



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
08.04.2020 Bulletin 2020/15

(51) Int Cl.:
E21D 11/08^(2006.01) E21D 11/10^(2006.01)

(21) Application number: **18806523.9**

(86) International application number:
PCT/CN2018/086275

(22) Date of filing: **10.05.2018**

(87) International publication number:
WO 2018/214737 (29.11.2018 Gazette 2018/48)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

- **ZHAO, Guodong**
Ji'nan
Shandong 250014 (CN)
- **WANG, Defu**
Ji'nan
Shandong 250014 (CN)
- **HU, Hao**
Ji'nan
Shandong 250014 (CN)
- **LI, Haizhen**
Ji'nan
Shandong 250014 (CN)
- **SUN, Xutao**
Ji'nan
Shandong 250014 (CN)
- **YAO, Yinbin**
Ji'nan
Shandong 250014 (CN)
- **WANG, Hao**
Ji'nan
Shandong 250014 (CN)

(30) Priority: **25.05.2017 CN 201710381186**

(71) Applicant: **China Railway 14th Bureau Group Co., Ltd.**
Ji'nan, Shandong 250014 (CN)

- (72) Inventors:
- **CHEN, Jian**
Ji'nan
Shandong 250014 (CN)
 - **WAGN, Chengzhen**
Ji'nan
Shandong 250014 (CN)
 - **ZHANG, Zhe**
Ji'nan
Shandong 250014 (CN)

(74) Representative: **Inchingalo, Simona**
Bugnion S.p.A.
Viale Lancetti, 17
20158 Milano (IT)

(54) **CONSTRUCTION METHOD FOR INNER STRUCTURE OF SINGLE-BORE DOUBLE-TRACK COMPOSITE LINING SHIELD TUNNEL**

(57) The present invention relates to the field of shield tunnel construction, and provides a construction method for an inner structure of a single-bore double-track composite lining shield tunnel. The method mainly include: a first stage and a second stage; in the first stage, composite lining construction is conducted on a middle section and/or a rear section of the tunnel synchronously during tunnel boring, and lining is conducted on the tunnel by adopting an order of first lining and then splitting from bottom to top in the composite lining construction; and the second stage is a construction stage after the tunnel is bored through. With the adoption of the construction method, the construction of the inner

lining structure is conducted on the middle section and/or the rear section of the tunnel synchronously during shield tunnel boring, and thus the construction efficiency is improved; moreover, the order of first lining and then splitting from bottom to top is generally adopted in the composite lining construction, and thus, the stability of the interior of the tunnel can be guaranteed, and smooth passing in a construction space is also guaranteed. The construction method provided by the present invention has good practicability.

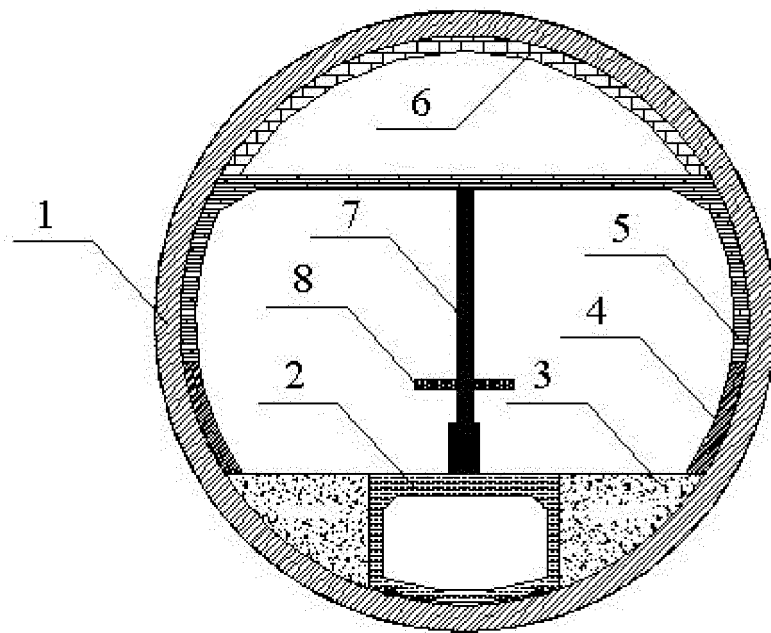


Fig. 1

Description

Technical Field

[0001] The present invention relates to the field of shield tunnel construction, and provides a construction method for an inner structure of a single-bore double-track composite lining shield tunnel.

Background

[0002] At present, the metro construction is upsurging in China. A great number of shield tunnels passing through complex areas and having long distances and large diameters are under construction or are to be constructed. During construction, each shield tunnel is faced with many technical problems such as complex geological condition, long construction period and large risk. Moreover, while the functional requirement on urban underground tunnel engineering is increased continuously, a composite lining structure is emerging in an urban metric shield tunnel under the requirements of fire protection, collision avoidance, explosion protection and durability. A shield tunnel of a single-bore double-track composite lining structure cannot meet the synchronous construction completely and are difficult to guarantee the construction efficiency and quality.

Summary

[0003] The present invention is mainly intended to provide a construction method for an inner structure of a single-bore double-track composite lining shield tunnel, which can conduct composite lining on the inner structure of the tunnel synchronously during tunnel boring and thus effectively improves the efficiency.

[0004] The technical solutions of the present invention are as follows: a construction method for an inner structure of a single-bore double-track composite lining shield tunnel mainly includes: a first stage and a second stage; in the first stage, composite lining construction is conducted on a middle section and/or a rear section of the tunnel synchronously during tunnel boring, and lining is conducted on the tunnel by adopting an order of first lining and then splitting from bottom to top in the composite lining construction; and the second stage is a construction stage after the tunnel is bored through.

[0005] The technical solutions of the present invention further include: the composite lining construction includes the following main steps.

- 1) A prefabricated box culvert component is installed.
- 2) A two-lining bottom arch wall is cast in place.
- 3) A flue sheet and a lining arch wall below the flue sheet are cast in place.
- 4) An arch top lining is cast in place.
- 5) A mid-partition is constructed.

