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(71) Applicant: **Nitto Kohki Co., Ltd.**
Tokyo 146-8555 (JP)

(72) Inventors:
• **SUZUKI, Yasumasa**
Tokyo 146-8555 (JP)
• **FUJIMORI, Takahiro**
Tokyo 146-8555 (JP)

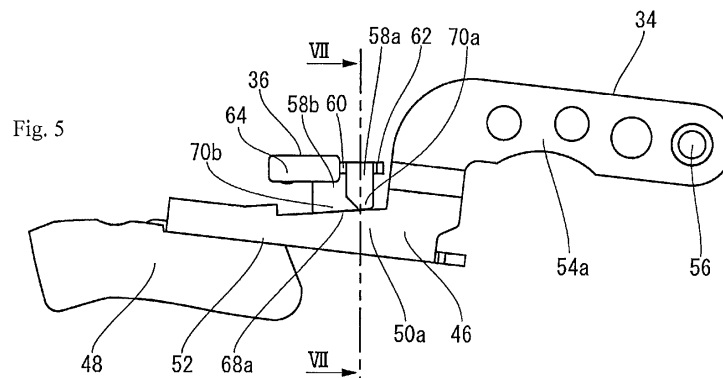
(74) Representative: **Emde, Eric**
Wagner & Geyer
Gewürzmühlstrasse 5
80538 München (DE)

(54) **PNEUMATIC TOOL**

(57) [Technical Problem] Provided is an air tool configured such that a restricting member restricting the displacement of a control lever is engageable with the control lever in a more stable condition.

[Solution to Problem] An air tool (10) includes a restricting member (36) restricting the displacement of a control lever (34). The control lever (34) is displaceable between a stop position where a valve (32) is closed and a drive position where the valve is open. The control lever (34) has two abutting projections (68a and 68b) projecting in a direction in which the control lever moves when displaced to the drive position. The restricting member (36) has two restricting projections (70a and 70b) projecting in a direction opposite to the projecting direction

of the abutting projections so as to oppose to the abutting projections. The restricting member (36) is displaceable between a restricting position where the restricting projections (70a and 70b) abut against the associated abutting projections (68a and 68b) to stop the control lever (34) from being displaced to the drive position and a release position where the restricting projections and the abutting projections do not abut against each other to allow the control lever to be displaced to the drive position. The abutting projections are spaced from each other in the displacement direction of the restricting member, and so are the restricting projections.



Description

Technical Field:

[0001] The present invention relates to air tools and, more particularly, to an air tool having a mechanism for restricting the operation of a control lever.

Background Art:

[0002] Air tools such as a pneumatic belt-type polishing machine and a pneumatic torque wrench, which operate on compressed air as a drive source, conventionally include an air motor, a tool body part accommodating the air motor and having an air supply path for supplying compressed air to the air motor, a valve for opening and closing the air supply path, and a control lever attached to the outside of the tool body part. By operating the control lever, the valve is opened and closed, thereby controlling the drive of the air motor.

[0003] Among such air tools are those having a safety mechanism for preventing the control lever from being accidentally operated. For example, Patent Literature 1 discloses an air tool in which the operation of the control lever is restricted by engagement of a stopper with a distal end portion of the control lever. The control lever has a groove formed on one side surface thereof so that the stopper is engageable with the groove. The displacement of the control lever is restricted by engagement of the stopper with the groove.

Citation List:

Patent Literature:

[0004] Patent Literature 1: Japanese Utility Model Registration No. 2517035

Summary of Invention:

Technical Problem:

[0005] In the air tool having the above-described safety mechanism, the restriction of the displacement of the control lever by the stopper needs to be made stably and firmly so that there is no possibility of the control lever being operated to start the air tool despite the stopper or other restricting member being placed in a position to restrict the operation of the control lever. In many conventional air tools such as those described above, however, the control lever and the stopper are usually engaged with each other in a somewhat unstable condition at only one point. Therefore, the conventional air tools are not necessarily satisfactory in terms of stability of the engaged condition.

[0006] The present invention has been made in view of the above-described problem with the conventional technique, and an object of the present invention is to

provide an air tool configured such that a restricting member restricting the displacement of a control lever is engageable with the control lever in a more stable condition.

Solution to Problem:

[0007] The present invention provides an air tool including the following: an air motor; a tool body part accommodating the air motor and having an air supply path for supplying compressed air to the air motor; a valve opening and closing the air supply path; a control lever displaceably attached to the tool body part to control opening and closing of the valve, the control lever being displaceable between a stop position where the valve is closed and a drive position where the valve is open, and the control lever having two abutting projections projecting in a direction in which the control lever moves when displaced from the stop position to the drive position; and a restricting member displaceably attached to the tool body part to restrict displacement of the control lever, the restricting member having two restricting projections projecting in a direction opposite to the projecting direction of the abutting projections of the control lever so as to oppose to the abutting projections, and the restricting member being displaceable between a restricting position where when the control lever is operated to be displaced from the stop position to the drive position, the restricting projections abut against the abutting projections associated therewith, respectively, to stop the control lever from being displaced to the drive position and a release position where when the control lever is displaced from the stop position to the drive position, the two restricting projections and the two abutting projections do not abut against each other to allow the control lever to be displaced to the drive position. The two abutting projections are spaced from each other in the direction of displacement of the restricting member, and the two restricting projections are also spaced from each other in the direction of displacement of the restricting member.

