

COMMONWEALTH OF AUSTRALIA

THE PATENTS ACT 1952

DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENT

In support of the Convention Application made for a patent for an invention entitled:

AUSTRALIA
CONVENTION:
STANDARD
& PETTY PATENT
DECLARATION

Title of Invention

APPARATUS FOR CONTROLLING HYDRAULIC PRESSURE FOR CLUTCH

Full name(s) and address(es) of Declarant(s)

I/We, Masao TANAKA, President

of Kabushiki Kaisha Komatsu Seisakusho,
3-6, Akasaka 2-chome, Minato-ku, Tokyo 107 Japan

do solemnly and sincerely declare as follows:—

Full name(s) of Applicant(s)

1. KX00XWEXXEXDXKXIKX0XCSIXDKXMXBKXKI

(or, in the case of an application by a body corporate)

1. I am/~~Wax~~ authorised by

Kabushiki Kaisha Komatsu Seisakusho

the applicant(s) for the patent to make this declaration on its/their behalf.

2. The basic application(s) as defined by Section 141 of the Act ~~was~~/were made

Basic Country(ies)

all in Japan

Priority Date(s)

on March 25, 1987; March 25, 1987; March 25, 1987 and
March 25, 1987

Basic Applicant(s)

all by Kabushiki Kaisha Komatsu Seisakusho

Full name(s) and address(es) of inventor(s)

3. ~~XXXXXXXXXXXXXXX(XX)XXXXXXXXXXXX~~
~~XXXXXXXXXXXXXX~~

(or where a person other than the inventor is the applicant)

3. Yoshio ASAYAMA, Makio TSUBOTA, Yasunori OKURA and Takayuki SATO

of 990-10, Yanagishima-Kaigan, Chigasaki-shi, Kanagawa-ken 253 Japan, 102, Shinomiya, Hiratsuka-shi, Kanagawa-ken 254 Japan, 18, Manda, Hiratsuka-shi, Kanagawa-ken 254 Japan, and 634-1, Minamihara, Hiratsuka-shi, Kanagawa-ken 254 Japan, (respectively)

is/are the actual inventor(s) of the invention and the facts upon which the applicant(s) is/~~are~~ entitled to make the application are as follows:

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s)

The inventors are employees of the applicant. The applicant obtained the right to obtain a patent by employment contract. The applicant is therefore a person who would be entitled to have the patent assigned to it if a patent were granted upon an application made by the inventors.

4. The basic application(s) referred to in paragraph 2 of this Declaration ~~was/were~~ the first application(s) made in a Convention country in respect of the invention(s) the subject of the application.

Declared at Tokyo this 15th day of November 19 88

KABUSHIKI KAISHA KOMATSU SEISAKUSHO

Masao Tanaka
Signature of Declarant(s)
Masao TANAKA, President

11/81

To: The Commissioner of Patents

5194

(12) PATENT ABRIDGMENT (11) Document No. AU-B-83209/87
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 601537

(54) Title
HYDRAULIC CLUTCH PRESSURE CONTROL APPARATUS

International Patent Classification(s)
(51)⁴ F16D 025/14

(21) Application No. : 83209/87

(22) Application Date : 30.11.87

(87) WIPO Number : WO88/07636

(30) Priority Data

(31) Number	(32) Date	(33) Country
62-70990	25.03.87	JP JAPAN
62-70991	25.03.87	JP JAPAN
62-70992	25.03.87	JP JAPAN
62-70993	25.03.87	JP JAPAN

(43) Publication Date : 02.11.88

(44) Publication Date of Accepted Application : 13.09.90

(71) Applicant(s)
KABUSHIKI KAISHA KOMATSU SEISAKUSHO

(72) Inventor(s)
YOSHIO ASAYAMA; MAKIO TSUBOTA; YASUNORI OKURA; TAKAYUKI SATO

(74) Attorney or Agent
SPRUSON & FERGUSON

(56) Prior Art Documents
AU 55749/86 F16D 25/14
DE 3441853
JP 54/27622

(57) Claim

1. An apparatus for controlling a hydraulic pressure usable for a clutch comprising;

a first valve including a spool with an orifice formed at an output port leading to said clutch, said first valve being opened under the effect of a differential pressure appearing across said orifice and closed under the effect of a restorable force of a first spring disposed on one end of said spool,

a second valve in the form of a pressure control valve adapted to be activated in response to an electric signal, said second valve functioning to open said first valve by feeding to the latter a hydraulic oil delivered from a pump during a period of changing speed and gradually increasing a hydraulic pressure for the clutch after the termination of filling,

a second spring disposed on the other end side of said spool for said first valve, and

(11) AU-B-83209/87
(10) 601537

-2-

filling and clutch pressure detecting means for detecting the termination of filling and a clutch pressure on the basis of a displacement of said spool for said first valve against a resilient force of said second spring.