[0006] The technical solutions of the present invention further include: the step 1) of the composite lining construction includes the following steps: the prefabricated box culvert component is conveyed to a shield tunneling machine frame, the prefabricated box culvert component is installed synchronously in shield boring, and upon the completion of installation, concrete filling is conducted in spaces at two sides of the prefabricated box culvert component.

[0007] The technical solutions of the present invention further include: the prefabricated box culvert component is a hollow square shaped box culvert, and the prefabricated box culvert component is installed on an inner lower portion of an annular pipe spliced by prefabricated segments.

[0008] The technical solutions of the present invention further include: the step 2) of the composite lining construction includes the following steps: the two-lining bottom arch wall is cast by using an manual erecting framework, and a casting space for the bottom arch wall is reserved in advance.

[0009] The technical solutions of the present invention further include: the step 3) of the composite lining construction includes the following steps: reinforcing steel bars are bond and the flue sheet and the lining arch wall below the flue sheet are cast in place, a connector is pre-buried in each prefabricated segment, the construction is conducted by multiple groups of trolleys synchronously when the reinforcing steel bars are bond, arch ring reinforcing steel bars are mechanically fixed on the connector, and a part of reinforcing steel bar skeleton on the flue sheet is suspended in the prefabricated segments on the top.

[0010] The technical solutions of the present invention further include: the mid-partition construction in the step 5) of the composite lining construction is mid-partition construction on a linear section; and during the mid-partition construction, a small steel sizing template is used first to construct a wall below an evacuation platform to serve as a substrate of the mid-partition, and then a mobile trolley is used to cast wall concrete of the mid-partition from an upper portion of the flue sheet to a bottom portion of the flue sheet to serve as an upper portion of the mid-partition.

[0011] The technical solutions of the present invention further include: a construction hole is reserved on the flue sheet, a concrete pumping pipe is connected to an area above the flue sheet via the construction hole, an air duct sheet is further provided in the flue sheet, a casting hole is reserved in the middle of the air duct sheet, and the concrete is poured into the mid-partition via the casting hole.

[0012] The technical solutions of the present invention further include: the second step includes the following main steps.

- 1) A mid-partition of a curved section is cast.
- 2) An evacuation platform is constructed.

3) A road leveling layer is constructed.

[0013] The technical solutions of the present invention further include: an artificial intelligence steel pipe support and a wood surface membrane cooperative structure is adopted by the evacuation platform.

[0014] It is to be noted that a front section, a middle section and a rear section of the tunnel take a direction in which the shield tunneling machine bores as a front direction.

[0015] The present invention has the following advantages: according to the construction method for the inner structure of the single-bore double-track composite lining shield tunnel provided by the invention, with the adoption of the construction method, the construction of the inner lining structure is conducted on the middle section and/or the rear section of the tunnel synchronously during shield tunnel boring, and thus the construction efficiency is improved; moreover, the order of first lining and then splitting from bottom to top is generally adopted in the composite lining construction, and thus, the stability of the interior of the tunnel can be guaranteed, and smooth passing in a construction space is also guaranteed. The construction method provided by the present invention has good practicability.

Brief Description of the Drawings

[0016] The accompanying drawings are described here to provide further understanding of the present invention, and form a part of the present invention. The schematic embodiments and description of the present invention are adopted to explain the present invention, and do not form improper limits to the present invention. In the drawings:

Fig. 1 is a cross-sectional effect diagram of a shield tunnel by adopting a construction method of the present invention.

Fig. 2 is a process flowchart of a construction method of the present invention.

Fig. 3 is a schematic diagram of installation of a prefabricated box culvert component of the present invention.

Fig. 4 is a schematic diagram of cast-in-place construction of a two-lining bottom arch wall.

Fig. 5 is a schematic diagram of a reinforcing steel bar trolley of a flue sheet.

Fig. 6 is a schematic diagram of an arch top two-lining reinforcing steel bar trolley.

Fig. 7 is a schematic diagram of construction of a flue sheet and a lining arch wall below.

Fig. 8 is a schematic diagram of cast-in-place construction of an arch top lining.

Fig. 9 is a schematic diagram of a cast-in-place mid-partition.

Fig. 10 is a vertical section view of construction of an inner structure.

Fig. 11 is a sectional flowchart of construction of an inner structure.

[0017] In the drawings, 1. prefabricated segment; 2. prefabricated box culvert component; 3. concrete filling; 4. bottom arch wall; 5. flue sheet and lining arch wall below; 6. arch top lining; 7. mid-partition; 8. evacuation platform

Detailed Description of the Embodiments

[0018] The present invention is further described below in combination with Fig. 1 to Fig. 11 and embodiments.

[0019] Moreover, the followings are merely a part of embodiments; and the embodiments in the present invention and the features in the embodiments may be combined with each other if there is no conflict.

[0020] A construction method for an inner structure of a single-bore double-track composite lining shield tunnel mainly includes: a first stage and a second stage; in the first stage, composite lining construction is conducted on a middle section and/or a rear section of the tunnel synchronously during tunnel boring, and lining is conducted on the tunnel by adopting an order of first lining and then splitting from bottom to top in the composite lining construction; and the second stage is a construction stage after the tunnel is bored through.

[0021] Embodiment 1: the composite lining construction includes the following main steps.

1) A prefabricated box culvert component 2 is installed.

2) A two-lining bottom arch wall 4 is cast in place.

3) A flue sheet and a lining arch wall 5 below the flue sheet are cast in place.

4) An arch top lining 6 is cast in place.

5) A mid-partition 7 is constructed.

[0022] Embodiment 2: the step 1) of the composite lining construction includes the following steps: the prefabricated box culvert component 2 is conveyed to a shield tunneling machine frame, the prefabricated box culvert component 2 is installed synchronously in shield boring, and upon the completion of installation, concrete filling 3 is conducted in spaces at two sides of the prefabricated box culvert component 2.

[0023] The prefabricated box culvert component 2 is a hollow square shaped box culvert, and the prefabricated box culvert component 2 is installed on an inner lower portion of an annular pipe spliced by prefabricated segments 1. The spliced installation of the prefabricated segments 1 is conducted synchronously during shield boring.