[0008] In the air tool, the two abutting projections of the control lever are engaged with the two restricting projections of the restricting member, respectively, and the abutting projections are spaced from each other, and so are the restricting projections. Accordingly, the restricting member abuts against the control lever in a more stable condition than in a conventional structure in which the restricting member engages the control lever at one point.

[0009] Preferably, the arrangement may be as follows. The control lever is attached to the tool body part so as to be pivotally displaced between the stop position and the drive position. The restricting member is attached to the tool body part so as to be displaced between the restricting position and the release position in a direction perpendicular to a plane in which the control lever pivots.

[0010] More preferably, the arrangement may be as follows. The control lever has a lever body part of U-

shaped cross-section comprising two sidewalls and a bottom wall connecting the two sidewalls. The two abutting projections are formed by at least respective parts of the two sidewalls.

[0011] Even more preferably, the arrangement may be as follows. The restricting member has a restricting member body part of U-shaped cross-section comprising two sidewalls and a top wall connecting the two sidewalls. The two restricting projections are formed by at least respective parts of the two sidewalls. The space between the two sidewalls of the restricting member is identical to the space between the two sidewalls of the control lever.

[0012] Because the control lever and the restricting member are formed to have the above-described U-shaped cross-sections, respectively, these members can be easily made by sheet metal working.

[0013] Preferably, the arrangement may be as follows. The tool body part has an air supply pipe forming the air supply path, and a housing accommodating the air supply pipe. The restricting member is disposed between the air supply pipe and the control lever. The air supply pipe has a guide surface configured to slidably support the restricting member. The guide surface is formed to face the abutting projections of the control lever.

[0014] With the above-described structure, when the control lever is operated when the restricting member is in the restricting position and thus the restricting member is pressed by the control lever, the restricting member is supported by the guide surface on the air supply pipe and therefore can receive the force from the control lever in a stable condition.

[0015] Preferably, the air tool may further include an urging member urging the restricting member toward the restricting position.

[0016] One embodiment of an air tool according to the present invention will be explained below on the basis of the accompanying drawings.

Brief Description of Drawings:

[0017]

Fig. 1 is a side view of an air tool according to one embodiment of the present invention.

Fig. 2 is a top view of the air tool shown in Fig. 1.

Fig. 3 is a side view showing the interior of a housing of the air tool in Fig. 1.

Fig. 4 is a sectional view taken along the line IV-IV in Fig. 2.

Fig. 5 is a side view showing a control lever and a restricting member.

Fig. 6 is a top view of the control lever and the restricting member shown in Fig. 5.

Fig. 7 is a sectional view taken along the line VII-VII in Fig. 5, showing the restricting member in a restricting position relative to the control lever.

Fig. 8 is a sectional view taken along the line VII-VII in Fig. 5, showing the restricting member in a release

position relative to the control lever.

Fig. 9 is a sectional view taken along the line VII-VII in Fig. 5, showing the control lever in a drive position relative to the control lever.

Description of Embodiments:

[0018] As shown in Figs. 1 and 2, an air tool 10 according to one embodiment of the present invention is a belt-type grinding tool 10 having a tool body part 12 and a belt driving part 14. The belt-type grinding tool 10 further has an endless grinding belt 22 wound between a drive pulley (not shown) rotationally driven by an air motor 16 (Figs. 3 and 4) accommodated in the tool body part 12 and an idle pulley 20 rotatably supported by a pulley support member 18. While being driven to rotate, the endless grinding belt 22 is pressed against a material to be ground to thereby grind the to-be-ground material.

[0019] As shown in Figs. 3 and 4, the tool body part 12 comprises a housing 24 accommodating the air motor 16 and an air supply-discharge pipe 26 disposed in the housing 24, the air supply-discharge pipe 26 being a discrete member formed separately from the housing 24. The air supply-discharge pipe 26 has formed therein an air supply path 28 for supplying compressed air to the air motor 16 and an air discharge path 30 for discharging compressed air from the air motor 16. The air supply-discharge pipe 26 has attached thereto a valve 32 for opening and closing the air supply path 28, a control lever 34 for opening and closing the valve 32, and a restricting member 36 for restricting the displacement of the control lever 34.

