)
9. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
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 - i. ☐ CD-ROM or CD-R (2 copies); or
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10. ☐ For publication of assignee information under 37 CFR 1.215(b), list the assignee as Samsung Electronics Co., Ltd. of Suwon-si, Republic of Korea. The Assignment papers will be filed later.

ACCOMPANYING APPLICATION PARTS

11. ☒ Assignment (cover sheet & document(s)) to Samsung Electronics Co., Ltd. of Suwon-si, Republic of Korea
☒ for publication of assignee information under 37 CFR 1.215(b)
12. ☐ 37 CFR 3.73(b) Statement (when there is an assignee) ☐ Power of Attorney
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15. ☐ Preliminary Amendment
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18. ☐ Request and Certification for Nonpublication under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form
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19. ☐ Other:

20. CORRESPONDENCE ADDRESS

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S&H Form (10/03)

NEW APPLICATION FEE TRANSMITTAL		Attorney Docket No.		1793.1290	
		Application Number			
		Filing Date		May 20, 2004	
AMOUNT ENCLOSED		\$ 1726.00		First Named Inventor	
				Won-ik CHO, et al.	
FEE CALCULATION (fees effective 10/01/03)					
CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS	47 - 20 =	27	X \$ 18.00 =	\$ 486.00
	INDEPENDENT CLAIMS	8 - 3 =	5	X \$ 86.00 =	430.00
	MULTIPLE DEPENDENT CLAIMS (any number; if applicable)			+ \$290.00 =	
				BASIC FILING FEE	770.00
				Total of above Calculations =	\$ 1686.00
	Surcharge for late filing fee, Oath or Declaration (37 CFR 1.53(f)) (\$130.00)				
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				TOTAL FILING FEE =	\$ 1686.00
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Signature				Date	May 20, 2004

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TITLE OF THE INVENTION

OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE USING THE SAME AND METHOD

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2003-35305, filed on June 2, 2003, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to an optical disk drive, and more particularly, to an optical disk drive including an optical pickup actuator employing a Lorenz force generated in a coil by electromagnetic induction.

2. Description of the Related Art

[0003] In general, an optical disk drive writes information by scanning light onto a disc that is a recording medium or reads information from the disc. The optical disk drive includes a spindle motor that rotates a disc and an optical pickup that records information on, or reproduces information from, a recording surface of the disc by emitting light onto the recording surface.

[0004] Typically, an optical pickup has an actuator for controlling the position of an objective lens in a focus and a tracking direction so that light is focused on a desired track formed onto a recording surface of the disc. The optical pickup actuator serves as a controller by constantly adjusting the distance between the objective lens and the recording surface so that the focus of a light spot is maintained and the light spot follows the desired track.

[0005] FIG. 1 is a perspective view of a conventional optical pickup actuator, and FIG. 2 is a top view of the optical pickup actuator of FIG. 1. Referring to FIG. 1, a blade 3 on which an objective lens 4 is mounted is positioned on a base 1 in such a way as to be elastically movable by wires 6. First coils 11a and 11b and second coils 12a and 12b are positioned on the blade 3. While the first coils 11a and 11b are wound in a vertical direction and positioned in a Y-direction symmetrically with respect to the objective lens 4, the second coils 12a and 12b are wound in a

horizontal direction and positioned in an X-direction symmetrically with respect to the objective lens 4.

[0006] Magnets 21a, 21b, 22a, and 22b are also mounted on the base 1. While the magnets 21a and 21b are disposed opposite the first coils 11a and 11b, respectively, the magnets 22a and 22b are disposed opposite the second coils 12a and 12b, respectively.

[0007] In FIG. 1, X, Z, and T directions represent tracking, focusing, and tilt directions, respectively.

[0008] A description of an operation of actuating the blade 3 in a tracking direction X follows. As shown in FIG. 2, when current is supplied to the first coils 11a and 11b, an electromagnetic force F_x is induced in the first coils 11a and 11b by an interaction with the magnets 21a and 21b. If current is applied to the first coils 11a and 11b in an opposite direction to the direction marked in FIG. 2, then an electromagnetic force $-F_x$ is induced in the first coils 11a and 11b. By controlling the direction that current is applied to the first coils 11a and 11b, the driving of blade 3 in a tracking direction X is controlled.

[0009] A description of the operation of actuating the blade 3 in a focusing direction Z follows. If current is supplied to the second coils 12a and 12b in the directions A1 and A3, respectively, an electromagnetic force F_z acting in upward +Z direction is induced in the second coils 12a and 12b by interaction with the magnets 22a and 22b. If current is applied to the second coils 12a and 12b in the directions A2 and A4, respectively, an electromagnetic force $-F_z$ acting in downward -Z direction is induced in the second coils 12a and 12b. By supplying the current to the second coils 12a and 12b in directions A1-A3 or A2-A4, the blade 3 is driven in a focusing direction Z.

[0010] A precisely focused light spot is created only when light exiting through the objective lens 4 is incident perpendicularly to the recording surface on the disc. Otherwise, it is not possible to create a precise light spot on the disc, which may cause an error in recording data on, or reproducing data from, the disc.

[0011] Adjusting an incident angle of light so that the light is perpendicular to the recording surface of a disc is referred to as tilt or skew adjustment. Since an ability to dynamically adjust

tilt is required for precise recording or reproduction, an optical pickup actuator also requires an ability to adjust in a tilt direction.

[0012] The operation of driving the blade 3 in a tilt direction T in the conventional optical pickup actuator of FIG. 1 is as follows. Actuation in the tilt direction T is performed by inducing electromagnetic forces in the second coils 12a and 12b in opposite directions. That is, if current is supplied to the second coils 12a and 12b in directions A1 and A4, respectively, then an electromagnetic force F_z acting upward is induced in the second coil 12a while an electromagnetic force $-F_z$ acting downward is induced in the second coil 12b. Furthermore, where current is applied to the second coils 12a and 12b in directions A2 and A3, respectively, electromagnetic forces $-F_z$ and F_z acting in upward and downward directions are induced in the second coils 12a and 12b, respectively. By supplying current to the second coils 12a and 12b in directions A1-A4 or A2-A3 in this manner, the blade 3 is driven in the tilt direction T.

[0013] The wires 6 not only elastically support the blade 3 on the base 1 but also serve as a path for supplying current to the first coils 11a and 11b and the second coils 12a and 12b. FIG. 1 shows four wires 6, and hinges 7, connecting with the wires 6, formed on the blade 3. The four wires 6, in two pairs, supply current to the first coils 11a and 11b and second coils 12a and 12b. This configuration is designed for actuation only in the focusing and tracking directions Z and X. To enable actuation in the tilt direction T, in addition to the above, current needs to be supplied separately to the second coils 12a and 12b in different directions. Thus, although not shown in the drawings, a further pair of wires are needed. Likewise, in a case where a third coil (not shown) is positioned on the blade 3 for actuation in the tilt direction T, an additional pair of wires are required.

[0014] Since the center of gravity of the blade 3 supported by the wires 6 needs to be considered, the placement of the hinge 7 is critical. As shown in FIG. 1, the four wires 6, sufficient only for actuation in focusing and tracking directions Z and X are coupled with two hinges that are formed on either an upper or a lower surface of the blade 3. However, if further actuation is required in the tilt direction T, two additional wires are needed. With the conventional optical pickup actuator of FIG. 1, coupling two additional hinges with the two wires is difficult since the first and second coils 11a, 11b, 12a, and 12b are positioned around the four sides of the blade 3.

[0015] In the conventional optical pickup actuator as described above, the magnets 21a, 21b, 22a, and 22b are positioned in four directions around the blade 3. In particular, the magnets 22a and 22b, for actuation in the focusing and tilt directions Z and T, are positioned in the tracking direction X, i.e., in a radial direction of the disc (not shown) in the optical disk drive having an optical pickup actuator. This poses a limitation in that the optical pickup actuator needs to be designed to avoid interference with a spindle motor (not shown) for rotating the disc. A recent increase in demand for super-slim disk drives requires further miniaturization and lightweight structure, i.e., by reducing the number of parts of an optical pickup actuator. Furthermore, an increase in the optical recording density requires improvement in sensitivity of actuation in tracking and tilt directions X and T.

SUMMARY OF THE INVENTION

[0016] According to an aspect of the present invention, an optical pickup actuator having a miniaturized and lightweight structure through an arrangement of coils and magnets, and optical disk drive using the same are provided.

[0017] According to an aspect of the present invention, an optical pickup actuator having improved sensitivity of actuation in focusing, tracking, and tilt directions by improving a shape of an inner yoke inserted in a coil, and optical disk drive using the same are provided.

[0018] According to an aspect of the present invention, an optical pickup actuator decreases a space limitation for installation of wires that elastically support a blade on a base, and an optical disk drive using the same are provided. Furthermore, according to an aspect of the present invention, an optical pickup actuator includes a stopper for preventing a blade from colliding with a base .

[0019] According to an aspect of the present invention, an optical pickup actuator is provided including a blade holding an objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable, a magnetic element positioned on the base, and a coil positioned horizontally on the blade to generate electromagnetic force in a focusing and/or tilting direction through interaction with the magnetic element, where the coil is divided into a plurality of subcoils that are vertically separated from one another.

[0020] According to another aspect of the present invention, an optical disc drive including a spindle motor for rotating a disc that is a recording medium, an optical pickup for recording and/or reproducing information by emitting light onto the disc through an objective lens, and an optical pickup actuator for controlling the position of the objective lens so that light is emitted on a desired position of the disc are provided. The optical pickup actuator includes a blade holding an objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable, a magnetic element positioned on the base, and a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element, where the coil is divided into a plurality of subcoils that are vertically separated from one another.

[0021] According to an aspect of the invention, the coil includes a pair of first coils placed on the blade in a first direction to face each other with respect to the objective lens.

[0022] According to an aspect of the invention, the coil includes a third coil positioned on the blade to surround an outer surface of the blade.

[0023] According to an aspect of the invention, the optical pickup actuator further includes a second coil positioned vertically on either one or two sides of the blade in a second direction perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.

[0024] According to an aspect of the invention, the optical pickup actuator further includes an inner yoke positioned on the base and inside the first coil, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

[0025] According to an aspect of the invention, the optical pickup actuator further includes a plurality of stoppers (e.g., three stoppers) interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a shape (e.g., triangular shape) centered on the objective lens.

[0026] According to another aspect of the present invention, an optical pickup actuator is provided including a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable, the optical pickup actuator further

includes a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in first direction, a second coil positioned vertically on either one or two sides of the blade in a second direction perpendicular to the first direction, and an inner yoke positioned on the base, the inner yoke positioned inside a cavity defined by walls of each of the first coils, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

[0027] According to another aspect of the present invention, an optical disc drive is provided including a spindle motor for rotating a disc that is a recording medium, an optical pickup for recording and reproducing information by emitting light onto the disc through an objective lens, and an optical pickup actuator for controlling a position of the objective lens so that light is emitted on a desired position of the disc, where the optical pickup actuator includes a blade holding the objective lens that is supported on a base by a plurality of suspension wires so that the blade is elastically movable, a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in first direction, a second coil positioned vertically on either one or two sides of the blade in second direction perpendicular to the first direction, and an inner yoke positioned on the base, the inner yoke being placed inside each of the first coils, and wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

[0028] According to an aspect of the invention, each of the first coils is divided into a plurality of subcoils that are vertically separated from one another.

[0029] According to an aspect of the invention, the optical pickup actuator further includes a third coil positioned to surround the sides of the blade.

[0030] According to an aspect of the invention, the third coil is divided into a plurality of subcoils that are vertically separated from one another.

[0031] According to an aspect of the invention, the optical pickup actuator further includes a pair of magnets disposed opposite each other with respect to the blade in the second direction, where the magnets are unipolar and magnetized to have the same polarity.

[0032] According to an aspect of the invention, the optical pickup actuator further includes three stoppers interposed between the blade and the base for preventing the blade from

colliding with the base when excessively driven toward the base and arranged, in a shape (e.g., a triangular shape) centered on the objective lens.

[0033] According to another aspect of the present invention, an optical pickup actuator includes a blade holding an objective lens supported on a base by a plurality of suspension wires so that the blade is elastically movable, and a plurality of stoppers (e.g., three stoppers) interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

[0034] According to another aspect of the present invention, an optical disc drive is provided including a spindle motor for rotating a disc that is a recording medium, an optical pickup for recording and/or reproducing information by emitting light onto the disc through an objective lens, and an optical pickup actuator controlling the position of the objective lens so that light is emitted on a desired position of the disc, where the optical pickup actuator includes a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable, and a plurality of stoppers (e.g., three stoppers) interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a shape (e.g., a triangular shape) centered on the objective lens. The stoppers are positioned in various locations, for example, either on the blade or the base.

[0035] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a conventional optical pickup actuator;

FIG. 2 is a top view of the conventional optical pickup actuator of FIG. 1;

FIG. 3 is a perspective view of a disk drive according to an aspect of the present invention;

FIG. 4 is an exploded perspective view of an optical pickup actuator according to an aspect of the present invention;

FIG. 5 is a top view of the optical pickup actuator of FIG. 4;

FIG. 6 is a vertical cross-sectional view showing the operation of a second coil according to an aspect of the invention;

FIG. 7 is a schematic rear view of the blade shown in FIG. 4; and

FIG. 8 is a perspective view of an optical pickup actuator according to another aspect of this invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0037] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0038] Referring to FIG. 3, a base 54 having a spindle motor 51 and an optical pickup 53 mounted thereon is positioned on a mainframe 50. The base 54 is supported on a pair of guide shafts 52 positioned in a radial direction of a disc D on the mainframe 50.