PCT

世界知的所有機関
国際事務局

AU-AI-83209/87



特許協力条約に基づいて公開された国際出願

(51) 国際特許分類⁴
F16D 25/14

A1

(11) 601537 WO 88/07636

(43) 国際公開日

1988年10月6日 (06.10.88)

(21) 国際出願番号 PCT/JP87/00929
(22) 国際出願日 1987年11月30日 (30. 11. 87)
(31) 優先権主張番号 特願昭62-70990
特願昭62-70991
特願昭62-70992
特願昭62-70993

(32) 優先日 1987年3月25日 (25. 03. 87)
1987年3月25日 (25. 03. 87)
1987年3月25日 (25. 03. 87)
1987年3月25日 (25. 03. 87)

(33) 優先権主張国 JP

(71) 出願人 (米国を除くすべての指定国について)

株式会社 小松製作所
(KABUSHIKI KAISHA KOMATSU SEISAKUSHO)(JP/JP)
〒107 東京都港区赤坂2丁目3番6号 Tokyo, (JP)

(72) 発明者: および

(75) 発明者/出願人 (米国についてのみ)

浅山芳夫 (ASAYAMA, Yoshio)(JP/JP)
〒253 神奈川県茅ヶ崎市柳島海岸990-10 Kanagawa, (JP)
坪田廣雄 (TSUBOTA, Makio)(JP/JP)
〒254 神奈川県平塚市四之宮102 Kanagawa, (JP)
大蔵泰則 (OKURA, Yasuho)(JP/JP)
〒254 神奈川県平塚市万田18 Kanagawa, (JP)

佐藤賢之 (SATO, Takayuki)(JP/JP)
〒254 神奈川県平塚市南原634-1 Kanagawa, (JP)

(74) 代理人

弁理士 木村高久 (KIMURA, Takahisa)
〒104 東京都中央区銀座2丁目11番2号 銀座大作ビル6階
Tokyo, (JP)

(81) 指定国

AT (欧州特許), AU, BE (欧州特許), CH (欧州特許),
DE (欧州特許), FR (欧州特許), GB (欧州特許),
IT (欧州特許), LU (欧州特許), NL (欧州特許),
SE (欧州特許), SU, US.

添付公開書類

A.O.J.P. 1 DEC 1988

国際調査報告書

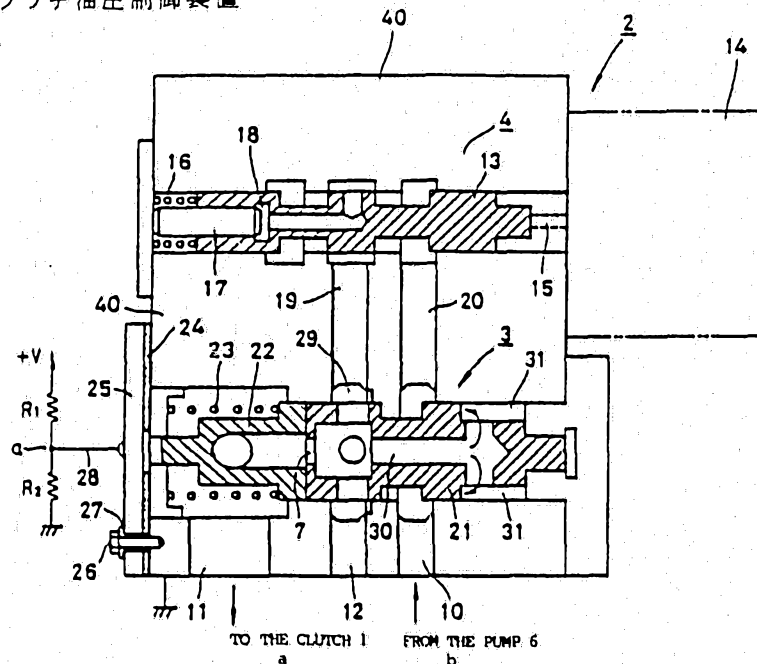
AUSTRALIAN

- 2 NOV 1988

PATENT OFFICE

(54) Title: HYDRAULIC CLUTCH PRESSURE CONTROL APPARATUS

(54) 発明の名称 クラッチ油圧制御装置



This document contains the
amendments made under
Section 49 and is correct for
printing.

(57) Abstract

A hydraulic clutch pressure control apparatus according to the present invention is used for a transmission in a construction machine, and provided for each of a plurality of clutches (1), which are controlled thereby separately. This hydraulic clutch pressure control apparatus has a first valve (3) for supplying an oil at a high flow rate to a clutch, and a second valve (4) for electronically controlling a clutch pressure, and is adapted to detect the completion of a filling operation and a clutch pressure on the basis of the movements of a spool (21) in the first valve (3) and a separately provided piston (20) in the second valve (4) so as to prevent the occurrence of an overshooting pressure at the time of completion of a filling operation.

(57) 要約

この発明のクラッチ油圧制御装置は、建設機械等のトランスミッションに用いられ、複数のクラッチ1に対し各別に設けられるとともに、それぞれ独立に制御される。このクラッチ油圧制御装置は、クラッチに大流量の油を流すための第1のバルブ3と、クラッチ圧を電子制御する第2のバルブ4とを有し、第1バルブ3のスプール21や、別置のピストン等の動きに基づきフィリング終了やクラッチ圧を簡易な構成で検出するようにしている。また第1のバルブ3のスプール21に受圧面積差を設けることにより、フィリング終了時のオーバーシュート圧を防止するようにしている。

情報としての用途のみ

PCTに基づいて公開される国際出願のパンフレット第1頁にPCT加盟国を同定するために使用されるコード

AT	オーストリア	FR	フランス	MR	モーリタニア
AU	オーストラリア	GA	ガボン	NW	マラウイ
BR	バルバドス	GB	イギリス	NL	オランダ
BE	ベルギー	HU	ハンガリー	NO	ノルウェー
BG	ブルガリア	IT	イタリア	RO	ルーマニア
BJ	ベナン	JP	日本	SD	スーダン
BR	ブラジル	KP	朝鮮民主主義人民共和国	SE	スウェーデン
CF	中央アフリカ共和国	KR	大韓民国	SN	セネガル
CG	コンゴ	LI	リヒテンシュタイン	SU	ソビエト連邦
CH	スイス	LK	スリランカ	TD	チャド
CM	カメルーン	LU	ルクセンブルグ	TC	タークス
DE	西ドイツ	MC	モナコ	US	米国
DK	デンマーク	MG	マダガスカル		
FI	フィンランド	ML	マリ		

SPECIFICATION

APPARATUS FOR CONTROLLING HYDRAULIC PRESSURE FOR CLUTCH

TECHNICAL FIELD

The present invention relates to an apparatus for controlling a hydraulic pressure usable for a clutch and more particularly to an apparatus of the foregoing type which assures that detection of filling and detection of a clutch pressure are carried out by a simple electronic control type valve arrangement to prevent an occurrence of double engagement with clutches and speed changing is smoothly achieved.