[0024] Embodiment 3: in view of the influence from pipelines at two sides, in the process when a shield tunneling machine is manufactured and pipelines are paved, an enough bottom arch wall casting space is reserved in advance; the two-lining bottom arch wall 4 is cast by using

an manual erecting framework, a splicing template is a small arc sizing template, and its size is subject to the design condition of the tunnel, and that the template can be carried by an site operator, and should not be excessively large.

[0025] Embodiment 4: the step 3) of the composite lining construction includes the following steps: reinforcing steel bars are bond and the flue sheet and the lining arch wall below the flue sheet are cast in place, and the construction is conducted by multiple groups of trolleys synchronously when the reinforcing steel bars are bond; a connector is pre-buried in each prefabricated segment 1, the construction is conducted by the multiple groups of trolleys synchronously when the reinforcing steel bars are bond, arch ring reinforcing steel bars are mechanically fixed on the connector, and a reinforcing steel bar skeleton on the flue sheet is suspended in the prefabricated segments 1 on the top. The flue sheet and the lining arch wall below the flue sheet are cast by adopting a template trolley.

[0026] Embodiment 5: in the step 4) of the composite lining construction, when the arch top lining is cast in place, the arch top lining 6 is constructed after the concrete of the flue sheet is up to a design strength; and a lower trolley may also be used during strength period of the flue sheet as a support for an upper arched top in construction to perform concrete construction of the arch top. After the trolley moves and is positioned accurately, the concrete casting is implemented. A concrete delivery pump is adopted by the casting to supply the concrete at the front single side of the template trolley; the concrete is delivered from the top of the flue sheet. For concrete vibration of the side arc lining, an attached flat-plate vibrator is installed by using a rib portion of a trolley panel to vibrate artificially in combination with a vibration rod.

[0027] Embodiment 6: the mid-partition 7 construction in the step 5) of the composite lining construction is mid-partition construction on a linear section; and during the mid-partition 7 construction, a small steel sizing template is used first to construct a wall below an evacuation platform to serve as a substrate of the mid-partition 7, and then a mobile trolley is used to cast wall concrete of the mid-partition 7 from an upper portion of the flue sheet to a bottom portion of the flue sheet to serve as an upper portion of the mid-partition 7.

[0028] A construction hole is reserved on the flue sheet, a concrete pumping pipe is connected to an area above the flue sheet via the construction hole, an air duct sheet is further provided in the flue sheet, a casting hole is reserved in the middle of the air duct sheet, the concrete is poured into the mid-partition via the casting hole, and the casting hole is also served as a vibration hole.

[0029] Embodiment 7: the second step includes the following main steps.

- 1) A mid-partition 7 of a curved section is cast.
- 2) An evacuation platform 8 is constructed, an artificial intelligence steel pipe support and wood sur-

face membrane cooperative structure being adopted by the evacuation platform 8.

3) A road leveling layer is constructed.

[0030] Since the space in the tunnel is limited, the mid-partition of the linear section is constructed first, and after the tunnel is passed through, the curved section is constructed.

[0031] The above are preferred embodiments of the present invention and are not intended to limit the preset invention in any form. Any modifications, equivalent replacements, improvements and the like made within the spirit and principle of the present invention should be included in a protection scope of the present invention.

Claims

1. A construction method for an inner structure of a single-bore double-track composite lining shield tunnel, mainly comprising: a first stage and a second stage; in the first stage, composite lining construction is conducted on a middle section and/or a rear section of the tunnel synchronously during tunnel boring, and lining is conducted on the tunnel by adopting an order of first lining and then splitting from bottom to top in the composite lining construction; and the second stage is a construction stage after the tunnel is bored through.
2. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 1, wherein the composite lining construction mainly comprising:
 - 1) installing prefabricated box culvert component (2);
 - 2) casting a two-lining bottom arch wall (4) in place;
 - 3) casting flue sheet and a lining arch wall (5) below the flue sheet in place;
 - 4) casting an arch top lining (6) in place; and
 - 5) constructing a mid-partition (7).
3. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the step 1) of the composite lining construction comprising: conveying the prefabricated box culvert component (2) to a shield tunneling machine frame, installing the prefabricated box culvert component (2) synchronously in shield boring, and upon the completion of installation, conducting concrete filling in spaces at two sides of the prefabricated box culvert component (2).
4. The construction method for the inner structure of the single-bore double-track composite lining shield

tunnel as claimed in claim 3, wherein the prefabricated box culvert component (2) is a hollow square shaped box culvert, and the prefabricated box culvert component (2) is installed on an inner lower portion of an annular pipe spliced by prefabricated segments (1).

5. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein in the step 2) of the composite lining construction, the two-lining bottom arch wall is cast by using an manual erecting framework, and a casting space for the bottom arch wall (4) is reserved in advance.
6. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the step 3) of the composite lining construction comprises: binding reinforcing steel bars and casting the flue sheet and the lining arch wall (5) below the flue sheet in place, pre-burying a connector in each prefabricated segment (1), conducting the construction by multiple groups of trolleys synchronously when the reinforcing steel bars are bond, fixing arch ring reinforcing steel bars mechanically on the connector, and suspending a part of reinforcing steel bar skeleton on the flue sheet in the prefabricated segments (1) on the top.
7. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the mid-partition (7) construction in the step 5) of the composite lining construction is mid-partition construction on a linear section; and during the mid-partition (7) construction, a small steel sizing template is used first to construct a wall below an evacuation platform to serve as a substrate of the mid-partition (7), and then a mobile trolley is used to cast wall concrete of the mid-partition (7) from an upper portion of the flue sheet to a bottom portion of the flue sheet to serve as an upper portion of the mid-partition (7).
8. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 7, wherein a construction hole is reserved on the flue sheet, a concrete pumping pipe is connected to an area above the flue sheet via the construction hole, an air duct sheet is further provided in the flue sheet, a casting hole is reserved in the middle of the air duct sheet, and the concrete is poured into the mid-partition via the casting hole.
9. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in any one of claims 1 to 8, wherein the second step comprises the following main steps:

- 1) casting a mid-partition of a curved section;
- 2) constructing an evacuation platform; and
- 3) constructing a road leveling layer.

10. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 9, wherein an artificial intelligence steel pipe support and a wood surface membrane cooperative structure is adopted by the evacuation platform.

Amended claims under Art. 19.1 PCT

1. A construction method for an inner structure of a single-bore double-track composite lining shield tunnel, mainly comprising: a first stage and a second stage; in the first stage, composite lining construction is conducted on a middle section and/or a rear section of the tunnel synchronously during tunnel boring, and lining is conducted on the tunnel by adopting an order of first lining and then splitting from bottom to top in the composite lining construction; and the second stage is a construction stage after the tunnel is bored through.
2. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 1, wherein the composite lining construction mainly comprising:
 - 1) installing prefabricated box culvert component (2);
 - 2) casting a two-lining bottom arch wall (4) in place;
 - 3) casting flue sheet and a lining arch wall (5) below the flue sheet in place;
 - 4) casting an arch top lining (6) in place; and
 - 5) constructing a mid-partition (7).
3. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the step 1) of the composite lining construction comprising: conveying the prefabricated box culvert component (2) to a shield tunneling machine frame, installing the prefabricated box culvert component (2) synchronously in shield boring, and upon the completion of installation, conducting concrete filling in spaces at two sides of the prefabricated box culvert component (2).
4. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 3, wherein the prefabricated box culvert component (2) is a hollow square shaped box culvert, and the prefabricated box culvert component (2) is installed on an inner lower portion

of an annular pipe spliced by prefabricated segments (1).

5. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein in the step 2) of the composite lining construction, the two-lining bottom arch wall (4) is cast by using an manual erecting framework, and a casting space for the bottom arch wall (4) is reserved in advance. 5 10
6. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the step 3) of the composite lining construction comprises: binding reinforcing steel bars and casting the flue sheet and the lining arch wall (5) below the flue sheet in place, pre-burying a connector in each prefabricated segment (1), conducting the construction by multiple groups of trolleys synchronously when the reinforcing steel bars are bond, fixing arch ring reinforcing steel bars mechanically on the connector, and suspending a part of reinforcing steel bar skeleton on the flue sheet in the prefabricated segments (1) on the top. 15 20 25
7. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 2, wherein the mid-partition (7) construction in the step 5) of the composite lining construction is mid-partition construction on a linear section; and during the mid-partition (7) construction, a small steel sizing template is used first to construct a wall below an evacuation platform to serve as a substrate of the mid-partition (7), and then a mobile trolley is used to cast wall concrete of the mid-partition (7) from an upper portion of the flue sheet to a bottom portion of the flue sheet to serve as an upper portion of the mid-partition (7). 30 35 40
8. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 7, wherein a construction hole is reserved on the flue sheet, a concrete pumping pipe is connected to an area above the flue sheet via the construction hole, an air duct sheet is further provided in the flue sheet, a casting hole is reserved in the middle of the air duct sheet, and the concrete is poured into the mid-partition (7) via the casting hole. 45 50
9. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in any one of claims 1 to 8, wherein the second step comprises the following main steps: 55

- 1) casting a mid-partition of a curved section;
- 2) constructing an evacuation platform; and

3) constructing a road leveling layer.

10. The construction method for the inner structure of the single-bore double-track composite lining shield tunnel as claimed in claim 9, wherein an artificial intelligence steel pipe support and a wood surface membrane cooperative structure is adopted by the evacuation platform.