[0039] The spindle motor 51 rotates the disc D, and a turntable 55 on which the disc D rests is coupled with a rotary axis of the spindle motor 51. The optical pickup 53 records information on, or reproduces information from, the disc D by emitting light onto the disc D through the objective lens 56. The optical pickup 53 is positioned on the base 54 to reciprocate along the guide shaft 52 in a radial direction of the disc D.

[0040] To allow light to be accurately incident on a desired location of the disc D, it is necessary, in some cases, for the objective lens 56 to be driven in two or more directions: a focusing direction (Z), a tracking direction (X), and in a tilt direction. The optical disk drive includes a device for driving the objective lens 56 (i.e., an optical pickup actuator).

[0041] FIG. 4 is an exploded perspective view of an optical pickup actuator according to an aspect of the present invention used in the optical disk drive of FIG. 3. FIG. 5 is a top view of the optical pickup actuator of FIG. 4.

[0042] Referring to FIGS. 4 and 5, the optical pickup actuator has a base 100 and a blade 110 holding an objective lens 120. Outer and inner yokes 171 and 190 and a pair of magnets 180 (i.e., a magnetic element retaining magnetism) are positioned on the base 100. According to an aspect of the present invention, the outer and inner yokes 171 and 190 are integrated in a yoke assembly 170. The pair of magnets 180 shown in FIGS. 4 and 5 are disposed opposite to each other in a Y direction (second direction), and are unipolar and magnetized with an N pole. Alternatively, the magnets 180 are unipolar and magnetized with a S pole according to another aspect of the invention. By using only the pair of magnets 180 positioned in the Y direction, a risk of interference with the spindle motor 51 that rotates the disc D is decreased while reducing the number of components of the optical pickup actuator.

[0043] First, second and third coils 130, 140, and 150, respectively, are positioned on the blade 110. The first coil 130 is positioned horizontally on the blade 110 and includes a pair of coils 131 and 132 positioned in an X direction (first direction) symmetrically with respect to the objective lens 120. The second coil 140 is disposed on either one or two sides 113 and 114 in the Y direction (second direction) of the blade 110 (i.e., opposite the magnets 180) to generate an electromagnetic force in tracking direction a X due to interaction with the magnets 180. The second coil 140 is positioned vertically on either one or two sides 113 and 114 of the blade 110 and includes coils 141 and 142 positioned on the two sides 113 and 114 symmetrically with respect to the objective lens 120, respectively. According to an aspect of the present invention, coils 141 and/or 142 are formed in pairs, but may be otherwise disposed in other aspects.

[0044] The third coil 150 is positioned to surround the outside of the blade 110 horizontally. The third coil 150 is vertically divided into a plurality of coils. As shown in FIG. 4, the third coil 150 is separated into two subcoils : upper and lower coils 151 and 152. One reason for the separation between the coils 151 and 152 of the third coil 150 is to permit flexibility in determining a location of a hinge 160, which will be described later in more detail.

[0045] A holder 101 is positioned on the base 100, and a plurality of the hinges 160 are positioned on the blade 110. The blade 110 is positioned to allow the inner yoke 190 to be inserted into the cavity defined by the walls of the first coil 130. Since one end of each of a plurality of suspension wires W is connected to the holder 101 and the other end is connected to the hinge 160, the blade 110 is supported on the base 110 to be elastically movable.

[0046] Types of optical pickup actuators include, respectively, (a) focus and tracking coils, (b) focus and tracking coils, of which the focus coil also serves as a tilt coil, or (c)-focus, tracking, and tilt coils. The type of optical pickup actuator according to aspects of the invention is dependent on whether the optical pickup actuator includes the third coil 150 and whether the first coil 130 serves as focus and/or tracking coils .

[0047] An electromagnetic force acting in the $\pm Z$ direction is induced in the first coil 130. An electromagnetic circuit related to the first coil 130 is constructed in different ways depending on the type of the optical pickup actuator. In the case of an (a)-type optical pickup actuator without a third coil 150 and a first coil 130 used as the focus coil, the electromagnetic circuit is constructed so that current is supplied to the coils 131 and 132 in the same direction. In the case of a (b)-type optical pickup actuator without a third coil 150 and a first coil 130 serving as both focus and tilt coils, the electromagnetic circuit is constructed so that current is separately supplied to each of the coils 131 and 132. In the case of the (c)-type optical pickup actuator where the first coil 130 is used only as a tilt coil, the electromagnetic circuit is constructed so that the current is supplied to the coils 131 and 132 in opposite directions. Two sides 131a and 132a placed opposite the magnets 180 are effectively utilized in inducing an electromagnetic force in the coils 131 and 132 of the first coil 130.

[0048] Referring to FIG. 6, an inner one 141b of two sides 141a and 141b in the vertical direction of the second coil 140 is effectively used for inducing an electromagnetic force. Thus, a width L of the magnets 180 is determined so as to prevent a magnetic force from acting on the side 141a. When current flows through the second coil 140 in the direction indicated by arrow C1, an electromagnetic force F_x is induced in the second coil 140. If the direction of the current flowing through the second coil 140 is reversed, then an electromagnetic force $-F_x$ is induced in the second coil 140. Thus, the blade 110 is driven in a tracking direction X by controlling the direction of the current supplied to the second coil 140.

[0049] Two sides 150a and 150b (see FIG. 5) of the third coil 150 opposite the magnets 180 are used for actuation in a focusing direction Z. By controlling the direction of current flowing through the third coil 150, an electromagnetic force F_z or $-F_z$ acting in the focusing direction Z is induced in the third coil 150.

[0050] The inner yoke 190 is disposed opposite the outer yoke 171 to create a magnetic path. A pair of first walls 191 are disposed to face the second coil 140 and separated from each other in the Y direction (second direction). A second wall 192 extending along the Y direction (second direction) is attached to the pair of first walls 191.

[0051] An example of operation of the inner yoke 190 follows. Since only one side 141b of the second coil 140 is used for actuation in the tracking direction X, there is possibility of weakening sensitivity of tracking. Increasing the number of turns in the second coil 140 will improve sensitivity of tracking, but increase the weight of the optical pickup actuator. Thus, to obtain the maximum tracking sensitivity for a given number of turns, it is necessary to concentrate a magnetic field generated by the magnet 180 in the second coil 140. Thus, the inner yoke 190 having a pair of first walls 191 is used to increase an effective area facing the magnet 180 as compared to an inner yoke having only a second wall 192. By including the inner yoke 190 having the first walls 191, it is possible to increase tracking sensitivity. Furthermore, a magnetic path created between the first wall 191 and the outer yoke 171 improves the sensitivity of the first coil 130. Thus, even in the case of the (a)-type optical pickup actuator wherein the first coil 130 is used as a focus coil, it is possible to increase focusing sensitivity. For the (b)-type optical pickup actuator in which the first coil 130 functions as both focus and tilt coils, it is possible to improve focusing and tilt sensitivities. In the (c)-type optical pickup actuator where the first coil 130 serves as a tilt coil, tilt sensitivity is be improved.

[0052] Tables 1 and 2 show magnitudes of electromagnetic forces induced in first, second, and third coils, respectively, 130, 140, and 150, which are measured for the (c)-type optical pickup actuator. Case 1 shows magnitudes for an actuator including an inner yoke 190 having only the second wall 192. Case 2 shows magnitudes for an actuator including an inner yoke 190 having both first and second walls 191 and 192, respectively. Current supplied to the respective coils 130, 140, and 150 is 150 mA, and Fx, Fy, and Fz are measured in units of Newton/Volt (N/V).

<Table 1>

CASE 1	Electromagnetic force		
	Fx	Fy	Fz
First coil (tilt coil)	0.00325	- 0.00003	0.03387
Second coil (tracking coil)	0.03594	0.00012	- 0.00003
Third coil (focus coil)	-0.00006	0.00009	0.07178

<Table 2>

CASE 2	Electromagnetic force		
	F _x	F _y	F _z
First coil (tilt coil)	0.00358	- 0.00015	0.04478
Second coil (tracking coil)	0.05677	0.00004	- 0.00006
Third coil (focus coil)	- 0.00004	0.00003	0.07170

[0053] As evident from Tables 1 and 2, while CASE 1 and CASE 2 exhibit almost equal electromagnetic forces F_z in a focusing direction Z induced in the third coil 150, CASE 2 shows that electromagnetic forces F_y and F_x in tilt and tracking directions T and X induced in the first and second coils 130 and 140, respectively, are greater (i.e., by about 32% and 58% greater) than respective forces in CASE 1. In other words, including an inner yoke 190 having the first walls 191 makes it possible to significantly improve sensitivities in tracking and tilt directions X and T. The result of this experiment also apply to the (a)-type and (b)-type of optical pickup actuators.

[0054] Next, an example of operation of an optical pickup actuator including a third coil 150 follows:

[0055] The blade 110 is supported on the base 100 by the plurality of suspension wires W to be elastically movable. For the blade 110 to be driven in the desired direction by an electromagnetic force generated due to interaction between the magnets 180 and each of the first, second, and third coils, respectively, 130, 140, and 150, the location of each of the plurality of hinges 160 being connected to one end of each suspension wire W is important. For example, improper selection of the location of the hinge 160 causes the blade 110 to roll, yaw, or pitch, which prohibits it from being precisely driven.

[0056] A factor in determining the position of the hinges 160 includes considering the location of the center of gravity of the blade 110 after all other components including the objective lens 120 and the first, second, and third coils 130, 140, and 150, respectively, have been mounted. With the recent decrease in the size and weight of an optical recording apparatus and increase in demand for higher recording densities, the size and weight of the blade 110 is decreasing while the level of precision required for optical pickup actuators

continues to increase. Thus, this further decreases the space available for the hinges 160. For the optical pickup actuator to further perform actuation in a tilt direction, at least six suspension wires W are required, which further reduces flexibility in determining the position of the hinges 160.

[0057] According to an aspect of the present invention, to address this problem, the third coil 150 is vertically divided into two subcoils. As an example of the location of the hinges 160 to be positioned, three hinges 161 through 163 are positioned on either side of the blade 110 in the X direction (first direction), as shown, for example, in FIG. 4. In this case, two of the three hinges i.e., 161 and 163 are positioned at the top and bottom of the third coil 150, respectively. The remaining hinge 162 is positioned between the two subcoils 151 and 152. Depending on the position of the hinge 160 and considering the center of gravity of the blade 110, an improved determination of a division of the third coil 150 is possible. For example, the number of subcoils and location of division of the third coil 150 are determined. Although an aspect of the present invention has been described with reference to the example in which the third coil 150 is vertically divided into two subcoils, the present invention is not so limited. According to an aspect of the invention, depending on the related conditions, the third coil 150 is vertically divided into three or more subcoils. By dividing the third coil 150 into a plurality of subcoils, it is possible to position the hinges 160 in such a manner that the blade 110 is optimally supported on the base 100. It is also possible to minimize a change in a number of turns in the third coil 150, and thus maintain the excellent focusing sensitivity.

[0058] As described above, the third coil 150 acting as a focus coil is divided into a plurality of subcoils in a (c)-type optical pickup actuator including the first through third coils, 130, 140, and 150, respectively. However, the present invention is not limited to the illustrative example. For example, as shown in FIG. 8, a first coil 130 in (a)-type and (b)-type optical pickup actuators is exposed to two sides of a blade 110. In this case, the first coil 130 is vertically divided into a plurality of subcoils to facilitate installation of the hinges 160.

[0059] Additionally, when the blade 110 is driven in the focusing direction Z, it is necessary to restrict the driving distance because an excessive driving distance causes the blade 110 to collide with the base 100 or yoke assembly 170. This collision results in damage to various optical components including lenses (not shown) mounted on the base 100, as well as the objective lens 120.

[0060] As shown as by broken-line boxes in FIG. 7, an optical pickup actuator may include stoppers 251 and 252, or 253 and 254. Although it is desirable for the blade 110 to descend precisely in a focusing direction Z, the blade 110 may be tilted toward directions marked by diagonal lines 256 and 257 or directions 258 and 259 due to many factors while descending. An optical pickup actuator having the stoppers 251 and 252 cannot prevent the blade 110 from colliding with the base 100 or the yoke assembly 170 when the blade 110 is tilted toward the direction marked by the diagonal line 257. Likewise, an optical pickup actuator having the stoppers 253 and 254 cannot prevent the blade 110 from colliding with the base 100 or the yoke assembly 170 when the blade 110 is tilted toward the direction marked by the diagonal line 256. To solve these problems, all the stoppers 251 through 254 may be used. However, since it is not possible for the blade 110 to be simultaneously tilted toward the directions 256 and 257, using all the stoppers 251 through 254 imposes an excessive constraint on the optical pickup actuator.

[0061] As shown in FIG. 7, the blade 110 according to an aspect of the present invention has three stoppers 250 centered on the objective lens 120. This configuration prevents the blade 110 from being tilted toward any of the directions 256 through 259 while descending. The stoppers 250 may be positioned on the base 100 or yoke assembly 170.