[0020] The valve 32 comprises a valve element 40 sealingly engageable with a valve seat portion 38 provided in the air supply path 28, a spring 42 urging the valve element 40 to press against the valve seat portion 38, and a valve-operating shaft 44 connected to the valve element 40 and extending to the outside of the air supply-discharge pipe 26. When the valve-operating shaft 44 is pushed into the air supply path 28, the valve element 40 is tilted to form a gap between the valve element 40 and the valve seat portion 38. Thus, the air supply path 28 is opened. When the force to push in the valve-operating shaft 44 is removed, the valve element 40 is sealingly reengaged with the valve seat portion 38 by the urging force of the spring 42, and the air supply path 28 is closed. Consequently, the valve-operating shaft 44 is pushed back toward the outside of the air supply path 28.

[0021] The control lever 34 has a lever body part 46 accommodated in the housing 24, and an operating part 48 partially projecting to the outside of the housing 24. The lever body part 46 comprises, as shown in Figs. 5 and 6, two sidewalls 50a and 50b and a bottom wall 52 connecting the sidewalls 50a and 50b, and has a U-shaped sectional configuration, as shown in Fig. 7. The two sidewalls 50a and 50b are contiguously connected with lever mounting portions 54a and 54b, respectively, which extend between the air supply-discharge pipe 26

and the housing 24. The two lever mounting portions 54a and 54b are configured to laterally sandwich the air supply-discharge pipe 26 therebetween. The control lever 34 is pivotally attached at the lever mounting portions 54a and 54b to the air supply-discharge pipe 26 through a pivot 56. In Figs. 3 and 4, the valve 32 is in a closed position where the valve 32 closes the air supply path 28, and the control lever 34 is pressed downward as seen in the figures by the valve-operating shaft 44 of the valve 32, which is in the closed position. Thus, the control lever 34 is held in a stop position. When the operating part 48 of the control lever 34 is pushed into the housing 24 to pivot the control lever 34 against the urging force of the spring 42 of the valve 32, the valve-operating shaft 44 engaged with the bottom wall 52 of the lever body part 46 is pushed into the air supply path 28, and the valve 32 is brought into an open position where the valve 32 opens the air supply path 28. Thus, the control lever 34 can pivot about the pivot 56 between a stop position where the valve 32 is closed and a drive position where the valve 32 is open. By displacing the control lever 34 from the stop position to the drive position, the valve 32 is opened, so that compressed air is supplied to the air motor 16 to start the drive of the air tool 10. It should be noted that the lever body part 46 and the lever mounting portions 54a and 54b are formed as an integral member made by sheet metal working.

[0022] The restricting member 36 comprises, as shown in Figs. 5 and 6, a restricting member body part 62 of U-shaped cross-section comprising two sidewalls 58a and 58b and a top wall 60 connecting the sidewalls 58a and 58b, and an operating part 64 secured to the top wall 60 of the restricting member body part 62. The restricting member 36 is attached to the air supply-discharge pipe 26 with the top wall 60 slidably engaged with a guide surface 66 formed on the lower surface of the air supply-discharge pipe 26. The restricting member 36 is displaceable in a direction perpendicular to a plane (i.e. a plane constituting the sheet surface of Figs. 3 and 4) in which the control lever 34 pivots. Between the restricting member 36 and the housing 24 is set a spring 67 to urge the restricting member 36 laterally (downward as seen in Fig. 6). The restricting member body part 62 of U-shaped cross-section is made by sheet metal working.

[0023] The two sidewalls 50a and 50b of the control lever 34 project in a direction in which the control lever 34 moves when displaced from the stop position to the drive position, i.e. upward, and respective parts of the sidewalls 50a and 50b constitute abutting projections 68a and 68b. On the other hand, the two sidewalls 58a and 58b of the restricting member 36 constitute restricting projections 70a and 70b, respectively, projecting in a direction opposite to the projecting direction of the abutting projections 68a and 68b of the control lever 34, i.e. downward. The abutting projections 68a and 68b of the control lever 34 are spaced from each other in the direction of displacement of the restricting member 36, and so are the restricting projections 70a and 70b of the restricting

member 36. Further, the abutting projections 68a and 68b and the restricting projections 70a and 70b extend parallel to the plane in which the control lever 34 pivots. The space between the sidewalls 50a and 50b of the control lever 34 and the space between the sidewalls 58a and 58b of the restricting member 36 are identical to each other. Accordingly, the space between the two abutting projections 68a and 68b in the displacement direction of the restricting member 36 and the space between the two restricting projections 70a and 70b in the same direction as the above are also identical to each other.