BACKGROUND ART

Fig. 15 illustrates a hitherto widely employed control for speed changing with a transmission. In the illustrated case, speed changing from a first speed to a second speed is taken into account. This conventional control for speed changing is such that a clutch for the first speed is turned off when a command for speed changing is outputted and at the same time a hydraulic oil starts to flow in a clutch for the second speed. Consequently, a hydraulic pressure in the clutch for the first speed is lowered from a predetermined



pressure to a level of zero when the command for speed changing is outputted, while a hydraulic pressure in the clutch for the second speed starts to increase gradually after a period of filling time t_f elapses. This filling time t_f designates a period of time required for filling the interior of a clutch pack of the clutch for the second speed with a hydraulic oil.

In this manner, with the conventional apparatus, the time t_f that elapses until the clutch pack is filled with a hydraulic oil is reserved and no torque is transmitted during the period of time t_f . This causes a so-called breathing phenomenon to appear during a period of speed changing with the conventional apparatus and the breathing phenomenon gives rise to a problem concerning running performances such as riding comfortability, acceleration characteristic or the like. Particularly, with respect to a large-sized construction machine, a period of filling time is prolonged due to a large capacity of respective clutches, which has a substantial effect on running performances.

In view of the foregoing problems, in the recent years attention has been paid to a crossover control as disclosed in an official gazette of Japanese Laid-Open Patent NO. 13758/1963 and the crossover control has been lately carried out using electronic type pressure control valves. Specifically, according to the prior invention as proposed



by the inventors under Japanese Patent Application NO. 271055/1985, a crossover control as shown in Fig. 16 is carried out using an electronic modulation system for all clutches to prevent an occurrence of breathing during a period of speed changing due to the presence of filling time.

The proposal as shown in Fig. 16 is such that when a command for speed changing is outputted, a hydraulic oil starts to flow in a clutch for the second speed to be next brought in an engaged state, thereafter when the termination of filling is detected, a clutch for the first speed which has been previously brought in an engaged state is turned off and a build-up control is initiated for the clutch for the second speed.

According to this proposal, an occurrence of breathing phenomenon due to the presence of filling time t_f is not only prevented reliably but also speed changing can be smoothly achieved, resulting in improved running performances being assured. However, to properly carry out such speed changing, it is required that the filling time t_f is exactly detected and an occurrence of double engagement is prevented without fail.

Hitherto, detection of the filling has been performed by properly controlling a pattern with which a hydraulic pressure is gradually increased as time elapses after a



command for speed changing is outputted. Specifically, hitherto, a time required for filling the clutch pack with a hydraulic oil is suitably set on the basis of prior experiments, the termination of filling is identified when the set time elapses after a command for speed changing is outputted, and thereafter a hydraulic pressure is increased gradually.

However, it has been found that detecting of the filling having such time control employed therefor can not absorb fluctuation in filling time. For instance, when the clutch pack is filled with a hydraulic oil before the set time elapses, this allows an useless waiting time to be produced, which brings a factor of causing time lag. In addition, since there is a shortage in reliability of detection, a problem is that the aforementioned time control can not be applied to the conventional crossover control for speed changing.

Additionally, according to this crossover control for speed changing, there is a danger that clutches are brought in double engagement, if releasing and engagement timing of clutches located at the preceding stage as well as at the following stages are deviated from correct ones. Accordingly, this becomes a serious problem from the viewpoint of measures to be taken for safety.

However, any particular measure for assuring safety is



not taken with the conventional apparatus and this leads to a fear of causing troubles such as damage or injury of components or instruments.

To prevent an occurrence of double engagement, it suffices that an engaged state of the respective clutches can be determined. To this end, there is a need of watching which clutch is filled with a hydraulic oil having a certain intensity of pressure. To provide structural arrangement for the purpose of watching in that way, there has been made a proposal for arrangement of a strain gauge type pressure sensor or a semiconductor type pressure sensor which is available on the commercial basis. However, the proposal has a problem that the commercial pressure sensor is expensive and it has a difficulty in durability. Further, to prevent an occurrence of double engagement, it suffices that whether or not the clutch is filled with a hydraulic oil having a certain intensity of pressure is known. According, a quantitatively detected value derived by a pressure sensor is not required.

~~The present invention has been made with the foregoing background in mind and its object resides in providing an apparatus for controlling a hydraulic pressure usable for a clutch which assures that detection of filling and detection of presence or absence of a hydraulic pressure for clutches can be exactly attained by a simple and inexpensive~~



DISCLOSURE OF THE INVENTION

It is the object of the present invention to overcome or substantially ameliorate the above disadvantages.