[0062] As described in the foregoing, the optical pickup actuator according to aspects of the present invention has numerous advantages. For example, an aspect of the present invention improves flexibility in the installation of hinges coupled to suspension wires, respectively, on the blade by dividing a coil into a plurality of subcoils. Thus, it is possible to stably support the blade on the base. In addition, an aspect of the present invention has an inner yoke increases an effective area facing the magnet, thereby improving sensitivity in actuation of the blade. Also, by using only a pair of unipolar magnets, the size and weight of the optical pickup actuator is decreased while decreasing the risk of interference with the spindle motor. In addition, an aspect of the present invention has three stoppers that stably reduce excessive actuation of the blade in a focusing direction.

[0063] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

CLAIMS

What is claimed is:

1. An optical pickup actuator for use with an objective lens on a base, comprising:
a blade holding the objective lens;
a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;
a magnetic element positioned on the base; and
a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing and/or tilting direction through an interaction with the magnetic element,

wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction.
2. The optical pickup actuator according to claim 1, wherein the coil comprises a pair of first coils positioned on the blade in a first direction and facing each other with respect to the objective lens.
3. The optical pickup actuator according to claim 1, wherein the coil comprises a coil surrounding an outer surface of the blade.
4. The optical pickup actuator according to claim 2, further comprising a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.
5. The optical pickup actuator according to claim 4, wherein the second coil is positioned on both sides of the blade.
6. The optical pickup actuator according to claim 4, further comprising an inner yoke positioned on the base and positioned within a cavity defined by walls of the first coil,

wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

7. The optical pickup actuator according claim 5, further comprising an inner yoke positioned on the base and positioned within a cavity defined by walls of the first coil,

wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

8. The optical pickup actuator according to claim 1, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade and have the same polarity.

9. The optical pickup actuator according to claim 4, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.

10. The optical pickup actuator according to claim 1, further comprising three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

11. An optical disc drive for a disc that is a recording medium, comprising:
a spindle motor for rotating the disc ;
an optical pickup for recording and/or reproducing information by emitting light onto the disc through an objective lens ; and
an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:
a blade holding the objective lens,
a plurality of suspension wires supporting the blade on a base so that the blade is elastically movable,
a magnetic element positioned on the base, and
a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element,

wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction.

12. The optical disc drive according to claim 11, wherein the coil comprises a pair of first coils positioned on the blade in a first direction so as to face each other with respect to the objective lens.

13. The optical disc drive according to claim 11, wherein the coil comprises a coil positioned on the blade so as to surround an outer surface of the blade.

14. The optical disc drive according to claim 12, wherein the optical pickup actuator further comprises a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.

15. The optical disc drive according to claim 14, wherein the second coil is positioned on both sides of the blade.

16. The optical disc drive according to claim 14, wherein the optical pickup actuator further comprises an inner yoke positioned on the base and placed inside the first coil, and wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

17. The optical disc drive according to claim 14, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.

18. The optical disc drive according to claim 11, wherein the optical pickup actuator further comprises three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

19. An optical pickup actuator for use with an objective lens on a base, comprising:

a blade holding the objective lens;
a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;
a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction;
a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction; and
an inner yoke positioned on the base, the inner yoke positioned inside a cavity defined by each of the first coils,
wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

20. The optical pickup actuator according to claim 19, wherein each of the first coils is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction.

21. The optical pickup actuator according to claim 19, further comprising a third coil positioned so as to surround the sides of the blade.

22. The optical pickup actuator according to claim 21, wherein the third coil is divided into a plurality of subcoils that are vertically separated from one another.

23. The optical pickup actuator according to claim 19, further comprising a pair of unipolar magnets disposed opposite each to other with respect to the blade in the second direction and have the same polarity.

24. The optical pickup actuator according to claim 19, further comprising three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

25. The optical pickup actuator according to claim 19, wherein the second coil is positioned vertically on both sides of the blade in the second.

26. An optical disc drive for a disc that is a recording medium, comprising:
a spindle motor for rotating the disc ;
an optical pickup for recording and/or reproducing information by emitting light focuses onto the disc through an objective lens ; and
an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:
a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable,
a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction,
a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction, and
an inner yoke positioned on the base, the inner yoke positioned inside a cavity formed by walls of each of the first coils,
wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.

27. The optical disc drive according to claim 26, wherein each of the first coils is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in the vertical direction.

28. The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises a third coil positioned to surround the sides of the blade.

29. The optical disc drive according to claim 28, wherein the third coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in the vertical direction.

30. The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises a pair of unipolar magnets disposed opposite to each other with respect to the blade in the second direction and have the same polarity.

31. The optical disc drive according to claim 26, wherein the optical pickup actuator further comprises three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

32. An optical pickup actuator for use with an objective lens on a base, comprising:
a blade holding the objective lens;
a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable; and
three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

33. The optical pickup actuator according to claim 32, wherein the stoppers are positioned on the blade.

34. The optical pickup actuator according to claim 32, wherein the stoppers are positioned on the base.

35. An optical disc drive for a disc that is a recording medium, comprising:
a spindle motor for rotating the disc ;
an optical pickup for recording and/or reproducing information by emitting light focused onto the disc through an objective lens ; and
an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:
a blade holding the objective lens;
a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable; and
three stoppers interposed between the blade and the base for preventing the blade from colliding with the base when excessively driven toward the base and arranged in a triangular shape centered on the objective lens.

36. The optical disc drive according to claim 35, wherein the stoppers are positioned on the blade.

37. The optical disc drive according to claim 35, wherein the stoppers are positioned on the base.

38. An optical pickup actuator for use with an objective lens on a base, comprising:
a blade holding the objective lens;
a plurality of suspension wires movingly supporting the blade on the base;
a pair of unipolar magnets positioned on the base; and
a plurality of coils positioned on the blade and interacting with the unipolar magnets to create an electromagnet force to move the blade; and
an inner yoke positioned inside a cavity defined by the walls of a coil, wherein the yoke comprises three sections with each of the three sections of the yoke being parallel to a different wall of the cavity to increase an effective area facing the magnets.

39. The optical pickup actuator according to claim 38, wherein one of the coils is divided into a plurality of subcoils that are separated from one another.

40. The optical pickup actuator according to claim 38, wherein one of the coils is positioned to surround the sides of the blade.

41. The optical pickup actuator according to claim 38, wherein the base has only a single pair of unipolar magnets

42. An optical pickup actuator for use with an objective lens on a base, comprising:
a blade holding the objective lens;
a plurality of suspension wires movingly supporting the blade on the base;
a plurality of hinges each of coupled to an end of a suspension wire;
a pair of unipolar magnets positioned on the base; and
a plurality of coils connected to an electric circuit and interacting with the unipolar magnets to create an electromagnet force to move the blade; and
wherein at least one of the plurality of coils is divided into subcoils and a hinge coupled to each of the plurality of suspension wires is between an adjacent pair of subcoils.

43. The optical pickup actuator according to claim 42, wherein the plurality of suspension wires are at least six suspension wires and the coil is divided into three or more subcoils.

44. The optical pickup actuator according to claim 42, wherein a first hinge and a second hinge are positioned on each of a top and a bottom of one of the coils, respectively, and a third hinge is positioned between two of the subcoils.

45. The optical pickup actuator according to claim 42, wherein the coils are focus and tracking coils and the electric circuit supplies current to the coils in the same direction.

46. The optical pickup actuator according to claim 42, wherein the coils are focus and tracking coils, of which the focus coil also serves as a tilt coil and the electric circuit supplies current separately to each of the coils.

47. The optical pickup actuator according to claim 42, wherein the coils are focus, tracking, and tilt coils and the circuit supplies current to the coils in opposite directions.

ABSTRACT OF DISCLOSURE

An optical pickup actuator and optical disc drive using the same. The optical pickup actuator includes a blade holding an objective lens and supported on a base by a plurality of suspension wires so that it is elastically movable, a magnetic element positioned on the base, and a coil positioned horizontally on the blade to generate electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element. The coil is divided into a plurality of subcoils separated vertically from one another.

—

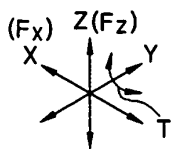


FIG. 2 (PRIOR ART)

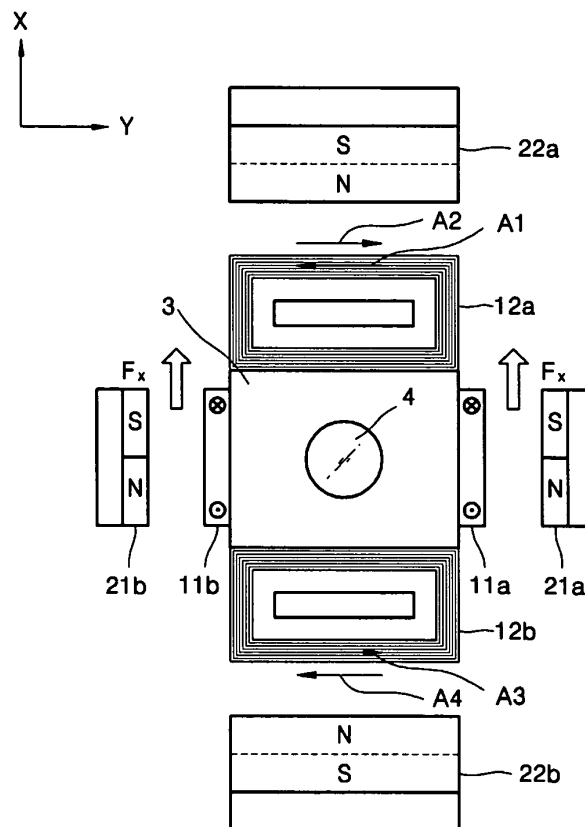


FIG. 5

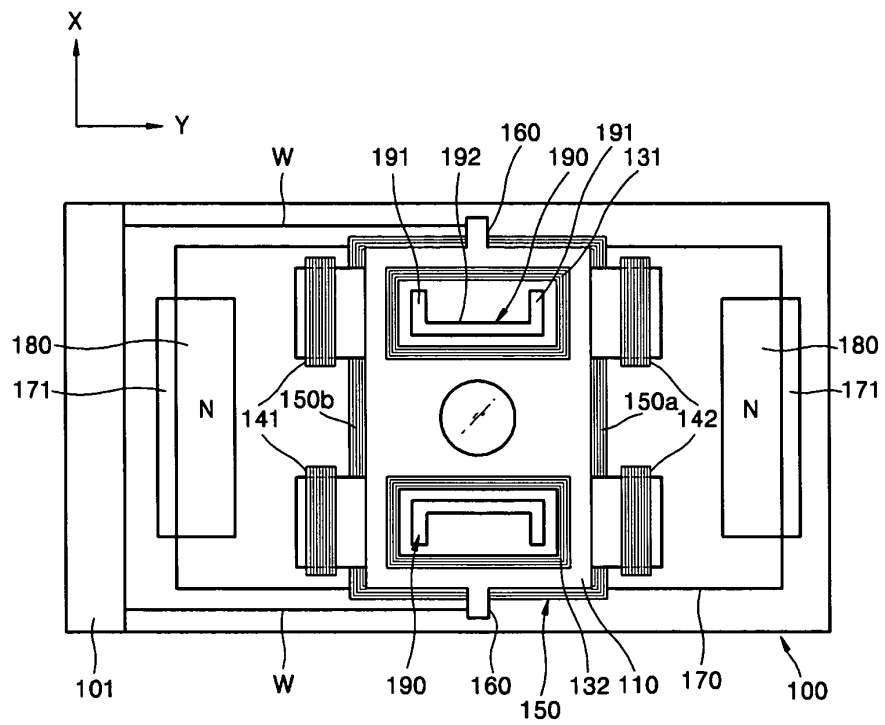


FIG. 6

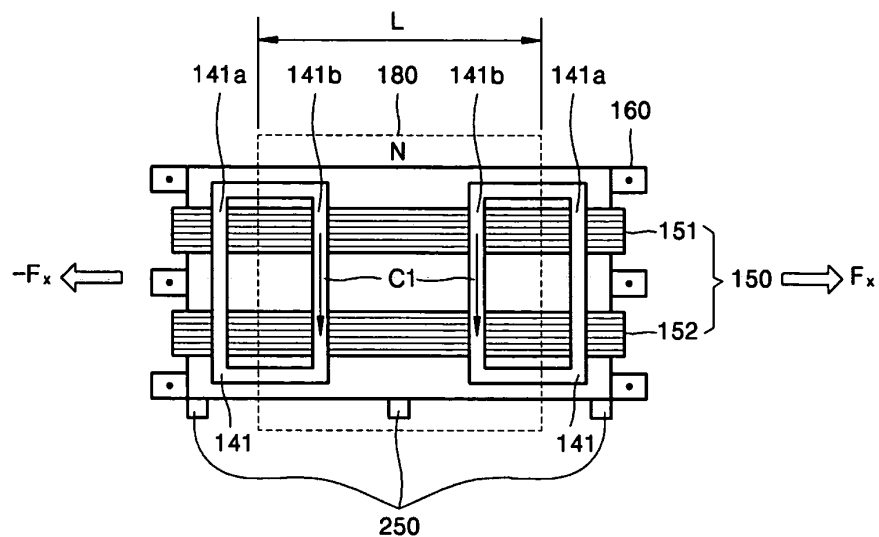
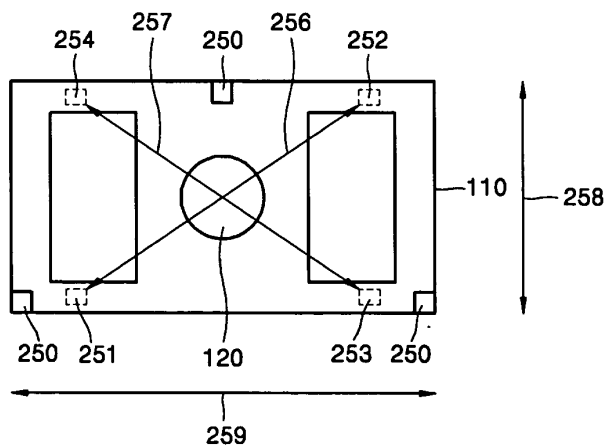
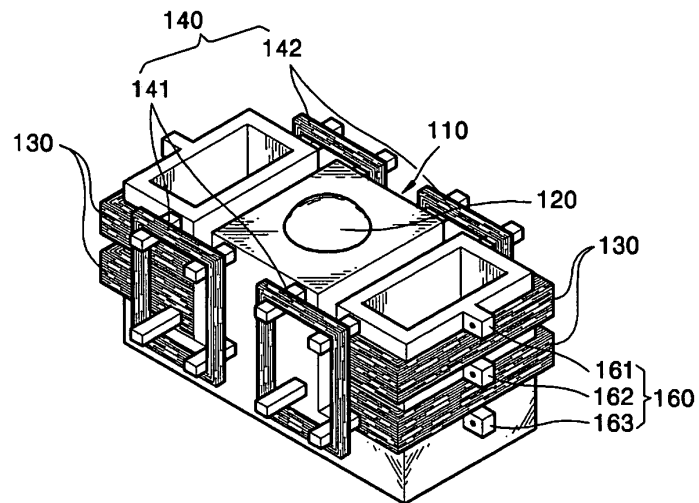