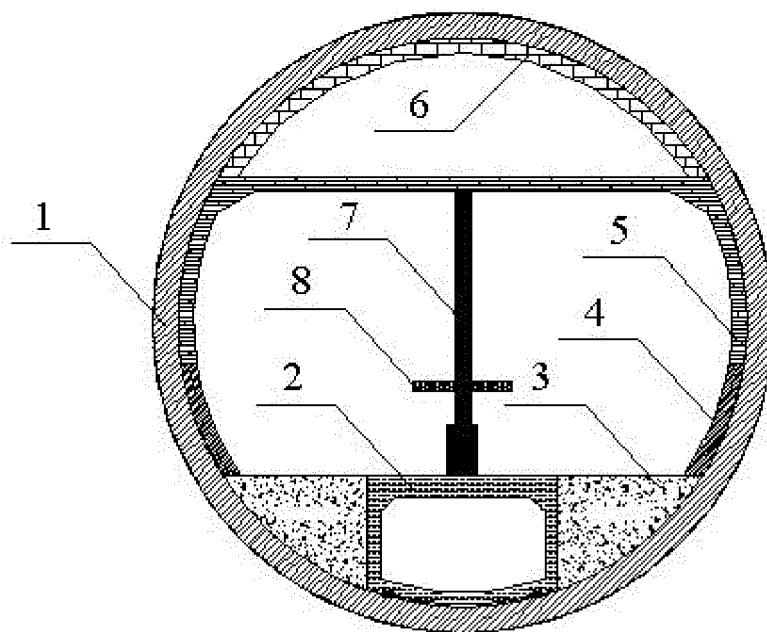


Fig. 1

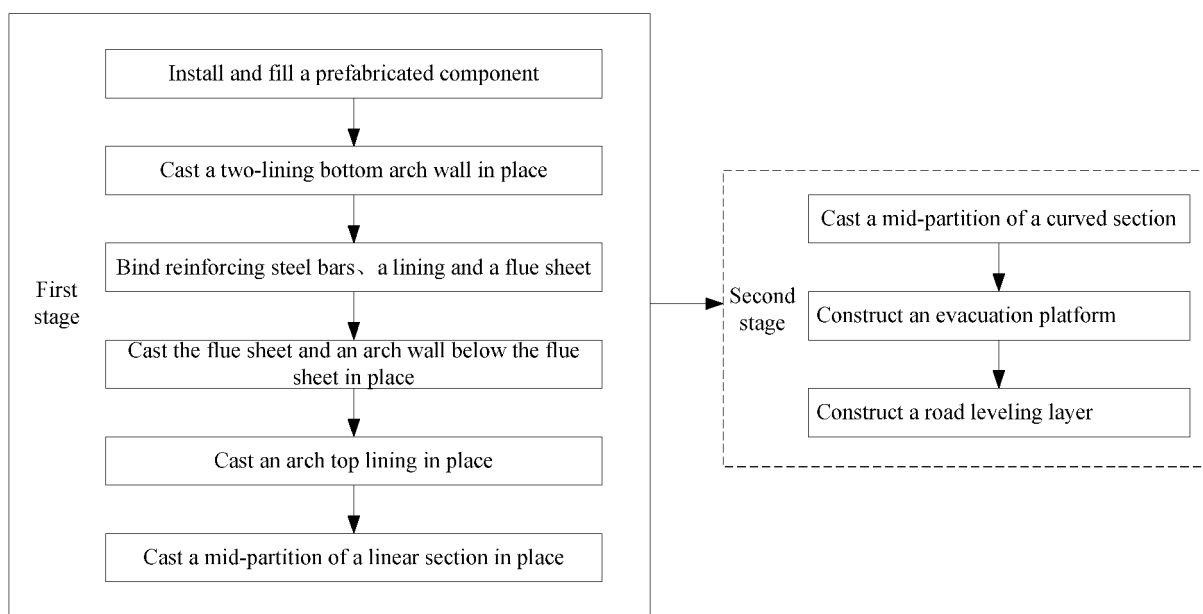


Fig. 2

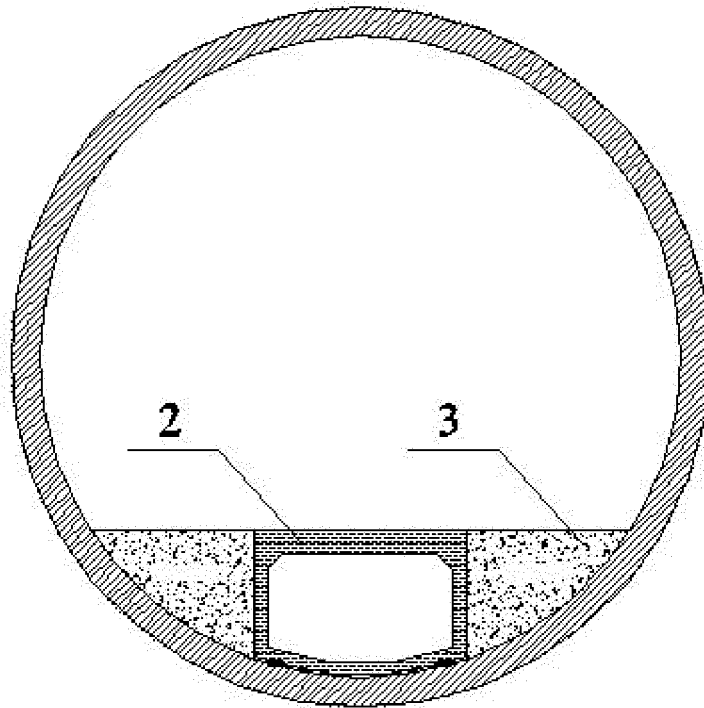


Fig. 3

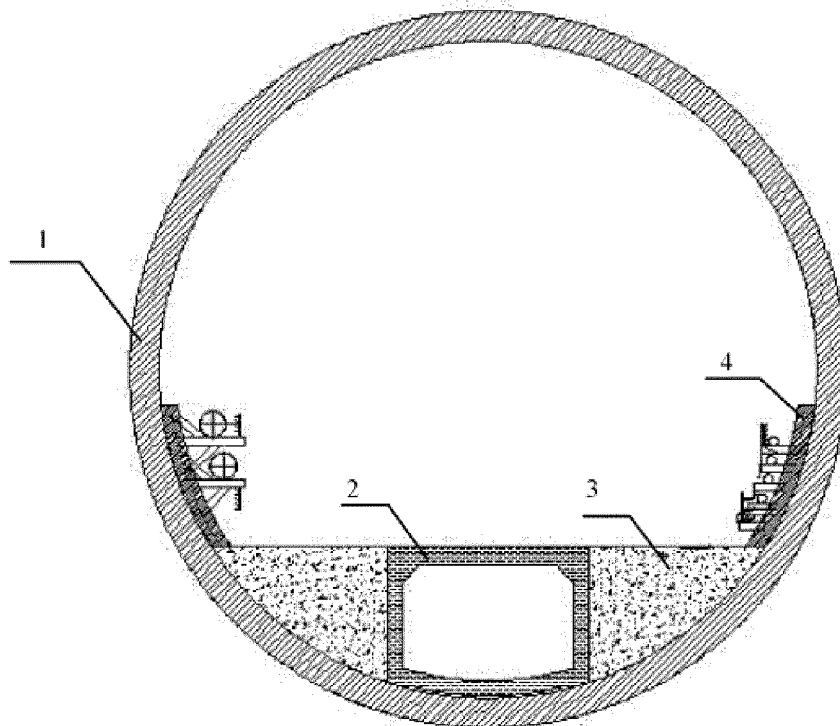


Fig. 4

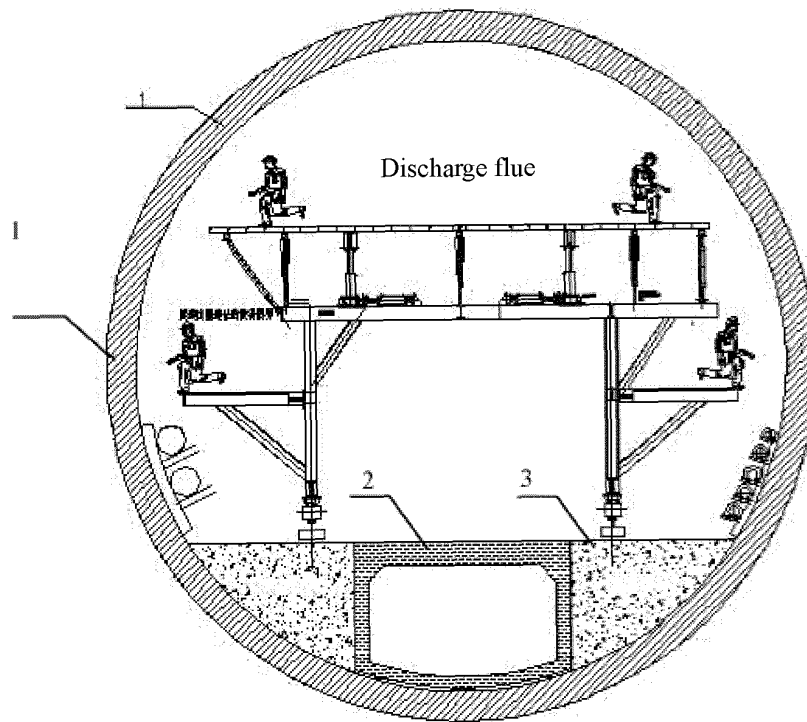


Fig. 5

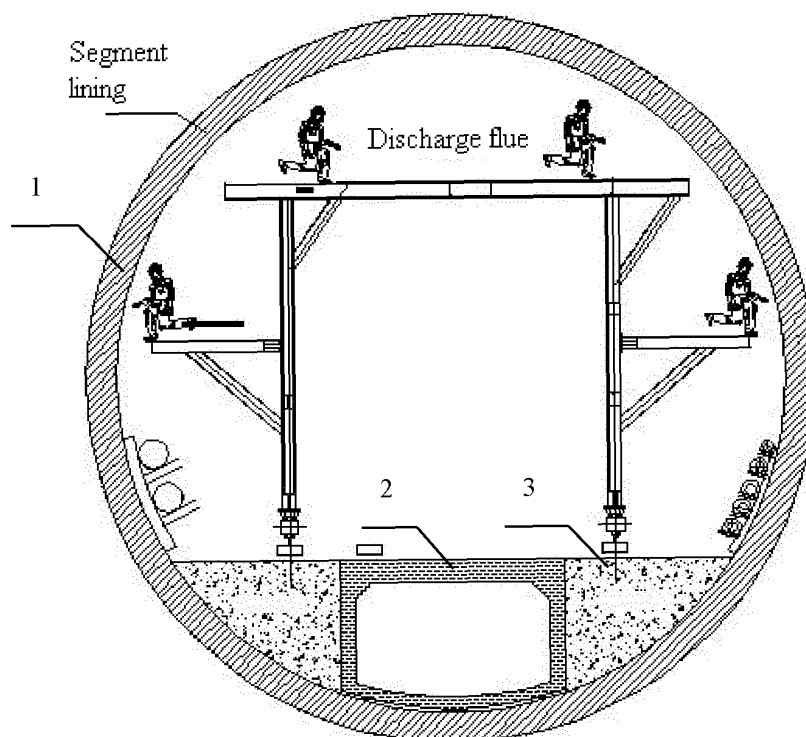


Fig. 6

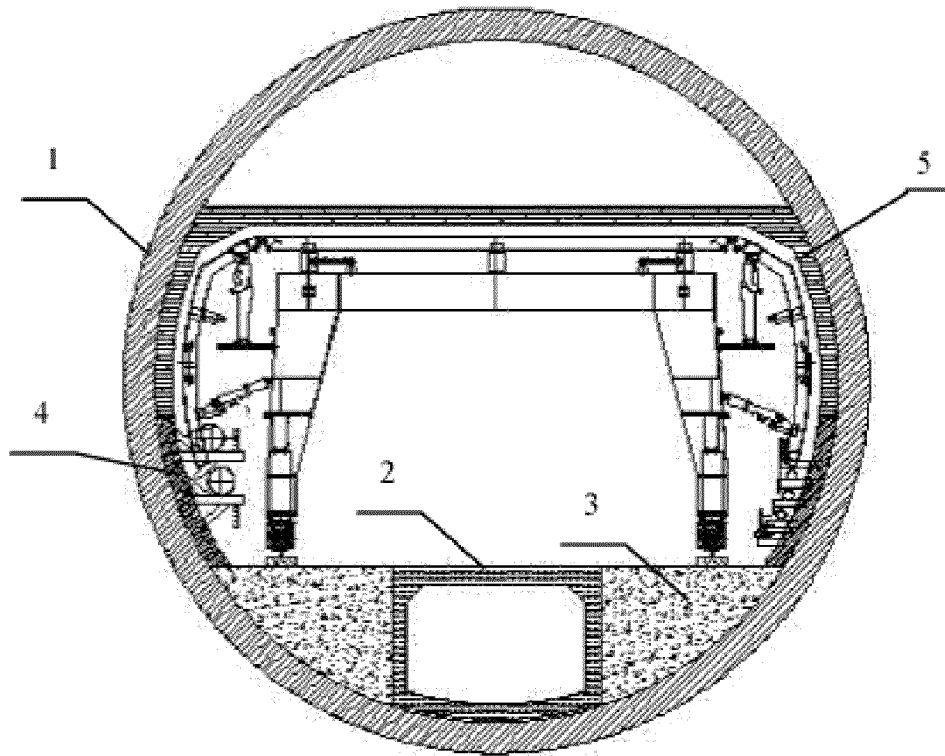


Fig. 7

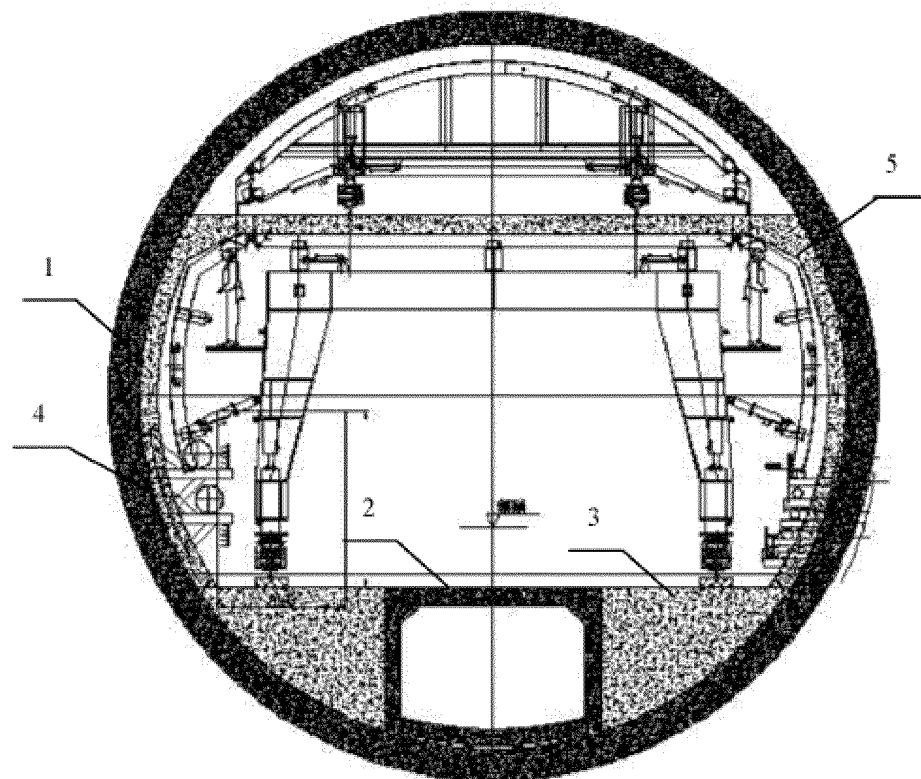


Fig. 8

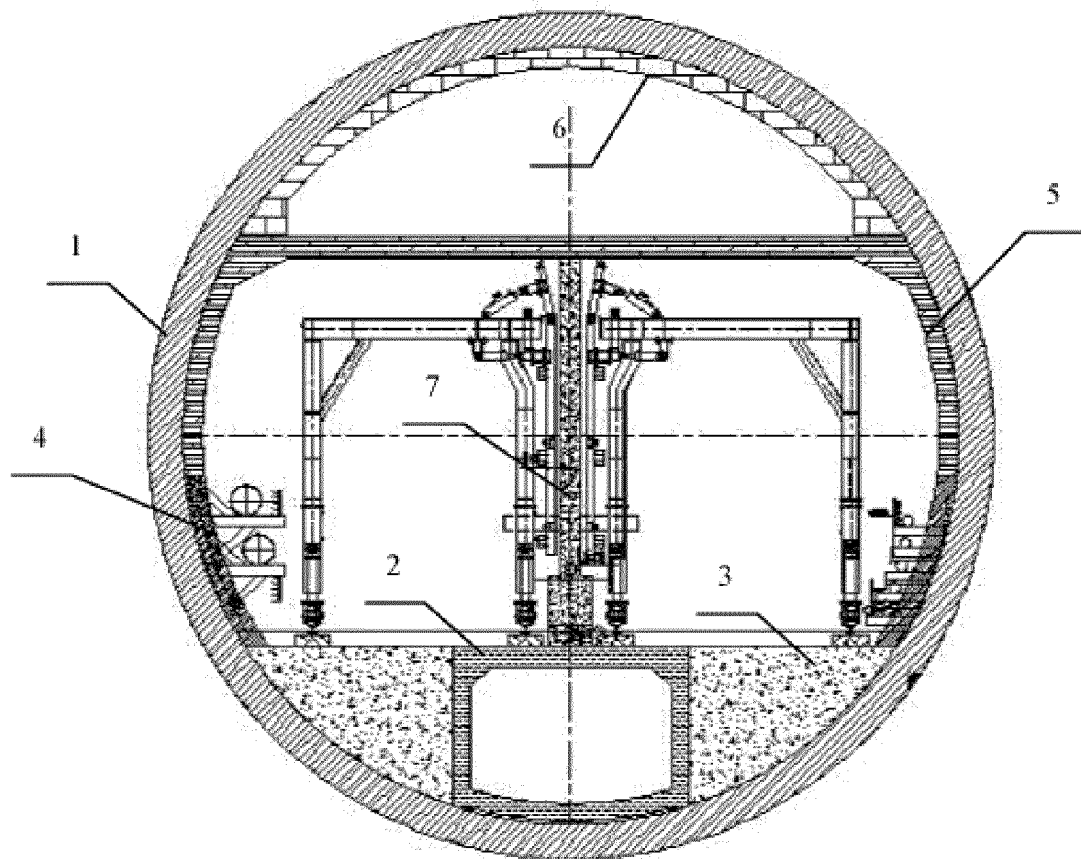


Fig. 9

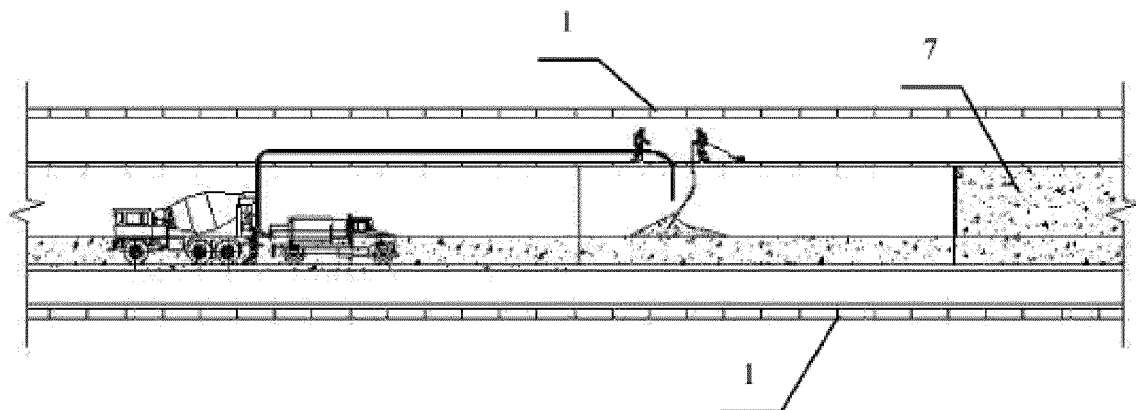


Fig. 10

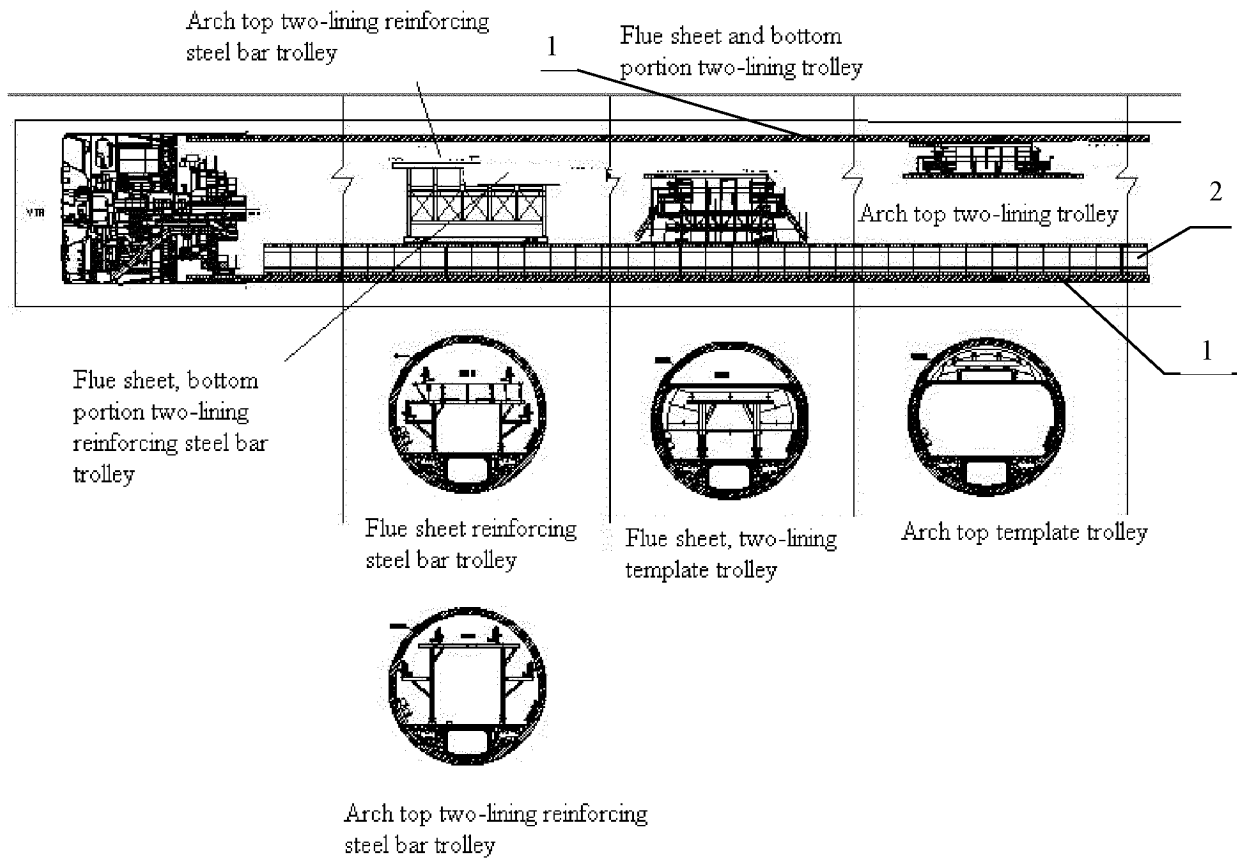


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/086275

A. CLASSIFICATION OF SUBJECT MATTER