[0024] When the restricting member 36 is placed in the restricting position, shown in Fig. 7, being urged by the spring 67, the abutting projections 68a and 68b and the associated restricting projections 70a and 70b are aligned in position to face each other. Accordingly, even if the control lever 34 is operated to pivot from the stop position toward the drive position in a state where the restricting member 36 is placed in the restricting position, the abutting projections 68a and 68b abut against the associated restricting projections 70a and 70b, respectively, to stop the control lever 34 from being displaced to the drive position. At this time, the control lever 34 and the restricting member 36 abut against each other at two points. Therefore, the control lever 34 and the restricting member 36 are subjected to no uneven stress and can be kept in a stable condition. Further, the restricting member 36 is attached to the guide surface 66, which is formed on the air supply-discharge pipe 26 so as to face the abutting projections 68a and 68b. Therefore, the restricting member 36 as pressed by the control lever 34 is supported by the guide surface 66 and thus capable of maintaining a stable posture. When the restricting member 36 is in the restricting position, the operating part 64 of the restricting member 36 is projecting to the outside of the housing 24 of the tool body part 12, as shown in Fig. 2.

[0025] When the operating part 64 of the restricting member 36 is pushed into the housing 24 against the urging force of the spring 67, the restricting member 36 is displaced leftward as seen in Fig. 8 to the release position shown in the figure. When the restricting member 36 is displaced to the release position, the restricting projections 70a and 70b of the restricting member 36 are displaced relative to the abutting projections 68a and 68b of the control lever 34 so that the restricting projections 70a and 70b do not squarely face the abutting projections 68a and 68b in the displacement direction of the control lever 34 (in the vertical direction as seen in the figure). Accordingly, when the control lever 34 is displaced from the stop position to the drive position by pushing the operating part 64, the restricting projections 70a and 70b and the abutting projections 68a and 68b do not abut against each other; therefore, the control lever 34 can be displaced to the drive position shown in Fig. 9. When the control lever 34 is displaced to the drive position, the valve 32 is opened, as has been stated above. Thus, compressed air is supplied to the air motor 16 to drive the air tool 10. When the control lever 34 is in the drive

position, the abutting projections 68a and 68b of the control lever 34 and the restricting projections 70a and 70b of the restricting member 36 are in telescopic relation to each other, and the sidewalls 58a and 58b of the restricting member 36 and the sidewalls 50a and 50b of the control lever 34 are laterally engaged with each other. Therefore, the restricting member 36 is held in the release position.

[0026] When the force pushing the operating part 48 of the control lever 34 placed in the drive position is relaxed, the control lever 34 is pushed downward through the valve-operating shaft 44 by the urging force of the spring 42 of the valve 32 and the pressure that the valve element 40 receives from the compressed air. Thus, the control lever 34 pivots to the stop position. As the control lever 34 returns to the stop position, the restricting member 36 is also returned to the restricting position by the spring 67.

[0027] In the air tool 10, the amount of displacement required to displace the restricting member 36 from the restricting position to the release position is only a distance corresponding to the thickness of each of the sidewalls 58a, 58b, 50a and 50b. Accordingly, the amount of displacement of the restricting member 36 can be reduced as compared with the space between abutting positions at which the control lever 34 and the restricting member 36 abut against each other, i.e. the space between the abutting projections 68a and 68b and between the restricting projections 70a and 70b. The reduction in the amount of displacement of the restricting member 36 allows a reduction in the overall size of the air tool 10.

[0028] In the above-described embodiment, most parts of the control lever 34 and restricting member 36 are accommodated in the housing 24, and only the respective operating parts 48 and 64 of the control lever 34 and the restricting member 36 are projecting to the outside of the housing 24. Therefore, even when the air tool 10 is dropped, for example, there is not much possibility of a shock being applied directly to the control lever 34 or the restricting member 36. Thus, it is possible to reduce considerably the possibility that the control lever 34 or the restricting member 36 may be damaged.

[0029] Although in the foregoing embodiment a belt-type grinding tool is shown as one embodiment of the air tool 10 of the present invention, the present invention may also be applied to other tools such as polishing machines and torque wrenches. Further, although the control lever 34 and the restricting member 36 respectively have two abutting projections 68a and 68b and two restricting projections 70a and 70b, the control lever 34 and the restricting member 36 may have additional abutting and restricting projections, respectively. Further, although the air supply path 28 and the air discharge path 30 are formed by the air supply-discharge pipe 26, which is a discrete member formed separately from the housing 24, the air supply path 28 and the air discharge path 30 may be formed by an air supply pipe and an air discharge pipe, respectively, which are discrete members. Alterna-

tively, both or one of the air supply path 28 and the air discharge path 30 may be formed in the housing 24.