FIG. 7



TITLE: OPTICAL PICKUP ACTUATOR AND
OPTICAL DISK DRIVE ADOPTING
THE SAME AND METHOD
INVENTORS: Won-ik CHO, et al.
SERIAL NO.:
DOCKET NO.: 1793.1290

FIG. 8



COMBINED DECLARATION/POWER OF ATTORNEY FOR UTILITY/DESIGN PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME AND METHOD

the specification of which is attached hereto, unless the following box is checked:

☐ was filed on ___ as United States Application Number or PCT International Application Number ___ and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56.

I hereby claim foreign priority benefit(s) under 35 U.S.C. § 119(a)-(d) or § 365(a)-(c) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority NOT
Claimed

<u>2003-35305</u>	<u>Republic of Korea</u>	<u>2/June/2003</u>	☐
(Number)	(Country)	Day/Month/Year Filed	
 (Number)	 (Country)	 Day/Month/Year Filed	 ☐

I hereby claim the benefit under 35 U.S.C. § 120 or § 119(e) of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application(s) in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application Serial No.)	(Filing Date)	(Status – patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status – patented, pending, abandoned)

I hereby appoint the attorneys and agents of Staas & Halsey LLP under USPTO Customer No. 21,171 to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:



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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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☒ Additional inventors are being named on separately numbered sheets attached hereto.

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COMBINED DECLARATION/POWER OF ATTORNEY FOR UTILITY/DESIGN PATENT APPLICATION

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Won-ik CHO, et al.

Application No.:

Group Art Unit:

Filed: May 20, 2004

Examiner:

For: OPTICAL PICKUP ACTUATOR AND OPTICAL DISK DRIVE ADOPTING THE SAME
AND METHOD

**SUBMISSION OF CERTIFIED COPY OF PRIOR FOREIGN
APPLICATION IN ACCORDANCE
WITH THE REQUIREMENTS OF 37 C.F.R. § 1.55**

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.55, the applicant(s) submit(s) herewith
a certified copy of the following foreign application:

Korean Patent Application No(s). 2003-35305

Filed: June 2, 2003

It is respectfully requested that the applicant(s) be given the benefit of the foreign filing
date(s) as evidenced by the certified papers attached hereto, in accordance with the
requirements of 35 U.S.C. § 119.

Respectfully submitted,

STAAS & HALSEY LLP



Date: May 20, 2004

By: _____

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This is to certify that the following application annexed hereto
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출 원 번 호 : 10-2003-0035305
Application Number

출 원 년 월 일 : 2003년 06월 02일
Date of Application JUN 02, 2003

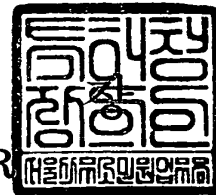
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2004 년 01 월 12 일

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COMMISSIONER



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【수신처】	특허청장
【참조번호】	0009
【제출일자】	2003.06.02
【국제특허분류】	G11B
【발명의 명칭】	광픽업 액츄에이터 및 이를 채용한 광디스크 드라이브
【발명의 영문명칭】	Optical pickup actuator and optical disc drive adopting the same
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【성명의 영문표기】	PARK, No Cheol
【주민등록번호】	631110-1011123
【우편번호】	120-080
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【국적】	KR
【심사청구】	청구
【취지】	특허법 제42조의 규정에 의한 출원, 특허법 제60조의 규정에 의한 출원심사를 청구합니다. 대리인 이영필 (인) 대리인 정상빈 (인)
【수수료】	
【기본출원료】	20 면 29,000 원
【가산출원료】	20 면 20,000 원
【우선권주장료】	0 건 0 원
【심사청구료】	38 항 1,325,000 원
【합계】	1,374,000 원
【첨부서류】	1. 요약서·명세서(도면)_1통

【요약서】**【요약】**

개시된 광디스크 드라이브는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드와, 베이스에 설치되는 자성부재와, 블레이드에 수평방향으로 설치되어 자성부재와의 상호작용에 의해 전자기력을 발생시키는 것으로서 상하 방향으로 상호 이격되도록 다수개로 분할되어 설치된 코일을 포함하는 광픽업 액츄에이터를 구비한다. 이와 같은 구성에 의해 블레이드를 베이스에 대해 탄성적으로 지지하는 서스펜션 와이어의 설치에 있어서의 공간적 제약을 완화할 수 있다.

【대표도】

도 3

【명세서】

【발명의 명칭】

광픽업 액츄에이터 및 이를 채용한 광디스크 드라이브{Optical pickup actuator and optical disc drive adopting the same}

【도면의 간단한 설명】

도 1은 종래의 광픽업 액츄에이터를 도시한 사시도.

도 2는 도 1의 평면도.

도 3은 본 발명에 따른 디스크 드라이브의 일 실시예를 도시한 사시도.

도 4는 본 발명에 따른 광픽업 액츄에이터의 일 실시예를 도시한 분해사시도.

도 5는 도 4의 평면도.

도 6은 제2코일의 작용을 보여주는 수직 단면도.

도 7은 도 4에 도시된 블레이드의 개략적인 배면도.

도 8은 본 발명에 따른 광픽업 액츄에이터의 일 실시예를 도시한 사시도.

<도면의 주요부분에 대한 부호의 설명>

50.....메인프레임

51.....스핀들모터

52.....가이드 샤프트

53.....광픽업

55.....턴테이블

56.....대물렌즈

54,100.....베이스

110,210.....블레이드

120.....대물렌즈

130,230.....제1코일

140.....제2코일	150.....제3코일
160.....힌지부	170.....요크 조립체
180.....마그넷	190.....내측 요크
250.....스토퍼	W.....서스펜션 와이어
X.....트래킹 방향	T.....틸트 방향
Z.....포커싱 방향	

【발명의 상세한 설명】

【발명의 목적】

【발명이 속하는 기술분야 및 그 분야의 종래기술】

- <21> 본 발명은 광디스크 드라이브에 관한 것으로서, 특히 전자기 유도에 의해 코일에 발생되는 로렌츠 힘을 이용하는 광픽업 액츄에이터를 구비하는 광디스크 드라이브에 관한 것이다.
- <22> 일반적으로 광디스크 드라이브는 기록매체인 디스크에 광을 조사하여 정보를 기록하거나 또는 그로부터 정보를 읽어들이어 재생하는 장치로서, 이를 위해 통상 디스크를 회전시키는 스피들모터 및, 그 디스크의 기록면에 광을 조사하며 기록재생작업을 수행하기 위한 광픽업 등을 구비한다.
- <23> 통상적으로 광픽업에는 디스크 기록면의 원하는 트랙에 광의 초점이 잘 맺힐 수 있도록 대물렌즈의 위치를 포커싱 방향과 트래킹 방향으로 제어하는 광픽업 액츄에이터가 구비되어 있다. 이에 의해 대물렌즈와 디스크 기록면 간의 거리를 일정하게 맞춰서 광스폿의 초점을 유지하고 광스폿이 원하는 트랙을 추종하도록 제어한다.
- <24> 도 1은 종래의 광픽업 액츄에이터를 도시한 사시도이며, 도 2는 도 1의 평면도이다.

- <25> 도 1을 보면, 베이스(1)에는 대물렌즈(4)가 탑재된 블레이드(3)가 와이어(6)에 의해 탄력적으로 유동될 수 있도록 설치된다. 블레이드(3)에는 제1코일(11a)(11b)과 제2코일(12a)(12b)이 설치된다. 제1코일(11a)(11b)은 수직방향으로 감긴 것으로서, 대물렌즈(4)를 중심으로 대칭되게 Y 방향으로 설치된다. 제2코일(12a)(12b)은 수평방향으로 감긴 것으로서, 대물렌즈(4)를 중심으로 대칭되게 X 방향으로 설치된다.
- <26> 베이스(1)에는 또한 마그넷(21a)(21b)(22a)(22b)이 설치된다. 마그넷(21a)(21b)은 각각 제1코일(11a)(11b)과 대면되도록 설치되며, 마그넷(22a)(22b)은 각각 제2코일(12a)(12b)와 대면되도록 설치된다.
- <27> 도 1에서, X, Z, T는 각각 트래킹방향, 포커싱 방향, 틸트 방향을 표시한 것이다.
- <28> 먼저, 블레이드(3)를 트래킹 방향(X)으로 구동하는 경우에 대해 설명한다. 제1코일(11a)(11b)에 도 2에 도시된 바와 같이 전류가 공급되면, 마그넷(21a)(21b)과의 상호 작용에 의해 제1코일(11a)(11b)에는 전자기력 F_x 가 유도된다. 제1코일(11a)(11b)에 공급되는 전류의 방향을 도 2에 도시된 것과 반대로 하면, 제1코일(11a)(11b)에는 전자기력 $-F_x$ 가 유도된다. 이와 같이 제1코일(11a)(11b)에 인가되는 전류의 방향을 제어함으로써 블레이드(3)는 트래킹 방향(X)으로 구동된다.
- <29> 다음으로 블레이드(3)를 포커싱 방향(Z)으로 구동하는 경우에 대해 설명한다. 제2코일(12a)(12b)에 각각 A1, A3 방향으로 전류를 공급하면, 마그넷(22a)(22b)과의 상호 작용에 의해 제2코일(12a)(12b)에는 +Z 방향으로 상승하려는 전자기력 F_z 이 유도된다. 또, 제2코일(12a)(12b)에 각각 A2, A4 방향으로 전류를 공급하면, 제2코일(12a)(12b)에는 -Z 방향으로 하강하려는 전자기력 $-F_z$ 가 유도된다. 이와 같이 제2코일마그넷(12a)(12b)과의 상호 작용에 의해

에 A1-A3 또는 A2-A4 방향의 전류를 공급함으로써 블레이드(3)는 포커싱 방향(Z)으로 구동된다.

<30> 대물렌즈(4)를 통하여 출사된 광은 디스크의 기록면에 수직으로 입사되어야만 정확한 초점의 광스폿을 형성할 수 있게 된다. 만일, 광의 입사방향이 틀어지게 되면 디스크에 정확한 광스폿을 형성할 수 없게 되고, 그렇게 되면 데이터의 기록하고 재생하는데 있어서 에러가 발생할 수 있게 된다. 따라서 광스폿이 원하는 트랙상에 정확하게 형성되도록 하기 위해서는 디스크의 기록면에 광이 수직으로 입사되도록 해야 한다. 이와 같이 디스크 기록면에 대한 광의 수직 입사를 조정하는 것을 틸트(tilt) 조정 또는 스큐(skew) 조정이라고도 한다. 보다 정밀한 기록과 재생작업을 위해서는 이러한 틸트도 동적으로 조정할 수 있는 기능이 필요한데, 광픽업 액츄에이터는 틸트 방향의 조정기능을 더 구비할 수 있다.

<31> 이제, 도 1에 도시된 종래의 광픽업 액츄에이터에서 블레이드(3)를 틸트 방향(T)으로 구동하는 경우에 대해 설명한다. 틸트 방향(T)의 구동은 제2코일(12a)(12b)에 각각 반대방향의 전자기력이 유도되도록 함으로써 가능하다. 제2코일(12a)(12b)에 각각 A1, A4 방향으로 전류를 공급한다. 그러면, 제2코일(12a)에는 상승하려는 전자기력 F_z 가 유도되고, 제2코일(12b)에는 하강하려는 전자기력 $-F_z$ 가 유도된다. 또, 제2코일(12a)(12b)에 각각 A2, A3 방향으로 전류를 공급하면, 제2코일(12a)에는 하강하려는 전자기력 $-F_z$ 가 유도되고, 제2코일(12b)에는 상승하려는 전자기력 F_z 가 유도된다. 이와 같이, 제2코일(12a)(12b)에 A1-A4 또는 A2-A3 방향의 전류를 공급함으로써 블레이드(3)는 틸트 방향(T)으로 구동된다.