E21D 11/08 (2006.01) i; E21D 11/10 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; TWABS; CNTXT; CNKI; DWPI; SIPOABS: 单洞, 双线, 衬砌, 盾构, 王怀东, 张旭辉, 黄波, 双线单管, 单管双线, 南京地铁三号线, 隔, 施工, Single-hole, double-line, lining, liner, shield, mid-board

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 107435544 A (CHINA RAILWAY 14TH BUREAU GROUP CO., LTD.), 05 December 2017 (05.12.2017), claims 1-10	1-10
PX	CN 107916936 A (BEIJING MUNICIPAL CONSTRUCTION CO., LTD.), 17 April 2018 (17.04.2018), description, paragraphs 22-33	1-10
X	王怀东 等, “地铁长距离过江盾构隧道合理断面形式的研究”, 现代隧道技术, 50(6), 31 December 2013 (31.12.2013), ISSN: 1009-6582, pages 139-151, (WANG, Huaidong et al., “Study of a Reasonable Cross Section Type for a Long-Distance Shield Tunnel Crossing Under a River”, Modern Tunnelling Technology)	1-10
X	CN 103195440 A (CHINA RAILWAY TUNNEL SURVEY & DESIGN INSTITUTE CO., LTD.), 10 July 2013 (10.07.2013), description, paragraphs 23-31, and figures 1-8	1-10
A	CN 102003207 A (SHANGHAI TUNNEL ENGINEERING & RAIL TRANSIT DESIGN AND RESEARCH INSTITUTE), 06 April 2011 (06.04.2011), entire document	1-10
A	JP 2003206693 A (TAISEI CORP.), 25 July 2003 (25.07.2003), entire document	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	
“E” earlier application or patent but published on or after the international filing date	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	“&” document member of the same patent family

Date of the actual completion of the international search 05 July 2018	Date of mailing of the international search report 25 July 2018
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer GAO, Gang Telephone No. 86-(512)-88995324

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2018/086275

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 107435544 A	05 December 2017	None	
CN 107916936 A	17 April 2018	None	
CN 103195440 A	10 July 2013	None	
CN 102003207 A	06 April 2011	CN 102003207 B	29 August 2012
JP 2003206693 A	25 July 2003	None	

Form PCT/ISA/210 (patent family annex) (January 2015)