List of Reference Signs:

[0030] Air tool (belt-type grinding tool) 10; tool body part 12; belt driving part 14; air motor 16; pulley support member 18; idle pulley 20; endless grinding belt 22; housing 24; air supply-discharge pipe 26; air supply path 28; air discharge path 30; valve 32; control lever 34; restricting member 36; valve seat portion 38; valve element 40; spring 42; valve-operating shaft 44; lever body part 46; operating part 48; sidewalls 50a and 50b; bottom wall 52; lever mounting portions 54a and 54b; pivot 56; sidewalls 58a and 58b; top wall 60; restricting member body part 62; operating part 64; guide surface 66; spring 67; abutting projections 68a and 68b; restricting projections 70a and 70b.

Claims

1. An air tool comprising:

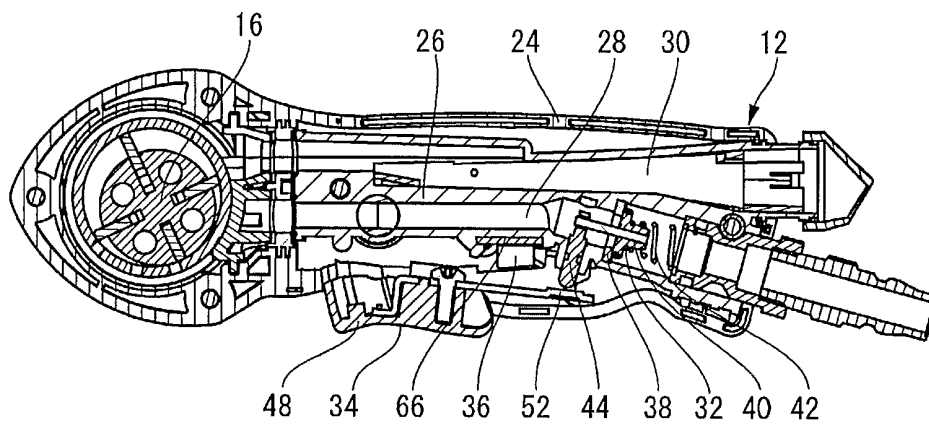
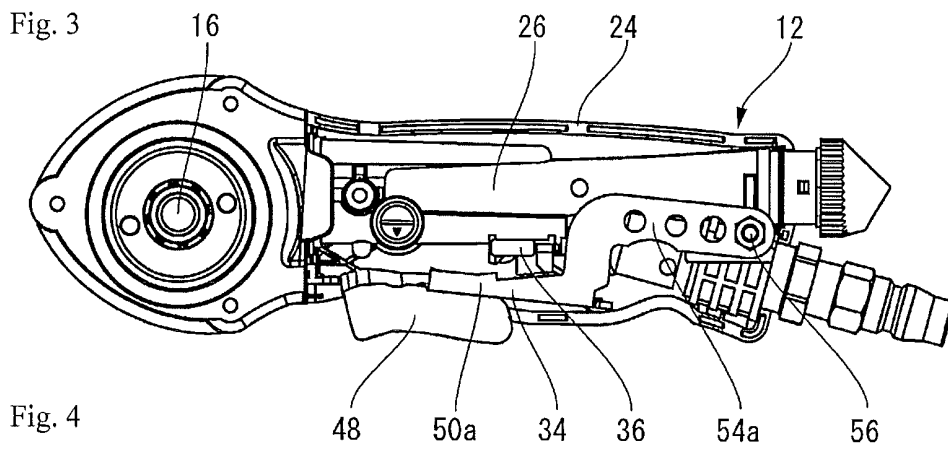
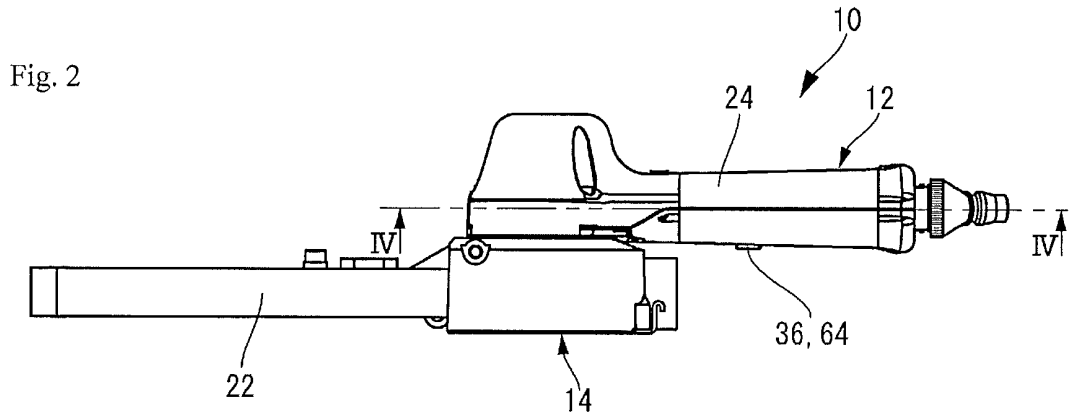
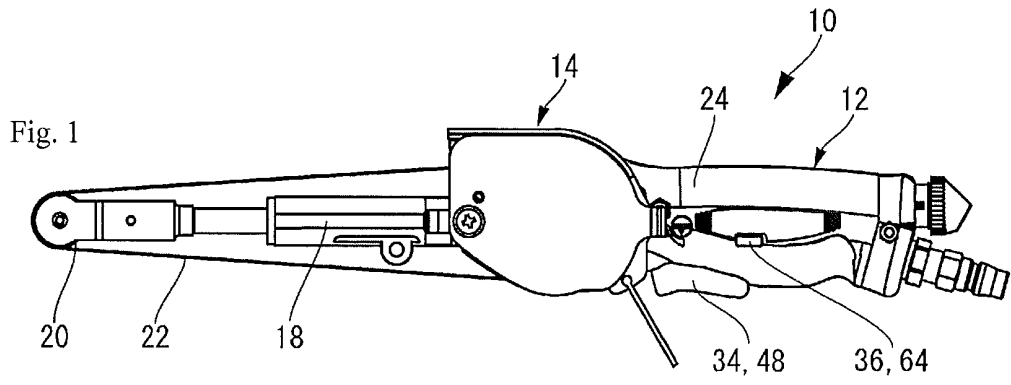
an air motor;
a tool body part accommodating the air motor and having an air supply path for supplying compressed air to the air motor;
a valve opening and closing the air supply path;
a control lever displaceably attached to the tool body part to control opening and closing of the valve, the control lever being displaceable between a stop position where the valve is closed and a drive position where the valve is open, and the control lever having two abutting projections projecting in a direction in which the control lever moves when displaced from the stop position to the drive position; and
a restricting member displaceably attached to the tool body part to restrict displacement of the control lever, the restricting member having two restricting projections projecting in a direction opposite to a projecting direction of the abutting projections of the control lever so as to oppose to the abutting projections, and the restricting member being displaceable between a restricting position where when the control lever is operated to be displaced from the stop position to the drive position, the restricting projections abut against the abutting projections associated therewith, respectively, to stop the control lever from being displaced to the drive position and a release position where when the control lever is displaced from the stop position to the drive position, the two restricting projections and the two abutting projections do not abut against each other to allow the control lever to be displaced to the drive position;