<32> 와이어(6)는 블레이드(3)를 베이스(1)에 탄력적으로 지지되도록 하는 동시에 제1코일(11a)(11b)과 제2코일(12a)(12b)에 전류를 공급하기 위한 통로의 역할을 한다. 도 1을 보면, 4개의 와이어(6)가 도시되어 있고, 블레이드(3)에는 와이어(6)과 연결되는 힌지(7)가 마련된다.

4개의 와이어(6)는 한 쌍씩 짝을 이루어 각각 제1코일(11a)(11b)과 제2코일(12a)(12b)에 전류를 공급한다. 이는 포커싱 방향(Z)과 트래킹 방향(X)의 구동만을 하도록 구성된 것이다. 상술한 바와 같이 틸트 방향(T)의 구동을 겸하기 위해서는 제2코일(12a)(12b)에 공급되는 전류의 방향이 각각 달라야 하므로 제2코일(12a)(12b)에 각각 전류를 공급하여야 한다. 따라서, 도면에 도시되지는 않았지만 한 쌍의 와이어가 더 필요하다. 물론, 틸트 방향(T)의 구동을 위해 제3코일(미도시)을 블레이드(3)에 더 설치할 수도 있으나, 이 경우에도 한 쌍의 와이어가 더 필요한 것은 마찬가지이다.

<33> 와이어(6)는 블레이드(3)를 지지함에 있어서 블레이드(3)의 무게 중심을 고려하여야 한다. 따라서, 블레이드(3)에 마련되는 힌지(7)는 그 위치의 선정이 매우 중요하다. 도 1에 도시된 바와 같이 포커싱 방향(Z) 및 트래킹 방향(X)의 구동만을 하는 경우에는 4개의 와이어(6)만 있으면 되므로 블레이드(3)의 상하면에 각각 두 개씩의 힌지(7)를 마련할 수 있다. 하지만, 틸트 방향(T)의 구동까지 겸하는 경우에는 두 개의 와이어가 더 필요한데, 도 1에 도시된 바와 같은 종래의 광픽업 액츄에이터에 있어서는 코일(11a)(11b)(12a)(12b)이 블레이드(3)의 네 측면에 설치되어 있어서 추가되는 와이어가 접속될 두 개의 힌지를 더 마련하는 것이 쉽지 않다.

<34> 상술한 바와 같은 종래의 광픽업 액츄에이터는 블레이드(3) 주위의 4방향에 마그넷(21a)(21b)(22a)(22b)이 설치된다. 특히, 포커싱 방향(Z)과 틸트 방향(T)의 구동을 위한 마그넷(22a)(22b)은 트래킹 방향(X) 즉, 광픽업 액츄에이터를 구비하는 광디스크 드라이브에 있어서 디스크(미도시)의 반경방향으로 설치된다. 이 경우에, 광픽업 액츄에이터를 설계함에 있어서 디스크를 회전시키기 위한 스피들모터(미도시)와 간섭을 피해야 한다는 제약을 받는다. 또한, 디스크 드라이브가 슬림화되고 있는 최근의 추세에 비추어 광픽업 액츄에이터도 부품의 수

를 줄이는 등 더욱 소형 경량화가 요구된다. 또한, 광기록 밀도의 증가에 따라 특히 트래킹 방향과 틸트 방향의 구동 감도의 향상이 요구된다.

【발명이 이루고자 하는 기술적 과제】

<35> 본 발명은 상기한 문제점과 필요성을 감안하여 창출된 것으로서, 코일과 마그네틱 배치를 최적화함으로써 소형 경량화가 가능한 광픽업 액츄에이터 및 이를 채용한 광디스크 드라이브를 제공하는 데 그 목적이 있다. 또한, 코일 내부에 삽입되는 내측 요크의 형상을 개선함으로써 포커싱 방향과 트래킹 방향과 틸트 방향의 감도가 향상된 광픽업 액츄에이터 및 이를 채용한 광디스크 드라이브를 제공한다. 또한, 하나의 코일을 다수 개로 분리함으로써 블레이드를 베이스에 대해 탄성적으로 지지하는 와이어의 설치에 있어서의 공간적 제약을 완화할 수 있도록 개선된 광픽업 액츄에이터 및 이를 채용한 광디스크 드라이브를 제공한다. 또한, 문제점으로서 언급되지는 않았지만 블레이드가 베이스와 충돌되는 것을 방지하기 위한 스토퍼의 배치가 최적화된 광픽업 액츄에이터를 제공한다.

【발명의 구성 및 작용】

<36> 상술한 목적을 달성하기 위한 본 발명의 일 특징에 따른 광픽업 액츄에이터는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 베이스에 설치되는 자성부재; 상기 블레이드에 수평방향으로 설치되어 상기 자성부재와의 상호작용에 의해 전자기력을 발생시키는 코일을 포함하며, 상기 코일은 상하 방향으로 상호 이격되도록 다수개로 분할되어 설치된다.

<37> 또한, 상술한 목적을 달성하기 위한 본 발명의 광디스크 드라이브는, 기록매체인 디스크를 회전시키는 스핀들모터와, 대물렌즈를 통해 상기 디스크에 광을 조사하여 정보를 기록하거

나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조사되도록 상기 대물렌즈의 위치를 제어하는 광픽업 액추에이터를 포함하는 광디스크 드라이브로서, 상기 광픽업 액추에이터는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 베이스에 설치되는 자성부재; 상기 블레이드에 수평방향으로 설치되어 상기 자성부재와의 상호작용에 의해 전자기력을 발생시키는 코일을 포함하며, 상기 코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 것을 특징으로 한다.

<38> 상기 코일은 상기 블레이드에 상기 대물렌즈를 중심으로 마주보게 제1방향으로 설치되는 적어도 한 쌍의 제1코일을 포함할 수 있다. 상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에는 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일이 수직방향으로 설치될 수 있다. 이와 같은 구성에 의해, 상기 제1코일은 포커싱 방향의 구동 또는 포커싱 방향과 틸트 방향의 구동을 위해 사용되고 상기 제2코일은 트래킹 방향의 구동을 위해 사용되는 일 실시예를 구현할 수 있다. 이 때, 상기 베이스에는 상기 제1코일의 내측에 위치되는 내측 요크가 더 구비될 수 있으며, 상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것이 바람직하다. 또한, 상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷을 포함할 수 있다.

<39> 상기 코일은 상기 블레이드의 측면을 둘러싸도록 마련되는 제3코일을 포함할 수 있다. 상기 블레이드에는 상기 대물렌즈를 중심으로 마주보게 제1방향으로 위치되는 적어도 한 쌍의 제1코일이 수평방향으로 더 설치될 수 있으며, 상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에는 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일이 수직방향으로 더

설치될 수 있다. 이와 같은 구성에 의해, 상기 제1코일은 틸트 방향, 제2코일은 트래킹 방향, 제3코일은 포커싱 방향의 구동을 위해 사용되는 일 실시예를 구현할 수 있다. 이 때, 상기 베이스에는 상기 제1코일의 내측에 위치되는 내측 요크가 더 구비될 수 있으며, 상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것이 바람직하다. 상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷을 포함할 수 있다.

<40> 상기 블레이드 또는 상기 베이스에는, 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼가 더 구비될 수 있다.

<41> 본 발명의 다른 특징에 따른 광픽업 액츄에이터는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향으로 위치되는 적어도 한 쌍의 제1코일; 상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일; 상기 베이스에 설치되며 상기 각 제1코일의 내측에 위치되는 적어도 한 쌍의 내측 요크;를 포함하며, 상기 각 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함한다.

<42> 또한, 본 발명의 다른 특징에 따른 광디스크 드라이브는, 기록매체인 디스크를 회전시키는 스핀들모터와, 대물렌즈를 통해 상기 디스크에 광을 조사하여 정보를 기록하거나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조사되도록 상기 대물렌즈의 위치를 제

어하는 광픽업 액츄에이터를 포함하는 광디스크 드라이브로서, 상기 광픽업 액츄에이터는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향으로 위치되는 적어도 한 쌍의 제1코일; 상기 블레이드의 상기 제1방향에 수직인 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일; 상기 베이스에 설치되며 상기 각 제1코일의 내측에 위치되는 적어도 한 쌍의 내측 요크;를 포함하며, 상기 각 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것을 특징으로 한다.

<43> 상기 각 제1코일은 상하 방향으로 상호 이격되도록 다수개로 분할될 수 있다. 이와 같은 구성에 의해 상기 제1코일은 포커싱 방향 또는 포커싱 방향과 틸트 방향, 상기 제2코일은 트래킹 방향의 구동을 위해 사용되는 일 실시예가 구현될 수 있다.

<44> 상기 블레이드의 외측을 에워싸며 수평방향으로 설치되는 제3코일;을 더 포함할 수 있으며, 상기 제3코일은 상하 방향으로 상호 이격되도록 다수개로 분할될 수 있다. 이와 같은 구성에 의해 상기 제1코일은 틸트 방향, 상기 제2코일은 트래킹 방향, 상기 제3코일은 포커싱 방향의 구동을 위해 사용되는 일 실시예가 구현될 수 있다.

<45> 상기 코일들과의 상호 작용에 의해 전자기력을 상기 코일들에 전자기력이 유도되도록 하는 자성부재로서는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷이 구비될 수 있다.

<46> 상기 블레이드 또는 상기 베이스에는, 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼가 더 구비될 수 있다.

<47> 본 발명의 다른 특징에 따른 광픽업 액츄에이터는, 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 포함한다.

<48> 본 발명의 다른 특징에 따른 광디스크 드라이브는, 기록매체인 디스크를 회전시키는 스피indle모터와, 대물렌즈를 통해 상기 디스크에 광을 조사하여 정보를 기록하거나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조사되도록 상기 대물렌즈의 위치를 제어하는 광픽업 액츄에이터를 포함하는 광디스크 드라이브로서, 상기 광픽업 액츄에이터는, 상기 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드; 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 포함하는 것을 특징으로 한다.

<49> 상기 스톱퍼는 상기 블레이드에 마련될 수 있으며, 상기 베이스에 마련될 수도 있다.

<50> 이하 첨부한 도면을 참조하면서 본 발명의 바람직한 실시예를 상세히 설명하기로 한다. -

<51> 도 3은 본 발명에 따른 디스크 드라이브의 일 실시예를 도시한 사시도이다.

- <52> 도 3을 보면, 메인프레임(50)에 스피들모터(51)와 광픽업(53)을 탑재한 베이스(54)가 설치된다. 베이스(54)는 예를 들면 도 3에 도시된 바와 같이 메인 프레임(50)에 디스크(D)의 반경방향으로 설치된 한 쌍의 가이드 샤프트(52)에 의해 슬라이딩될 수 있도록 지지된다.
- <53> 스피들모터(51)는 디스크(D)를 회전시키는 것으로서, 스피들모터(51)의 회전축에는 디스크(D)가 안착되는 턴테이블(55)이 결합되어 있다. 광픽업(53)은 대물렌즈(56)를 통하여 디스크(D)에 광을 조사하여 디스크(D)에 정보를 기록하거나 디스크(D)에 수록된 정보를 재생시키는 것으로서, 베이스(54)에 탑재되어 가이드 샤프트(52)를 따라 디스크(D)의 반경방향으로 왕복이동된다.
- <54> 디스크(D)상의 원하는 위치에 광이 정확히 입사되도록 하기 위해 대물렌즈(56)는 적어도 포커싱 방향(Z)과 트래킹 방향(X)으로 구동될 필요가 있으며, 경우에 따라서는 틸트 방향(T)으로도 구동될 필요가 있다. 이를 위해, 광디스크 드라이브에는 대물렌즈(56)를 구동하기 위한 장치가 구비되는데, 이를 광픽업 액츄에이터라 한다. 도 3에는 상세히 도시되지 않았지만, 이하에서 광픽업 액츄에이터에 대해 그 실시예들을 설명한다.
- <55> 도 4는 도 3에 도시된 광디스크 드라이브의 일 실시예에 채용된 광픽업 액츄에이터의 일 실시예를 도시한 분해사시도이며, 도 5는 도 4의 평면도이다.
- <56> 도 4와 도 5를 보면, 베이스(100), 대물렌즈(120)가 탑재된 블레이드(110)가 도시되어 있다.
- <57> 베이스(100)에는 외측 요크(171)와 내측 요크(190) 및 자기력을 제공하는 자성부재로서 한 쌍의 마그넷(180)이 구비된다. 본 실시예에서는 외측 요크(171)와 내측 요크(190)가 일체로 형성된 요크 조립체(170)를 채용한다.