There is disclosed herein an apparatus for controlling a hydraulic pressure usable for a clutch comprising;

5 a first valve including a spool with an orifice formed at an output port leading to said clutch, said first valve being opened under the effect of a differential pressure appearing across said orifice and closed under the effect of a restorable force of a first spring disposed on one
10 end of said spool,

15 a second valve in the form of a pressure control valve adapted to be activated in response to an electric signal, said second valve functioning to open said first valve by feeding to the latter a hydraulic oil delivered from a pump during a period of changing speed and gradually increasing a hydraulic pressure for the clutch after the termination of filling,

a second spring disposed on the other end side of said spool for said first valve, and

20 filling and clutch pressure detecting means for detecting the termination of filling and a clutch pressure on the basis of a displacement of said spool for said first valve against a resilient force of said second spring.

BRIEF DESCRIPTION OF THE DRAWINGS

25 A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

30 Fig. 1 is a hydraulic circuit illustrating a first embodiment of the present invention, Fig. 2 is a sectional view illustrating by way of example the inner structure of a hydraulic pressure control valve for a clutch in accordance with the first embodiment, Fig 3 is a time chart illustrating a timing for detecting the termination of



KLN/24871

filling, Fig. 4 is a sectional view illustrating a second embodiment of the present invention, Fig. 5 is a hydraulic circuit illustrating a third embodiment of the present invention, Fig. 6 is a sectional view illustrating the inner structure of a hydraulic pressure control valve for a clutch in accordance with the third embodiment, Fig. 7 is time charts illustrating by way of example operation of the hydraulic pressure control valve in accordance with the third embodiment respectively, Fig. 8 is a block diagram illustrating a structural arrangement to be monitored by a pressure detecting switch, Fig. 9 is a time chart illustrating a clutch pressure during a period of speed changing in which an overshoot pressure is generated, Fig. 10 is a fragmental enlarged view illustrating a fourth embodiment of the present invention, Fig. 11 is a time chart illustrating a clutch pressure during a period of speed changing in accordance with the fourth embodiment, Fig. 12 is a hydraulic circuit illustrating a fifth embodiment of the present invention, Fig. 13 is a sectional view illustrating by way of example the inner structure of a hydraulic pressure control valve for a clutch in accordance with the fifth embodiment, Fig. 14 is time charts illustrating by way of example operation of the hydraulic pressure control valve in accordance with the fifth embodiment respectively, Fig. 15 is time charts illustrating



a conventional control for speed changing respectively, Fig. 16 is time charts illustrating a control for speed changing in accordance with the conventional crossover control system, and Fig. 17 is a hydraulic circuit illustrating clutches for each of which an electronic type hydraulic pressure control valve is provided.

BEST MODE FOR CARRYING OUT THE INVENTION

Now, the present invention will be described in a greater detail hereunder with reference to the accompanying drawings which illustrate preferred embodiments thereof.

Figs. 1 and 2 illustrate a first embodiment of the present invention.

Fig. 1 illustrates by way of example a hydraulic circuit for an electronic type hydraulic pressure control valve 2 usable for driving a clutch 1 and Fig. 2 schematically shows a sectional structure of the hydraulic pressure control valve 2.

Referring to Figs. 1 and 2, the hydraulic pressure control valve 2 comprises a flow rate detecting valve 3, an electronic type pressure control valve 4 and a filling detecting switch 9, and the pressure control valve 4 is driven in response to an electrical signal outputted from a controller 5. The hydraulic pressure control valve 2 allows a hydraulic oil delivered from a pump 6 to flow therein via



an input port 10 and feeds it to the clutch 1 via an output port 11. At this moment, a port 12 is kept closed.

The electronic type pressure control valve 4 includes a spool 13, and the right end of the spool 13 comes in contact with a plunger 15 of a proportional solenoid 14, while the left end of the same is resiliently supported by a coil spring 16. A hydraulic pressure in a hydraulic passage 19 is introduced into a hydraulic chamber 18 defined by the spool 13 and the piston 17.

The flow rate detecting valve 3 includes a spool 21 and an orifice 7 is formed on the output port 11 side of the spool 21. A filling detecting piston 22 is brought in contact with the left end surface of the spool 21 and it is resiliently supported by a spring coil 23.

A cover 25 made of ferrous metallic material is fitted to the left-hand surface of a valve housing 40 with an electrical insulating sheet 24 interposed therebetween. Thus, the cover 25 is electrically isolated from the valve housing 40 in the presence of the insulating sheet 24. Additionally, a plurality of cover fitting bolts 26 are electrically isolated from the cover 25 using a plurality of insulating sleeves 27. The cover 25 has a lead wire 28 connected thereto which in turn is connected to a point a between resistances R_1 and R_2 which are connected to one another in series. A predetermined intensity of DC voltage



(for instance, 12 V) is applied to opposite ends of the resistances R_1 and R_2 . It should be noted that the valve housing 40 is earthed.

With this construction, the piston 22 comes in contact with the housing 40 at all times. However, the piston 22 is not normally brought in contact with the cover 25 made of ferrous metallic material but it comes in contact with the cover 25 when it is displaced in the leftward direction as viewed in the drawing.

In a case where the clutch 1 is to be brought in an engaged state with the construction as shown in Figs. 1 and 2, the controller 5 is so activated that a solenoid 14 for the electronic type hydraulic pressure control valve 4 is turned on with a considerably high intensity of electrical current. Consequently, the spool 13 for the pressure control valve 4 is displaced in the leftward direction so that a hydraulic oil delivered from the pump 6 is introduced into the pressure control valve 4 via the input port 10 and the hydraulic passage 20. Hydraulic oil introduced into the pressure control valve 4 flows in the flow rate detecting valve 3 via a hydraulic passage 19 and a port 29 and it flows further in the clutch 1 via an orifice 7 in the spool 21 and an output port 11. In addition, hydraulic oil introduced through the port 29 is delivered to a hydraulic chamber 31 via a hydraulic passage 30 in the spool 21.