wherein the two abutting projections are spaced from each other in a direction of displacement of the restricting member, and the two restricting projections are also spaced from each other in the direction of displacement of the restricting member. 5

2. The air tool of claim 1, wherein the control lever is attached to the tool body part so as to be pivotally displaced between the stop position and the drive position; 10
the restricting member being attached to the tool body part so as to be displaced between the restricting position and the release position in a direction perpendicular to a plane in which the control lever pivots. 15
3. The air tool of claim 1 or 2, wherein the control lever has a lever body part of U-shaped cross-section comprising two sidewalls and a bottom wall connecting the two sidewalls, the two abutting projections being formed by at least respective parts of the two sidewalls. 20
4. The air tool of claim 3, wherein the restricting member has a restricting member body part of U-shaped cross-section comprising two sidewalls and a top wall connecting the two sidewalls, the two restricting projections being formed by at least respective parts of the two sidewalls, and a space between the two sidewalls of the restricting member being identical to a space between the two sidewalls of the control lever. 25 30
5. The air tool of any one of claims 1 to 4, wherein the tool body part has an air supply pipe forming the air supply path, and a housing accommodating the air supply pipe; 35
the restricting member being disposed between the air supply pipe and the control lever; 40
the air supply pipe having a guide surface configured to slidably support the restricting member, the guide surface being formed to face the abutting projections of the control lever. 45
6. The air tool of any one of claims 1 to 5, further comprising:

an urging member urging the restricting member toward the restricting position. 50

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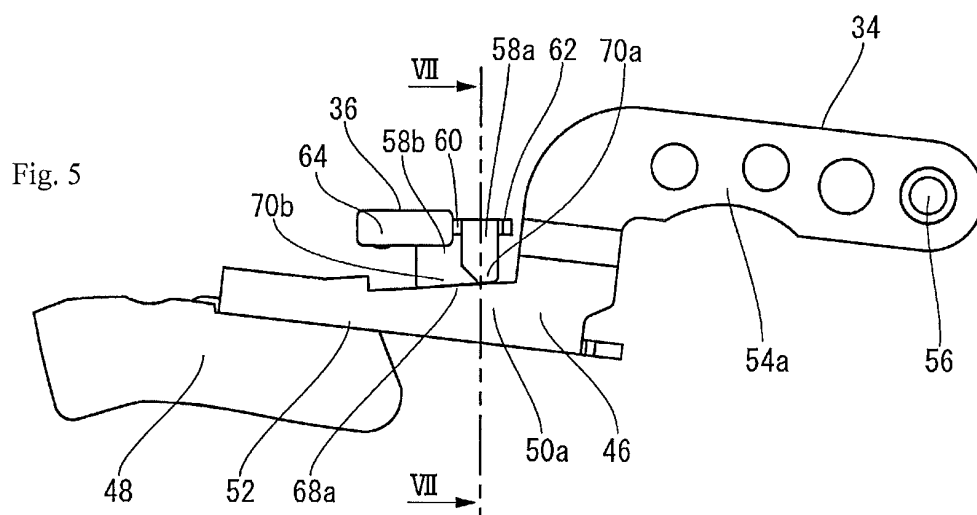