- <58> 본 실시예의 마그넷(180)은 Y 방향(제2방향)으로 서로 대면되게 위치되고, N극으로 단극 착자되어 있다. 마그넷(180)은 S극으로 단극 착자될 수도 있다. Y 방향(제2방향)으로 설치된 한 쌍의 마그넷(180) 만을 사용함으로써 디스크를 회전시키기 위한 스핀들모터(51)와 간섭위험을 줄일 수 있다. 또한, 광픽업 액츄에이터의 구성품의 수를 줄일 수 있다.
- <59> 블레이드(110)에는 제1코일(130)과 제2코일(140) 및 제3코일(150)이 마련된다.
- <60> 제1코일(130)은 수평방향으로 감긴 것으로서, 대물렌즈(120)를 중심으로 대칭되게 X 방향(제1방향)으로 배치된 한 쌍의 코일(131)(132)을 포함한다.
- <61> 제2코일(140)은 마그넷(180)과의 상호 작용에 의해 트래킹 방향(X)의 전자기력을 발생시키기 위한 것으로서, 블레이드(110)의 Y 방향(제2방향), 즉 마그넷(180)과 대면되는 방향의 두 측면(113)(114) 중 적어도 어느 한 측면에 설치되면 된다. 본 실시예의 제2코일(140)은 수직 방향으로 감긴 것으로서, 두 측면(113)(114)에 대물렌즈(120)를 중심으로 대칭되게 각각 한 쌍씩 설치된 코일(141)과 코일(142)를 포함한다.
- <62> 제3코일(150)은 수평방향으로 감긴 것으로서, 블레이드(110)의 외측을 에워싸도록 설치된다. 제3코일(150)은 상하 방향으로 다수개로 분리될 수 있다. 도 3을 보면, 제3코일(150)은 코일(151)과 코일(152)로 분리되어 있고, 두 코일(151)(152)은 상하 방향으로 서로 이격되어 있다. 제3코일(150)을 분리하는 이유는 후술하겠지만 힌지부(160)의 설치위치를 결정함에 있어서 자유도를 부여하기 위한 것이다.
- <63> 베이스(100)에는 홀더(101)가 마련된다. 블레이드(110)에는 다수의 힌지부(160)가 마련된다. 블레이드(110)는 내측 요크(190)가 제1코일(130)의 내측에 삽입되도록 설치된다. 다수의

서스펜션 와이어(W)의 일단이 홀더(101)에 연결되고 타단이 힌지부(160)에 연결됨으로써, 블레이드(110)는 베이스(100)에 대해 탄력적으로 유동 가능하게 지지된다.

<64> 광픽업 액츄에이터는 (a) 포커스 코일과 트래킹 코일을 구비하는 경우와, (b)포커스 코일과 트래킹 코일을 구비하고 포커스 코일이 틸트 코일의 역할을 겸하는 경우와, (c) 포커스 코일과 트래킹 코일과 틸트 코일을 각각 구비하는 경우가 있다. 도 3에 도시된 실시예에서 제3코일(150)이 구비되는지 여부와 제1코일(130)이 포커스 코일의 기능만을 할 것인지 또는 틸트 코일의 기능을 겸할 것인지 여부에 따라 상술한 (a), (b), (c) 방식의 광픽업 액츄에이터를 구현할 수 있다.

<65> 제1코일(130)에는 Z 또는 -Z 방향의 전자기력이 유도된다. 제1코일(130)과 관련된 전자 회로는 상술한 (a), (b), (c) 방식의 광픽업 액츄에이터의 경우에 각각 다르게 구성된다. (a)방식의 광픽업 액츄에이터의 경우에는 제3코일(150)이 구비되지 않고 제1코일(130)이 포커스 코일로서 이용되므로 각 코일(131)(132)에 같은 방향으로 전류가 공급될 수 있도록 전자기 회로가 구성된다. (b)방식의 광픽업 액츄에이터의 경우에는 제3코일(150)이 구비되지 않고 제1코일(130)이 포커스 코일 및 틸트 코일로서 이용되므로 각 코일(131)(132)에 같은 방향과 반대 방향의 전류가 각각 공급될 수 있도록 전자기 회로가 구성되어야 한다. 또 (c)방식의 광픽업 액츄에이터의 경우에는 제1코일(130)이 틸트 코일로서만 이용되므로 각 코일(131)(132)에 서로 반대 방향의 전류가 공급될 수 있도록 전자기 회로가 구성되어야 한다. 제1코일(130)의 각 코일(131)(132)에서 전자기력을 유도하기 위해 유효하게 사용되는 부분은 마그넷(180)과 대면되는 변(131a)(132a)이다.

<66> 도 6을 참조하면, 제2코일(140)은 상하방향의 두 변(141a)(141b) 중에서 안쪽에 있는 변(141b)이 전자기력을 발생시키기 위한 유효한 부분으로서 사용된다. 따라서, 마그넷(180)의 폭

(L)은 변(141a)에는 자기력이 미치지 않도록 결정된다. 제2코일(140)에 화살표시 C1과 같이 전류가 흐르면, 제2코일(140)에는 전자기력 F_x 가 유도된다. 제2코일(140)에 흐르는 전류의 방향을 반대로 하면, 제2코일(140)에는 전자기력 $-F_x$ 가 유도된다. 따라서, 제2코일(140)에 공급되는 전류의 방향을 제어함으로써 블레이드(110)는 트래킹 방향(X)으로 구동된다.

<67> 제3코일(150)은 마그넷(180)과 대면된 두 변(150a)(150b)(도 5 참조)이 포커싱 방향(Z)의 구동을 위해 사용된다. 제3코일(150)에 흐르는 전류의 방향을 제어함으로써 제3코일(150)에는 포커싱 방향(Z)의 전자기력 F_z 또는 $-F_z$ 가 유도된다.

<68> 내측 요크(190)는 외측 요크(171)와 대면되어 자로를 형성시킨다. 내측 요크(190)은 한 쌍의 제1벽(191)과 제2벽(192)을 구비한다. 한 쌍의 제1벽(191)은 제2코일(140)과 대면되도록 형성되며, Y 방향(제2방향)으로 상호 이격되어 있다. 제2벽(192)은 Y 방향(제2방향)으로 연장되어 있다. 제2벽(192)은 한 쌍의 제1벽(191)과 연결되는 것이 바람직하다.

<69> 이제, 본 발명에 따른 광픽업 액츄에이터의 일 특징인 내측 요크(190)의 작용효과를 설명한다.

<70> 제2코일(140)의 한 쪽 변(141b) 만이 트래킹 방향(X)의 구동을 위해서는 사용되므로 트래킹 감도가 약화될 소지가 있다. 물론 제2코일(140)의 감김량을 많이 하면 트래킹 감도가 향상되지만 이 경우에는 광픽업 액츄에이터의 무게가 증가되는 단점이 있다. 따라서, 주어진 감김량에 대해 최대한의 트래킹 감도를 얻기 위해 마그넷(180)에 의해 발생된 자기장을 최대한 제2코일(140)로 집중시킬 필요가 있다. 이를 위해, 한 쌍의 제1벽(191)을 구비하는 내측 요크(190)를 사용함으로써 제2벽(192)만이 구비된 내측 요크에 비해 마그넷(180)과 대면되는 유효면적을 증가시킨다. 이와 같이 제1벽(191)을 구비한 내측 요크(190)를 사용함으로써 트래킹 감도를 향상시킬 수 있다. 또한, 제1벽(191)과 외측 요크(171) 사이에 형성되는 자로

가 제1코일(130)에도 영향을 미치므로 제1코일(130)의 감도도 향상된다. 따라서, (a)방식의 광픽업 액츄에이터에서는 제1코일(130)이 포커스 코일로서 사용되므로 포커싱 감도도 향상시킬 수 있다. (b)방식의 광픽업 액츄에이터에서는 제1코일(130)이 포커스 코일과 틸트 코일로서의 기능을 겸하므로 포커싱 감도와 틸트 감도를 향상시킬 수 있다. 또 (c)방식의 광픽업 액츄에이터에서는 제1코일(130)이 틸트 코일로서 틸트 코일로서 사용되므로 틸트 감도를 향상시킬 수 있다.

<71> 표 1과 표2는 (c)방식의 광픽업 액츄에이터에서 제2벽(192) 만을 구비한 내측 요크(미도시)를 사용하는 경우(CASE 1)와 제1벽(191)과 제2벽(192)이 구비된 내측 요크(190)를 사용하는 경우(CASE 2)에 각 코일(130)(140)(150)에 유도되는 전자기력의 크기를 측정한 자료이다. 여기서, 각 코일(130)(140)(150)에 공급된 전류는 150mA이며, F_x , F_y , F_z 의 단위는 N/V(Newton/Volt)이다.

<72> 【표 1】

CASE 1	전자기력		
	F_x	F_y	F_z
제1코일(틸트코일)	0.00325	- 0.00003	0.03387
제2코일(트래킹 코일)	0.03594	0.00012	- 0.00003
제3코일(포커스 코일)	- 0.00006	0.00009	0.07178

<73> 【표 2】

CASE 2	전자기력		
	F_x	F_y	F_z
제1코일(틸트코일)	0.00358	- 0.00015	0.04478
제2코일(트래킹 코일)	0.05677	0.00004	- 0.00006
제3코일(포커스 코일)	- 0.00004	0.00003	0.07170

<74> 표 1과 표 2를 보면, 제3코일(150)에 유도되는 포커싱 방향(Z)의 전자기력 F_z 는 두 경우(CASE 1, CASE 2)에 거의 동일하다. 제1코일(130)과 제2코일(140)에

각각 유도되는 틸트 방향(T)과 트래킹 방향(X)의 전자기력 F_z 와 F_x 는 CASE 2가 CASE 1에 비해 각각 약 32% 와 58% 증가된 것을 알 수 있다. 다시 말하면, 제1벽(191)이 구비된 내측 요크(190)를 채용함으로써 트래킹 방향(X)과 틸트 방향(T)의 감도를 획기적으로 향상시킬 수 있다. 이와 같은 실험결과는 (a)와 (b)방식의 광픽업 액츄에이터에도 그대로 적용될 수 있다.

<75> 다음으로 본 발명에 따른 광픽업 액츄에이터의 다른 일 특징인 제3코일(150)의 작용효과에 대해 설명한다.

<76> 블레이드(110)는 다수의 서스펜션 와이어(W)에 의해 베이스(100)에 탄력적으로 유동될 수 있도록 지지된다. 블레이드(110)가 마그네틱(180)과 전류가 흐르는 코일들(130)(140)(150)과의 상호 작용에 의해 발생된 전자기력에 의해 요망되는 방향으로 정밀하게 구동되기 위해서는 서스펜션 와이어(W)의 일단부가 각각 연결되는 힌지부(160)의 위치결정이 매우 중요하다. 힌지부(160)의 위치 선정이 적절하지 않으면 블레이드(110)에 롤링(rolling), 요잉(yawing), 피칭(pitching)이 발생되어 블레이드(110)의 정밀한 구동을 방해하게 된다.

<77> 힌지부(160)의 위치는 대물렌즈(120), 코일(130)(140)(150) 등의 제반 요소들이 모두 탑재된 상태에서 블레이드(110)의 무게중심의 위치를 고려하여 결정된다. 근래에 광기록기기의 소형 경량화 및 고기록밀도화 추세에 따라 블레이드(110)의 크기가 소형 경량화되는 반면에 광픽업 액츄에이터에 요구되는 정밀도는 더욱 높아졌다. 따라서, 블레이드(110)에 힌지부(160)를 형성할 수 있는 공간은 더욱 줄어들게 되었고, 또한 광픽업 액츄에이터가 틸트 구동까지 겸하는 경우에는 최소 6개의 서스펜션 와이어(W)가 필요하게 되어 힌지부(160)를 설치할 수 있는 자유도는 더욱 감소되었다.

<78> 본 실시예에서는 이러한 경향에 대응할 수 있도록 제3코일(150)을 2단으로 분리하고 있다. 힌지부(160)의 설치 위치의 일 예로서, 도 3에 도시된 바와 같이 블레이드(110)의 X 방향(

제1방향)의 두 측면에 각각 세 개씩의 힌지(161)(162)(163)가 설치될 수 있다. 이 때, 두 개의 힌지(161)(163)는 제3코일(150)의 상하측에 각각 설치되고 한 개의 힌지(162)는 분할된 코일(151)(152) 사이에 설치될 수 있다. 제3코일(150)을 몇 개로 또 어느 위치에서 분할할 것인지는 블레이드(110)의 무게 중심을 고려한 힌지부(160)의 설치위치에 따라 적절히 결정될 수 있다. 본 실시예에서는 2단으로 분리된 경우에 대해 예로서 설명하고 있으나, 본 발명의 범위는 이에 한정되지 않으며 제반 여건에 따라 3단 또는 그 이상으로 분할될 수도 있다. 이와 같이, 제3코일(150)을 다수 개로 분할함으로써 블레이드(110)가 베이스(100)에 대해 최적의 상태로 지지될 수 있도록 힌지부(160)의 위치를 결정할 수 있다. 또한, 제3코일(150)의 감김량의 변화는 최소화할 수 있으므로 양호한 포커싱 감도를 유지할 수 있다.

<79> 이상에서는 제1 내지 제3코일(130)(140)(150)을 구비하는 경우, 즉 (c) 방식의 광픽업 액츄에이터에서 포커스 코일인 제3코일(150)을 다수개로 분할한 경우에 대해 설명하였으나, 본 발명의 범위가 이에 한정되는 것은 아니다. (a), (b)방식의 광픽업 액츄에이터에서 도 8에 도시된 바와 같이 제1코일(230)이 블레이드(210)의 측면으로 노출되도록 마련될 수도 있다. 이 경우에는 힌지부(160)의 설치가 용이하도록 제1코일(230)을 상하 방향으로 다수 개로 분할 수도 있다.

<80> 추가적으로, 블레이드(110)가 포커싱 방향으로 구동될 때, 구동거리를 제한할 필요가 있다. 왜냐하면, 포커싱 방향의 구동거리가 과도할 경우에는 블레이드(110)가 베이스(100)나 요크 조립체(170)와 충돌할 수 있기 때문이다. 이 경우에는 베이스(100)에 탑재된 렌즈들(미도시)을 비롯한 각종 광학 부품들을 손상시킬 수 있을 뿐 아니라 대물렌즈(120)가 손상될 수도 있다.