This causes a differential pressure ($P_A - P_B$) to be generated between the left side of the orifice 7 and the right side of the same, and the flow rate detecting valve 3 assumes an opened position under the influence of the differential pressure by allowing the spool 21 to be displaced in the leftward direction. Consequently, hydraulic oil introduced into the input port 10 flows directly into the port 29 and it is then delivered to the clutch 1 via the orifice 7.

On the other hand, since the piston 22 is displaced in the leftward direction as the spool 21 is displaced in the leftward direction, the left end surface of the piston 22 is brought in contact with the cover 25. Since the piston 22 comes in contact with the valve housing 40 at this moment, a potential at the point a is lowered to the earthed level as shown in Fig. 3, resulting in no voltage appearing at the point a.

Delivery of a hydraulic oil to the clutch 1 via the flow rate detecting valve 3 continues until a clutch pack is filled with hydraulic oil. When the clutch pack is completely filled with hydraulic oil, the filling is terminated and this causes no hydraulic oil to flow any more with the result that the differential pressure between the left side of the orifice 7 and the right side of the same disappears. Consequently, the spool 21 in the flow rate



detecting valve 3 is displaced in the rightward direction under the effect of a restorable force of the spring 23 so that the flow rate detecting valve 3 is returned to assume a closed state. On the other hand, when the spool 21 is displaced in the rightward direction on the termination of filling, the piston 22 is also displaced in the rightward direction under the effect of resilient force of the spring 23 whereby the left end surface of the piston 22 is parted away from the cover 25, resulting in a voltage V appearing at the point a again. Namely, the time point when the feeling is terminated can be known by detecting the time point when a potential rises at the point a.

A voltage signal derived from the point a is inputted in the controller 5 which in turn detects the rising of the voltage signal to detect the time point when the filling is terminated. When the controller 5 detects the termination of filling by way of the voltage signal, an intensity of electrical current to be fed to the solenoid 14 is gradually increased so that a hydraulic pressure to be exerted on the clutch is gradually increased. Incidentally, the controller 5 is so operated that the spool 13 is displaced by a long distance in the leftward direction by inputting a considerably high intensity of electrical current into the solenoid 14 when speed changing is initiated and thereafter it is kept in a waiting state till the termination of



filling while an intensity of electrical current to be inputted is lowered to a suitable initial level. When the controller 5 detects the termination of filling, it gradually increases an intensity of electrical current from this initial level.

In this manner, according to the first embodiment, the termination of filling can be simply and exactly detected by way of the steps of extracting via the piston 22 a displacement of the spool 21 for the flow rate detecting valve 3 adapted to operate in dependence on presence or absence of flowing of a hydraulic oil into the clutch 1, in the form of a movement of the piston 22 for contact with the cover 25 or a movement of the same away from the cover 25 and then electrically detecting the foregoing movement. Incidentally, in this embodiment, the spool 21 is supported by the spring 23 via the piston 22. However, the present invention should not be limited only to this. Alternatively, the spool 21 having the piston 22 secured thereto may be supported directly by the spring 23.

With this construction, a crossover control for speed changing as shown in Fig. 16 can be carried out reliably. Specifically, it suffices that a hydraulic pressure control valve 2 as constructed in the above-described manner is separately connected to a clutch in the respective speed change stages and that for instance,



in a case where speed changing is effected from a first speed to a second speed, a clutch for the second speed is filled with a hydraulic oil just before a clutch for the first speed is disengaged, the clutch for the first speed is disengaged when a potential at a point a on the hydraulic pressure control valve 2 disposed for the clutch for the second speed rises and a clutch pressure for the second speed is then built up by controlling the pressure control valve 4.

Fig. 4 illustrates a second embodiment of the present invention. This embodiment is such that an electromagnetic pickup 35 is arranged on the housing cover 34 side so that a movement of the spool 21 is detected by the pickup 35. Specifically, an induction voltage generated by the electromagnetic pickup 30 varies as the spool 21 moves and thereby a movement of the spool 21 can be detected by detecting a variation in induction voltage. In this case, since the spool 21 for the flow rate detecting valve 3 is returned to a position as shown in Fig. 4 under the effect of a restorable force of the spring 23 when the clutch pack is filled with a hydraulic oil in the same manner as in the foregoing embodiment, the termination of filling can be exactly detected by detecting the return movement of the spool 21 with the aid of the electromagnetic pickup 30.

Figs. 5 and 6 illustrate a third embodiment of the



present invention and same or similar components to those in the foregoing embodiments are identified by same reference numerals. Thus, repeated description will not be required.

Referring to Figs. 5 and 6, the hydraulic pressure control valve 2 for a pertinent clutch is equipped with a pressure detecting switch 50 besides the flow rate detecting valve 3 and the electronic type pressure control valve 4 as constructed in the same manner as in the foregoing embodiments.

In this case, the pressure control valve 4 includes the same spool 13 as that in the foregoing embodiments and the right end of the spool 13 comes in contact with a plunger 15 of the proportional solenoid 14, while the left end of the same is resiliently supported by a coil spring 16. A hydraulic pressure in the hydraulic passage 19 is introduced into a hydraulic chamber 18 defined by the spool 13 and the piston 17.