Fig. 5

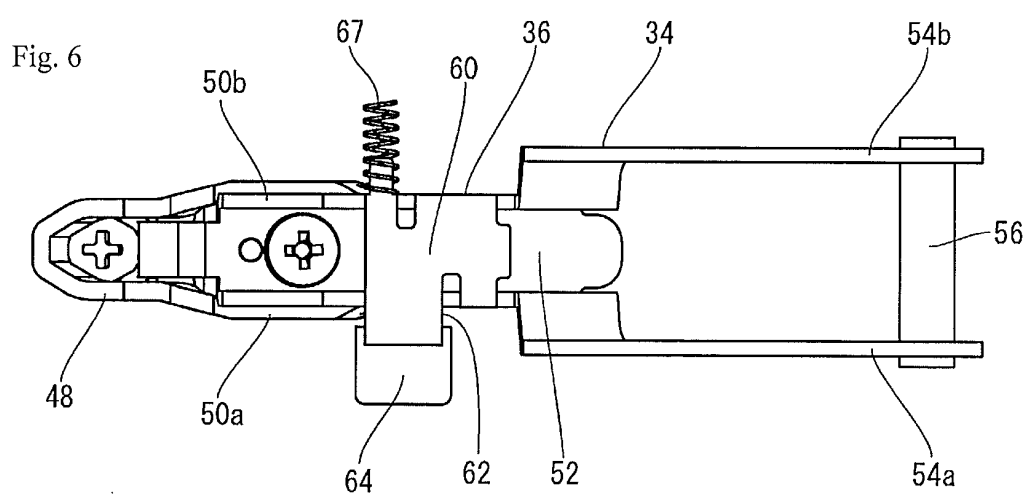


Fig. 6

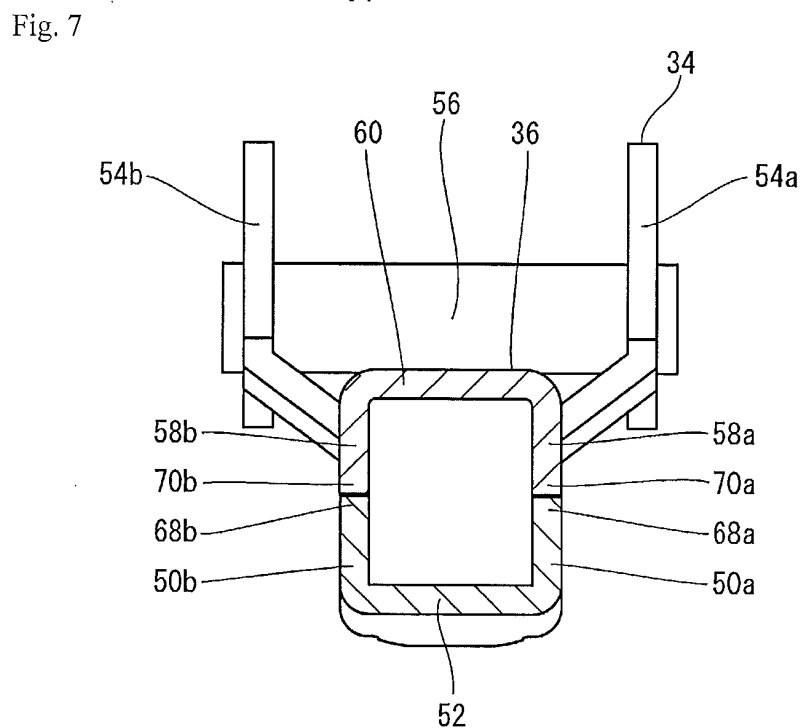
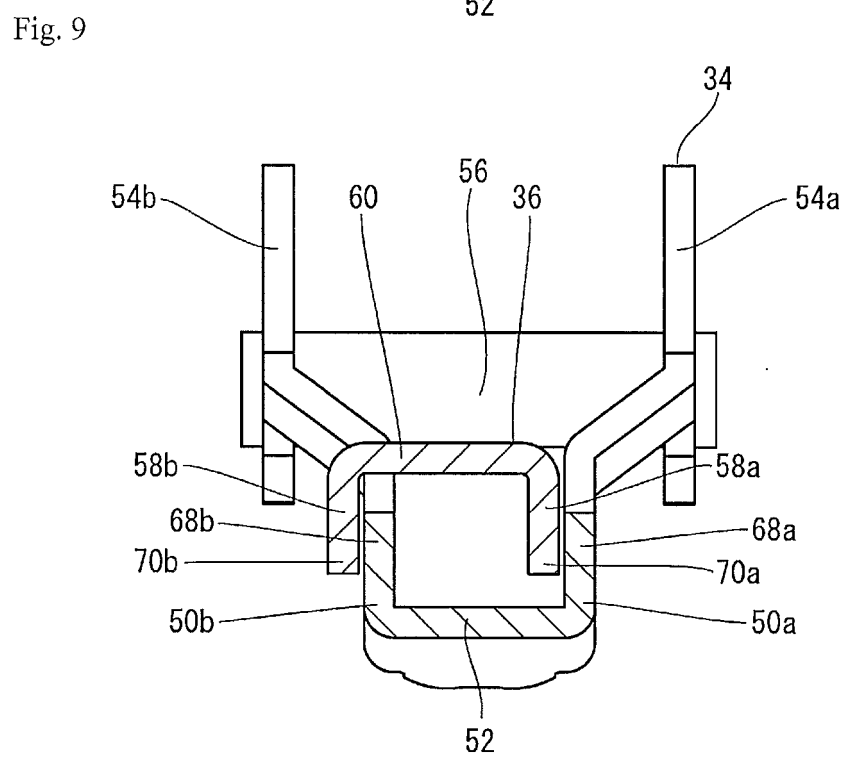
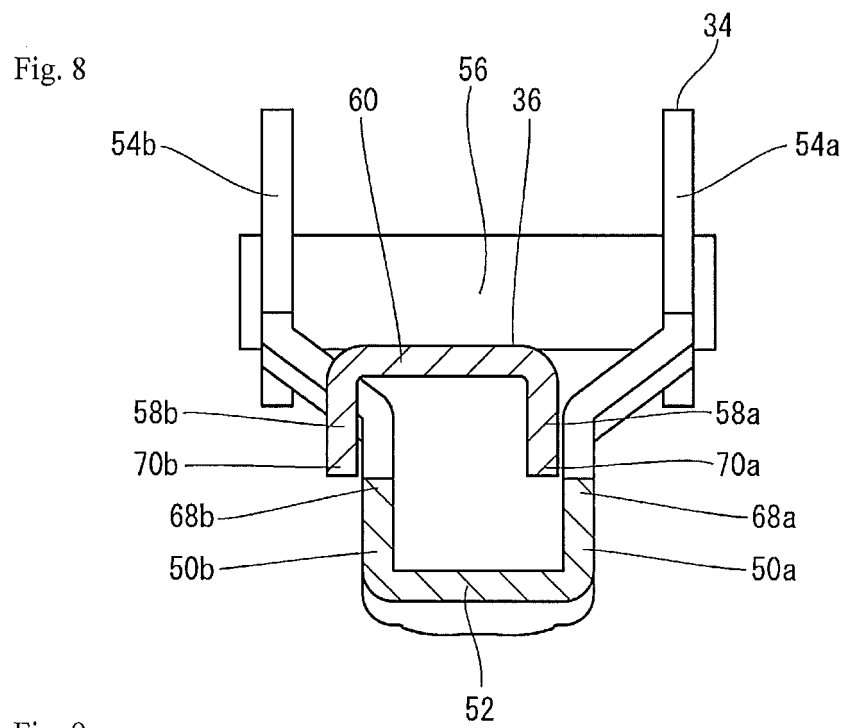


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/059542

A. CLASSIFICATION OF SUBJECT MATTER

B25F5/00(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)

B25F5/00, B25C1/04, B25B21/00, H01H9/20

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016

Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

DWPI(Thomson Innovation)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2009-255236 A (Ryobi Ltd.), 05 November 2009 (05.11.2009), paragraphs [0054] to [0056] (Family: none)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 128612/1989(Laid-open No. 68788/1991) (Shindaiwa Corp.), 08 July 1991 (08.07.1991), specification, page 10, line 12 to page 11, line 11 (Family: none)	1-6

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

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Date of the actual completion of the international search
26 May 2016 (26.05.16)Date of mailing of the international search report
14 June 2016 (14.06.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/059542

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 56-157975 A (Max Co., Ltd.), 05 December 1981 (05.12.1981), (Family: none)	1-6
A	JP 9-290377 A (Ryobi Ltd.), 11 November 1997 (11.11.1997), & DE 19707215 A1	1-6
A	US 2011/0248061 A1 (CENTRAL FASTENER CO., LTD.), 13 October 2011 (13.10.2011), (Family: none)	1-6
A	US 3858781 A (FASTENER CORP.), 07 January 1975 (07.01.1975), (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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