<81> 종래의 광픽업 액츄에이터의 경우에 도 7에서 점선으로 도시한 바와 같이 스톱퍼 251과 252 또는 253과 254를 구비하는 경우가 있다. 블레이드(110)는 정확히 포커싱 방향(Z)으로만 하강되는 것이 이상적이거나, 실제로는 여러 가지 요인에 의해 258, 259 방향은 물론 256, 257 방향으로 기울어져서 하강될 수도 있다. 이와 같은 블레이드(110)의 기울어짐을 고려할 때, 스톱퍼 251과 252를 구비하는 경우에는 블레이드(110)가 대각선 257 방향으로 기울어지는 경우에 대비할 수 없으며, 반대로 스톱퍼 253과 254를 구비하는 경우에는 블레이드(110)가 대각선 256 방향으로 기울어지는 경우에 대비할 수 없다. 이와 같은 문제점을 해결하기 위해 스톱퍼 251 내지 254를 모두 구비하는 경우를 상정할 수 있다. 하지만, 블레이드(110)가 256, 257 방향으로 동시에 기울어지는 경우는 상정할 수 없으므로 스톱퍼 251 내지 254를 모두 구비하는 것은 광픽업 액츄에이터의 설계에 있어서 과도한 제한(constrain)을 가하는 것이다.

<82> 본 실시예에 따른 블레이드(110)에는 도 7에 도시된 바와 같이 대물렌즈(120)를 중심으로 하여 3개의 스톱퍼(250)가 마련된다. 이와 같은 구성에 의하면, 블레이드(110)가 256 내지 259 방향 중 어느 방향으로 기울어져서 하강하더라도 모두 대응할 수 있다. 스톱퍼(250)는 베이스(100) 또는 요크 조립체(170)에 마련될 수도 있다.

【발명의 효과】

<83> 상술한 바와 같이 본 발명에 따른 광픽업 액츄에이터에 의하면, 다음과 같은 효과를 얻을 수 있다.

<84> 첫째, 코일을 다수 개로 분리함으로써 블레이드에 서스펜션 와이어와 연결되는 힌지부를 설치함에 있어서 자유도를 확보할 수 있다. 따라서, 베이스에 대해 블레이드의 안정적인 지지가 가능하다.

- <85> 둘째, 마그넷과 대면되는 유효 면적을 최대화할 수 있는 내측 요크를 구비함으로써 블레이드의 구동에 있어서 감도를 향상시킬 수 있다.
- <86> 셋째, 단극 착자된 한 쌍의 마그넷만을 구비함으로써 광픽업 액츄에이터의 소형 경량화를 구현할 수 있으며, 스핀들모터와의 간섭위험을 줄일 수 있다.
- <87> 넷째, 3개의 스토퍼를 구비함으로써 블레이드의 포커싱 방향으로의 과도한 구동에 가장 안정적으로 대응할 수 있다.
- <88> 본 발명은 상기에 설명되고 도면에 예시된 것에 의해 한정되는 것은 아니며, 다음에 기재되는 청구의 범위 내에서 더 많은 변형 및 변용예가 가능한 것임은 물론이다.

【특허청구범위】**【청구항 1】**

대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드;

상기 베이스에 설치되는 자성부재;

상기 블레이드에 수평방향으로 설치되어 상기 자성부재와의 상호작용에 의해 전자기력을 발생시키는 코일을 포함하며,

상기 코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 광픽업 액츄에이터.

【청구항 2】

제1항에 있어서,

상기 코일은, 상기 블레이드에 상기 대물렌즈를 중심으로 마주보게 제1방향으로 설치되는 적어도 한 쌍의 제1코일을 포함하는 광픽업 액츄에이터.

【청구항 3】

제2항에 있어서,

상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일을 더 구비하는 광픽업 액츄에이터.

【청구항 4】

제3항에 있어서,

상기 베이스에 설치되며 상기 제1코일의 내측에 위치되는 내측 요크;를 더 구비하며,
 상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1
 벽과 상기 제2방향으로 형성된 제2벽을 포함하는 광픽업 액츄에이터.

【청구항 5】

제2항 내지 제4항 중 어느 한 항에 있어서,
 상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은
 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 포함하는 광픽업 액츄에이터.

【청구항 6】

제1항에 있어서,
 상기 코일은 상기 블레이드의 측면을 둘러싸도록 마련되는 제3코일을 포함하는 광픽업
 액츄에이터.

【청구항 7】

제6항에 있어서,
 상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향
 으로 위치되는 적어도 한 쌍의 제1코일;
 상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에
 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일
 ;을 더 구비하는 광픽업 액츄에이터.

【청구항 8】

제7항에 있어서,

상기 베이스에 설치되며 상기 제1코일의 내측에 위치되는 내측 요크;를 더 구비하며,
 상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1
 벽과 상기 제2방향으로 형성된 제2벽을 포함하는 광픽업 액츄에이터.

【청구항 9】

제6항 내지 제8항 중 어느 한 항에 있어서,
 상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은
 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 포함하는 광픽업 액츄에이터.

【청구항 10】

제1항에 있어서,
 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도
 하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는
 3개의 스톱퍼;를 더 구비하는 광픽업 액츄에이터.

【청구항 11】

기록매체인 디스크를 회전시키는 스피들모터와, 대물렌즈를 통해 상기 디스크에 광을 조
 사하여 정보를 기록하거나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조
 사되도록 상기 대물렌즈의 위치를 제어하는 광픽업 액츄에이터를 포함하는 광디스크 드라이브
 에 있어서, 상기 광픽업 액츄에이터는,

상기 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될
 수 있게 지지된 블레이드;

상기 베이스에 설치되는 자성부재;

상기 블레이드에 수평방향으로 설치되어 상기 자성부재와의 상호작용에 의해 전자기력을 발생시키는 코일을 포함하며,

상기 코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 것을 특징으로 하는 광디스크 드라이브.

【청구항 12】

제11항에 있어서,

상기 코일은, 상기 블레이드에 상기 대물렌즈를 중심으로 마주보게 제1방향으로 설치되는 적어도 한 쌍의 제1코일을 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 13】

제12항에 있어서,

상기 광픽업 액츄에이터는, 상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일을 더 구비하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 14】

제13항에 있어서,

상기 광픽업 액츄에이터는,

상기 베이스에 설치되며 상기 제1코일의 내측에 위치되는 내측 요크를 더 구비하며,

상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 15】

제12항 내지 제14항 중 어느 한 항에 있어서,

상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 16】

제11항에 있어서,

상기 코일은 상기 블레이드의 측면을 둘러싸도록 마련되는 제3코일을 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 17】

제16항에 있어서,

상기 광픽업 액츄에이터는,

상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향으로 위치되는 적어도 한 쌍의 제1코일;

상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일;을 더 구비하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 18】

제17항에 있어서,

상기 광픽업 액츄에이터는,

상기 베이스에 설치되며 상기 제1코일의 내측에 위치되는 내측 요크;를 더 구비하며,
 상기 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1
 벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 19】

제16항 내지 제18항 중 어느 한 항에 있어서,
 상기 자성부재는, 상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은
 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 포함하는 것을 특징으로 하는 광디스크 드라
 이브.

【청구항 20】

제11항에 있어서,
 상기 광픽업 액츄에이터는,
 상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도
 하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는
 3개의 스톱퍼;를 더 구비하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 21】

대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있
 게 지지된 블레이드;

상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향
 으로 위치되는 적어도 한 쌍의 제1코일;

상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일 ;

상기 베이스에 설치되며 상기 각 제1코일의 내측에 위치되는 적어도 한 쌍의 내측 요크 ;를 포함하며,

상기 각 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것을 특징으로 하는 광픽업 액츄에이터.

【청구항 22】

제21항에 있어서,

상기 각 제1코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 광픽업 액츄에이터.

【청구항 23】

제21항에 있어서,

상기 블레이드의 외측을 에워싸며 수평방향으로 설치되는 제3코일;을 더 포함하는 광픽업 액츄에이터.

【청구항 24】

제23항에 있어서,

상기 제3코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 광픽업 액츄에이터.

【청구항 25】

제21항 내지 제24항 중 어느 한 항에 있어서,

상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 더 포함하는 광픽업 액츄에이터.

【청구항 26】

제21항에 있어서,

상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 더 구비하는 광픽업 액츄에이터.

【청구항 27】

기록매체인 디스크를 회전시키는 스피들모터와, 대물렌즈를 통해 상기 디스크에 광을 조사하여 정보를 기록하거나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조사되도록 상기 대물렌즈의 위치를 제어하는 광픽업 액츄에이터를 포함하는 광디스크 드라이브에 있어서, 상기 광픽업 액츄에이터는,

상기 대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드;

상기 블레이드에 수평방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 제1방향으로 위치되는 적어도 한 쌍의 제1코일;

상기 블레이드의 상기 제1방향에 수직한 제2방향의 두 측면 중 적어도 어느 한 측면에 수직방향으로 설치되며, 상기 대물렌즈를 중심으로 마주보게 위치되는 적어도 한 쌍의 제2코일 ;

상기 베이스에 설치되며 상기 각 제1코일의 내측에 위치되는 적어도 한 쌍의 내측 요크; 를 포함하며,

상기 각 내측 요크는 상기 제2코일과 대면되고 상기 제2방향으로 상호 이격된 한 쌍의 제1벽과 상기 제2방향으로 형성된 제2벽을 포함하는 것을 특징으로 하는 광픽업 액츄에이터.

【청구항 28】

제27항에 있어서,

상기 각 제1코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 것을 특징으로 하는 광디스크 드라이브.

【청구항 29】

제27항에 있어서,

상기 광픽업 액츄에이터는,

상기 블레이드의 외측을 에워싸며 수평방향으로 설치되는 제3코일;을 더 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 30】

제29항에 있어서,

상기 제3코일은 상하 방향으로 상호 이격되도록 다수개로 분할된 것을 특징으로 하는 광 디스크 드라이브.

【청구항 31】

제27항 내지 제30항 중 어느 한 항에 있어서,

상기 광픽업 액츄에이터는,

상기 블레이드를 중심으로 상기 제2방향으로 마주보게 위치되고 같은 극성으로 단극 착자된 적어도 한 쌍의 마그넷;을 더 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 32】

제27항에 있어서,

상기 광픽업 액츄에이터는,

상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 더 구비하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 33】

대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드;

상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 포함하는 광픽업 액츄에이터.

【청구항 34】

제33항에 있어서,

상기 스톱퍼는 상기 블레이드에 마련되는 것을 특징으로 하는 광픽업 액츄에이터.

【청구항 35】

제33항에 있어서,

상기 스톱퍼는 상기 베이스에 마련되는 것을 특징으로 하는 광픽업 액츄에이터.

【청구항 36】

기록매체인 디스크를 회전시키는 스핀들모터와, 대물렌즈를 통해 상기 디스크에 광을 조사하여 정보를 기록하거나 재생하는 광픽업과, 상기 광이 상기 디스크 상의 원하는 위치에 조사되도록 상기 대물렌즈의 위치를 제어하는 광픽업 액츄에이터를 포함하는 광디스크 드라이브에 있어서, 상기 광픽업 액츄에이터는,

대물렌즈를 탑재하고 다수의 서스펜션 와이어에 의해 베이스에 탄력적으로 유동될 수 있게 지지된 블레이드;

상기 블레이드와 상기 베이스 사이에 개재되어 상기 블레이드가 상기 베이스쪽으로 과도하게 구동되는 것을 방지하는 것으로서, 상기 대물렌즈를 중심으로 삼각형 형상으로 배치되는 3개의 스톱퍼;를 포함하는 것을 특징으로 하는 광디스크 드라이브.

【청구항 37】

제36항에 있어서,

상기 스톱퍼는 상기 블레이드에 마련되는 것을 특징으로 하는 광디스크 드라이브.

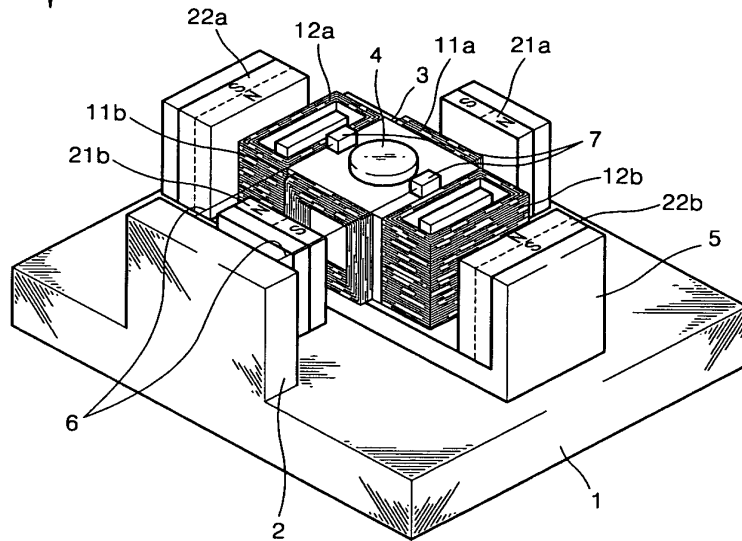
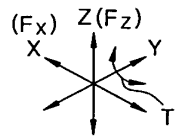
【청구항 38】

제36항에 있어서,

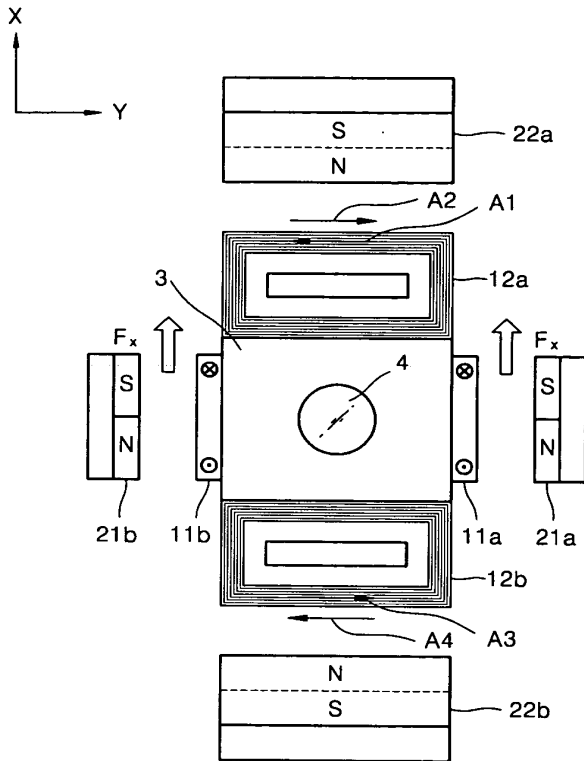
상기 스톱퍼는 상기 베이스에 마련되는 것을 특징으로 하는 광디스크 드라이브.