Similarly, the flow rate detecting valve 3 includes the same spool 21 as that in the foregoing embodiments. An orifice 7 is formed on the output port 11 side of the spool 21 and the left-hand end of the spool 21 is resiliently supported by a coil spring 23.

The pressure detecting switch 50 is provided at the upper end of the hydraulic passage 19 to detect a clutch pressure. The pressure detecting switch 50 comprises a



pressure detecting piston 51 and a coil spring 52 for resiliently supporting the piston 51.

The spring 52 is adapted to energize the piston 51 via a spring guide 53 under the effect of a resilient force thereof of which intensity is so determined that the piston 51 is not pushed back when a hydraulic pressure for the clutch, that is, a hydraulic pressure in the hydraulic passage 19 is lower than a predetermined set pressure P_h (for instance, 5 Kg/cm²). The piston 51 contacts a valve body 40 but normally does not contact a cover 54 of ferrous metallic material placed on the upper surface of the valve body 40. When the piston 51 is displaced upwardly against a resilient force of the spring 52, it is brought in contact with the cover 54. The cover 54 made of ferrous metallic material is electrically isolated from the body in the presence of an insulating sheet 55 interposed therebetween. Additionally, cover fitting bolts 56 are kept in an electrically isolated state from the cover 54 in the presence of insulating sleeves 57 fitted therethrough.

A lead wire 58 is extended from the cover 54 so that it is connected to a point b between resistances R_1 and R_2 which are connected to one another in series. A predetermined magnitude of DC voltage V (for instance, 12V) is applied to the point b and the valve body 40 is earthed.

The hydraulic pressure control valve 2 as constructed



in the above-described manner is connected to a clutch for the respective speed change stages and each of the control valves 2 is equipped with the aforementioned pressure detecting switch 50.

Next, operation of the apparatus constructed as illustrated in Figs. 5 and 6 will be described below with reference to time charts as shown in Fig. 7. In a case where it is required that the clutch 1 communicated with the hydraulic pressure control valve 2 is brought in an engaged state, the controller 5 is activated to input a trigger command to the solenoid 14 of the control valve 2 (see Fig. 7(a)). Incidentally, after the trigger command has been inputted in that way, the controller 5 is kept in a waiting state till the termination of filling while an intensity of command electrical current is lowered to a level indicative of a value of initial pressure command electrical current corresponding to an initial pressure P_a of the hydraulic pressure for the pertinent clutch.

The spool 13 in the pressure control valve 4 is displaced in the leftward direction in response to inputting of the trigger command and a hydraulic oil discharged from the pump 6 is introduced into the pressure control valve 4 via the input port 10 and the hydraulic passage 20. Hydraulic oil introduced into the pressure control valve 4 flows in the flow rate detecting valve 3 via the hydraulic



passage 19 and the port 29 and thereafter it flows in the clutch 1 via the orifice 7 and the output port 11.

Additionally, hydraulic oil introduced through the port 29 is delivered to the hydraulic chamber 31 via the hydraulic passage 30 formed in the spool 21.

Then, a differential pressure ($P_A - P_B$) is generated between the right side of the orifice 7 and the left side of the same and the spool 21 is displaced in the leftward direction under the influence of the differential pressure so that the flow rate detecting valve 3 is kept open. Consequently, hydraulic oil introduced through the input port 10 enters directly into the port 29 and it flows further in the clutch 1 via the orifice 7. Flowing of hydraulic oil in that way continues until the clutch pack is completely filled with hydraulic oil.

During a period of filling time t_f that elapses until the clutch pack is filled with hydraulic oil, a hydraulic pressure in the clutch pack is maintained substantially at a level of zero as shown in Fig. 7(b) and it does not reach the pressure Th set by the spring 52, resulting in the upper end surface of the pin 51 of the pressure detecting switch 50 failing to come in contact with the cover 54 made of ferrous metallic material. While this operative state is maintained, a potential appearing at the point b assumes a value of voltage derived by dividing the voltage V by the



resistances R_1 and R_2 , as shown in Fig. 7(c).

When the clutch pack is filled with hydraulic oil, the filling is terminated and no hydraulic oil flows any more. Thus, the differential pressure generated across the orifice 7 disappears with the result that the spool 21 in the flow rate detecting valve 3 is displaced in the rightward direction under the effect of a resilient force of the spring 23 and thereby the flow rate detecting valve 3 is returned to the closed state. After the filling is terminated, the controller 5 is so activated that an electrical current to be fed to the solenoid 14 is gradually increased from the value of command electrical current representative of the initial pressure, as shown in Fig. 7(a).

This permits a hydraulic pressure for the pertinent clutch to be gradually increased from the initial pressure P_a (for instance, about 2 Kg/cm^2), as shown in Fig. 7(b). Since the pressure T_h set for the spring 52 is set appreciably larger than the initial pressure P_a , the hydraulic pressure causes the pressure detecting piston 51 to be displaced upwardly against the resilient force of the spring 52, when it is in excess of the set value T_h . Consequently, the upper end surface of the piston 51 is brought in contact with the cover 54. This allow the cover 54 made of ferrous metallic material to be electrically



conducted to the earthed body 40 via the piston 51, resulting in the potential at the point b being lowered to a level of zero, as shown in Fig. 7(c). Thus, no voltage appears at the point b.

According to the third embodiment, presence or absence of a hydraulic pressure in the clutch pack is recognized in the form of a movement of the pressure detecting piston 51 at the upper end of the hydraulic passage 19 in contact with the cover 54 or a movement of the former away from the latter so that a movement of the piston 51 in contact with the cover 54 or a movement of the former away from the latter can be electrically detected via variation in voltage at the point b. Accordingly, presence or absence of a hydraulic pressure for the pertinent clutch can be known by examining presence or absence of a potential at the point b.

Additionally, according to this embodiment, an electronic type hydraulic pressure control valve 2 having the aforementioned pressure detecting switch 50 incorporated therein is provided for the respective clutches and outputs from the plural pressure detecting switches 50 are inputted in the controller 5, as shown in Fig. 8. The controller 5 monitors outputs from the plural pressure detecting switches 50 and then makes a determination on the basis of the result derived from monitoring as to whether double engagement is made or not. Namely, which clutch is kept in an engaged



state can be recognized by monitoring outputs from the plural pressure switches 50, and in a case where clutch pressure detecting signals are simultaneously outputted from two pressure switches 50, this can be determined as double engagement. When the controller 50 has determined that double engagement is made, it takes a countermeasure such that a command is outputted to reduce a hydraulic pressure in one of the clutches immediately or turn off all the clutches immediately in order to prevent pertinent components or instruments from being damaged or injured due to an occurrence of double engagement.

Indeed, with respect to the hydraulic pressure control valve 2 as shown in Fig. 6, it has been found that when the spool 21 for the flow rate detecting valve 3 is closed after the filling time t_f elapses, an overshoot pressure as shown in Fig. 9 is generated and this gives rise to a factor that a shock occurs during a period of speed changing or an abnormal sound is generated. Unless this overshoot pressure is reduced, any effort becomes useless which is intended to reduce a shock due to speed changing by carrying out torque compensation using the electronic type hydraulic pressure control valve. Accordingly, reduction of the overshoot pressure becomes a serious problem. To absorb the overshoot pressure, there has been proposed a method of providing an accumulator. However, problems arise that this method is



practiced at an expensive cost and moreover structure in the proximity of the valve is enlarged and complicated. For the reason, the conventional method fails to be put in practical use.

As results derived from a variety of research works conducted by the inventors with the foregoing problems in mind, it has been found that the overshoot pressure is generated when a return speed of the spool 21 in the flow rate detecting valve 3 is slow during a period in which the spool 21 returns (moves in the rightward direction) after the termination of filling. In this connection, an usual flow rate detecting valve 3 is so designed that a pressure receiving area A_1 of the spool 21 in the hydraulic chamber 31 is substantially equal to a pressure receiving area A_2 on the left-hand end surface of the same. Namely, with such construction as shown in Fig. 6, since the spool 21 is returned only by a restorable force of the spring 23 when the differential pressure between the left side of the orifice 7 and the right side of the same disappears, the result is that a speed of its return movement is slow and a certain time delay occurs until the spool 21 is completely closed.

To obviate the foregoing problems, the present invention provides a fourth embodiment. According to the fourth embodiment, as shown in Fig. 10, a certain amount of



difference is provided between the pressure receiving area A_2 at the left end of the spool 21 and the pressure receiving area A_1 of the same in the hydraulic chamber 31 in such a manner that the pressure receiving area A_2 on the left end surface of the spool 21 is larger than the pressure receiving surface A_1 of the same in the hydraulic chamber 31 and an equation as represented by $A_2 = 2A_1$ is established therebetween.

Here, when it is assumed that a pressure before the orifice 7 is represented by P_A and a pressure behind the same is represented by P_B as shown in Fig. 5, a differential pressure ΔP appearing across the orifice 7 is represented by $\Delta P = P_A - P_B$.

Accordingly, a force exerted on the left-hand end surface of the spool 21 is represented by $A_2 P_B$ and a force exerted on the spool 21 in the leftward direction in the presence of a hydraulic pressure in the hydraulic chamber 31 is represented by $A_1 P_A$.

Namely, a force F as represented by the following formula is exerted on the spool 21 in the rightward direction.

$$\begin{aligned} F &= A_2 P_B - A_1 P_A \\ &= 2A_1 P_B - A_1 P_A \\ &= A_1 (2P_B - P_A) \end{aligned} \quad \text{--- (1)}$$

Now, it is assumed that the differential pressure ΔP



becomes zero on the termination of filling. At this moment, P_A becomes equal to P_B and therefore the formula (1) is modified in the form of $F = A_1 P_A$. Thus, this force F is exerted on the spool 21 in the rightward direction, that is, in the direction of closing of the spool 21. It should be noted that P_A is not reduced completely to zero due to resistance existent throughout piping, return spring in the clutch or the like.

Consequently, in this case, when the filling is terminated, the spool 21 is returned under the effect of a force represented by a return force of the spring 23 with a force $F = A_1 P_A$ added thereto, resulting in the spool 21 being closed at a high speed.

Fig. 11 is a time chart illustrating a relationship of time vs. hydraulic pressure for a pertinent clutch in the valve constructed as shown in Fig. 10. With such valve construction, an overshoot pressure appearing after the filling time t_f elapses can be adequately reduced, as shown in Fig. 11.

Namely, the valve construction shown in Fig. 10 assures that the overshoot pressure is reliably reduced by such simple and inexpensive improvement that the pressure receiving area A_2 of the spool located on the side where a force is exerted in the direction of closing of the flow rate detecting valve 3 is determined larger than the

pressure receiving area A_1 of the same located on the side where a force is exerted in the direction of opening of the flow rate detecting valve 3 (it is preferable that a difference in area therebetween is larger).