【도면】

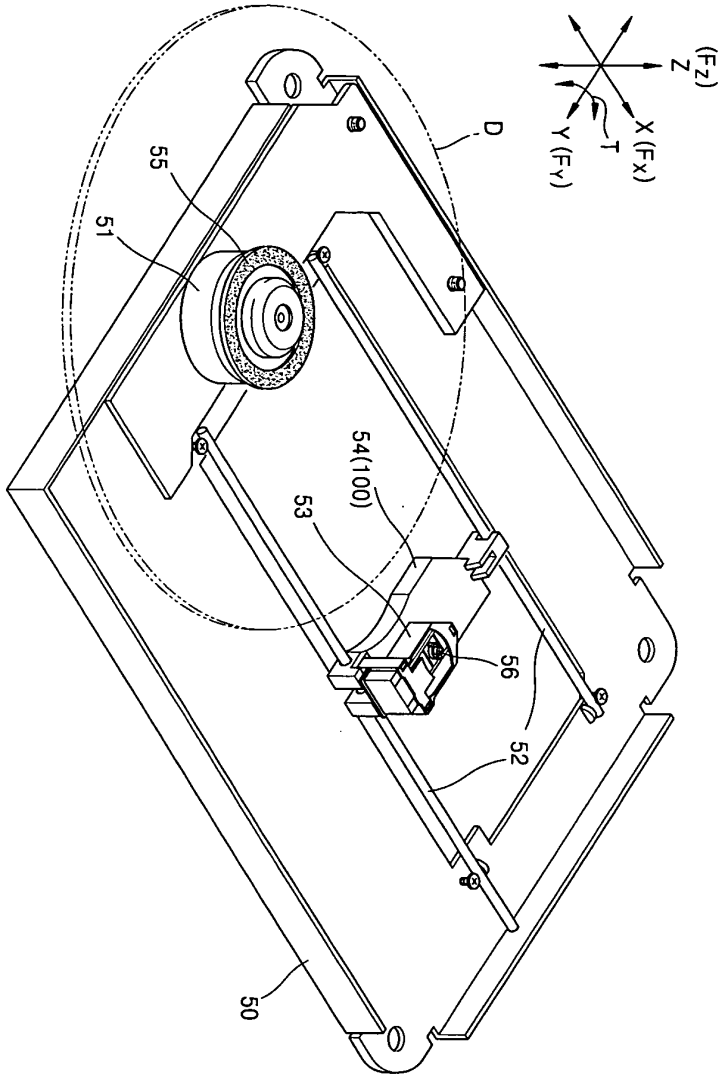
【도 1】



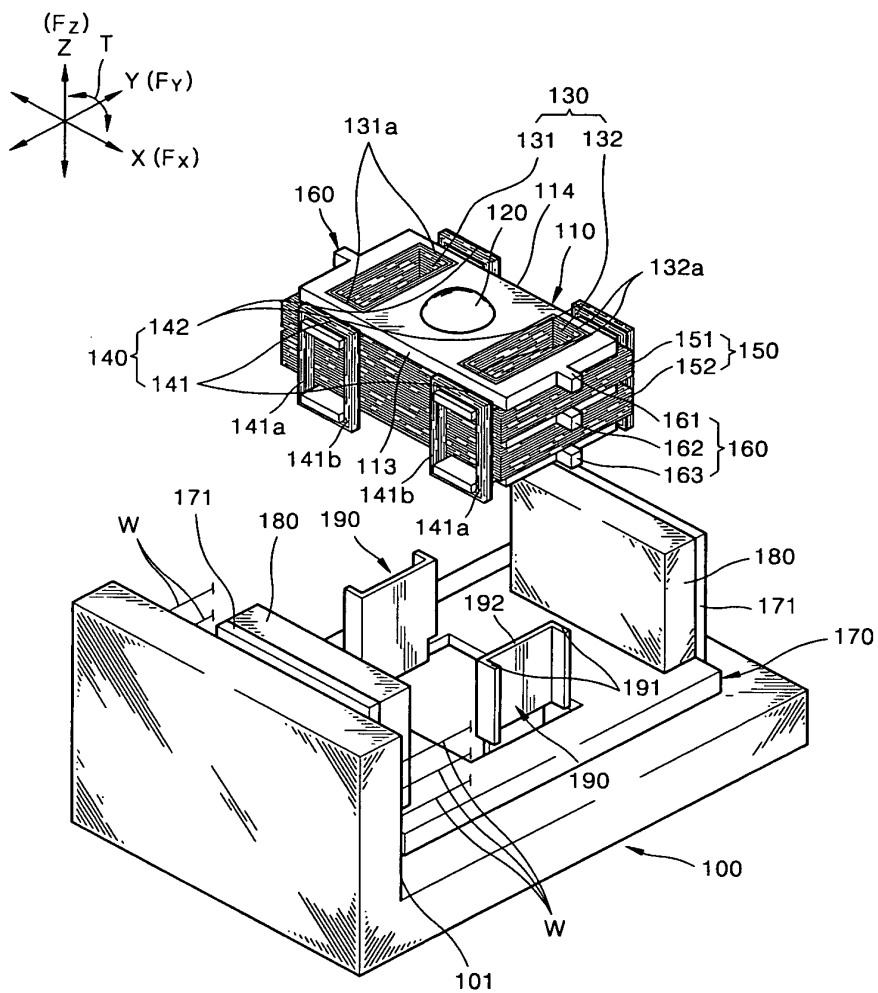
【도 2】



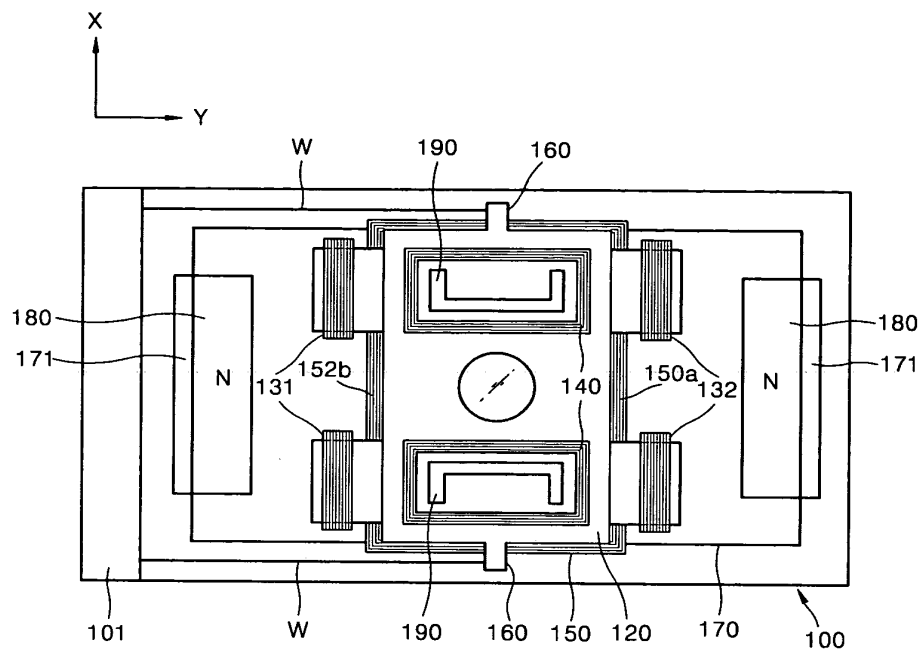
【도 3】



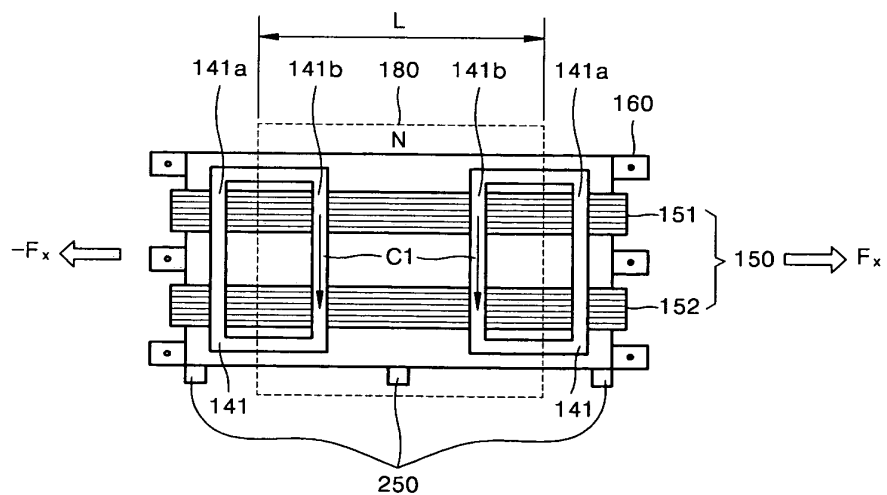
【도 4】



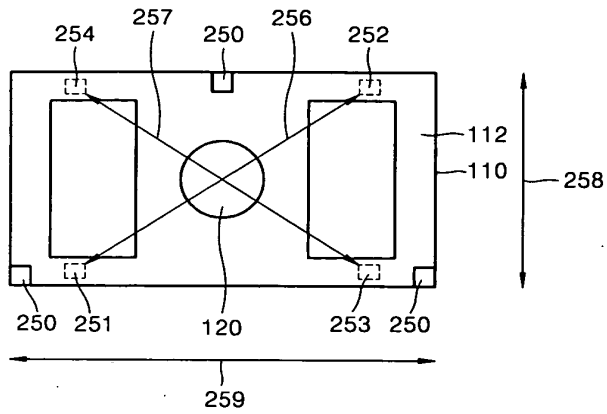
【도 5】



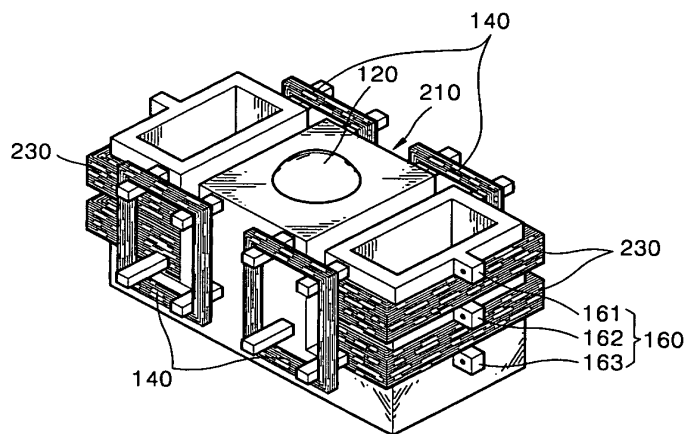
【도 6】



【도 7】



【도 8】



PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 2003

Application or Docket Number

10849190

CLAIMS AS FILED - PART I

(Column 1) (Column 2)

TOTAL CLAIMS	47	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	47 minus 20 =	* 27
INDEPENDENT CLAIMS	8 minus 3 =	* 5
MULTIPLE DEPENDENT CLAIM PRESENT ☐		

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

(Column 1) (Column 2) (Column 3)

AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	*	Minus	**	=
	Independent	*	Minus	***	=
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

(Column 1) (Column 2) (Column 3)

AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	*	Minus	**	=
	Independent	*	Minus	***	=
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

(Column 1) (Column 2) (Column 3)

AMENDMENT C		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total	*	Minus	**	=
	Independent	*	Minus	***	=
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY TYPE ☐ OR

OTHER THAN SMALL ENTITY

RATE	FEE		RATE	FEE
BASIC FEE	385.00	OR	BASIC FEE	770.00
X\$ 9=		OR	X\$18=	486
X43=		OR	X86=	430
+145=		OR	+290=	
TOTAL		OR	TOTAL	1686

SMALL ENTITY OR

OTHER THAN SMALL ENTITY

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X\$ 9=		OR	X\$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

05/21/2004 LWONDIM1 00000034 10849190

01 FC:1001	770.00 OP
02 FC:1202	486.00 OP
03 FC:1201	430.00 OP

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-287/89033