Figs. 12 and 13 illustrate a fifth embodiment of the present invention. This embodiment is such that both functions comprising a filling detecting function provided in accordance with the first and second embodiments and a clutch pressure detecting function provided in accordance with the third embodiment are attained by a single sensor construction.

Specifically, referring to Figs. 12 and 13, a hydraulic pressure control valve 60 comprises a pressure control valve 61 for controlling a hydraulic pressure usable for a clutch, a flow rate detecting valve 62 and a sensor section 63 for detecting a filling and a clutch pressure. The pressure control valve 61 is controlled by a controller 5, and a detection signal S from the sensor section 63 is inputted in the controller 5.

A hydraulic oil delivered from a pump which is not shown in the drawings is introduced into the hydraulic pressure control valve 60 via an input port 70 and it is then fed to the clutch 1 via an output port 71. At this moment, a port 72 is kept closed and ports 73 and 74 represent a drain port respectively.



The electronic type pressure control valve 61 includes a spool 75 of which right end comes in contact with a plunger 77 of a proportional solenoid 76, and a coil spring 78 is disposed at the left end of the spool 75. Additionally, a hydraulic pressure in a hydraulic passage 82 is introduced via a hydraulic passage 81 into a hydraulic chamber 80 defined by the spool 75 and the piston 79.

The flow rate detecting valve 62 includes a spool 85 which defines hydraulic chambers 86, 87 and 88. An orifice 90 is formed between both the hydraulic chambers 87 and 88. The spool 85 is so constructed that it has three different pressure receiving areas S_1 , S_2 and S_3 which have a relationship among them as represented by $S_1 + S_3 > S_2$ and $S_2 > S_3$. A coil spring 91 is disposed at the left end of the spool 85 and another coil spring 92 is disposed at the right-hand end of the same. When no hydraulic pressure is introduced into the hydraulic chambers 87 and 88, the spool 85 is maintained at a neutral position shown in Fig. 12 where both the springs 91 and 92 have their free length. Accordingly, when the spool 85 is held at a neutral state, a hydraulic oil which flows in the flow rate detecting valve 62 from a hydraulic passage 84 via the input port 70 is caused to stay in the hydraulic chamber 86.

Here, when it is assumed that spring constants of the springs 91 and 92 are represented by k_1 and k_2 , hydraulic



pressures in the hydraulic chambers 87 and 88 are represented by P_1 and P_2 and a displacement of the spool 85 from the neutral position is represented by x , a force F_1 represented by the following formula (2) is exerted on the spool 85 in the rightward direction when the spool 85 is located leftward of the neutral position shown in Fig. 13.

$$F_1 = k_1 x + S_1 P_2 + P_1 (S_3 - S_2) \quad \text{--- (2)}$$

On the contrary, when the spool 85 is located rightward of the neutral position, a force F_2 represented by the following formula (3) is exerted on the spool 85 in the leftward direction.

$$F_2 = k_2 x - S_1 P_2 - P_1 (S_3 - S_2) \quad \text{--- (3)}$$

Incidentally, in this case, $k_2 > k_1$ is assumed. Specifically, in this case, the spring 91 functions as a return spring for the spool 85 and the spring 92 functions as a pressure setting spring for the purpose of detecting a hydraulic pressure for the clutch.

A detecting pin 94 made of metallic material is disposed on the upper right side of the valve body 93 in order to detect that the spool 85 is displaced further rightward of the neutral position shown in Fig. 13 against a resilient force of the spring 92. The detecting pin 94 is attached to the valve body 93 by means of a cover 95 in the presence of an electrical insulating sheet 96 and a lead wire 97 is extended from the detecting pin 94.



The lead wire 97 is connected to a point c between resistances R_1 and R_2 which in turn are connected to one another in series. A predetermined magnitude of DC voltage V (for instance, 12 V) is applied to the resistances R_1 and R_2 therebetween and the valve body 93 is earthed. Namely, the sensor 63 for detecting a filling and a hydraulic pressure for the pertinent clutch comprises the spring 92; the detecting pin 94 serving as a contact on the spool 85 and the resistances R_1 and R_2 .

The hydraulic pressure control valve 60 having the sensor section 63 used therefor is disposed individually for clutches for respective speed change stages.

Next, operation of the apparatus constructed as illustrated in Figs. 12 and 13 will be described below with reference to time charts as shown in Fig. 14. It should be noted that Fig. 14(a) shows a command electrical current I from the controller 5, Fig. 14(b) does a pump pressure P_p , Fig. 14(c) does a hydraulic pressure P_1 in the hydraulic chamber 87 before the orifice 90, Fig. 14(d) does a hydraulic pressure (clutch pressure) P_2 in the hydraulic chamber 88 behind the orifice 90 and Fig. 14(e) does an output S from the sensor 63.

When it is required that a clutch allocated to a certain speed change stage is brought in an engaged state, the controller 5 is so activated that a trigger command



electrical current I_1 is inputted in the solenoid 76 of the pertinent valve 60 (time t_1), a command electrical current I is later lowered to an initial pressure command electrical current I_0 corresponding to an initial pressure P_a for the hydraulic pressure for the pertinent clutch (Fig. 14(d)) and it is then held in a waiting state till the termination of filling while the foregoing operative state is maintained.

As the trigger command electrical current I_1 is inputted in that way, the spool 75 in the pressure control valve 61 is displaced in the leftward direction and a hydraulic oil delivered from the pump flows in the hydraulic chamber 87 of the flow rate detecting valve 62 via the input port 70 and the hydraulic passage 82. Hydraulic oil introduced into the hydraulic chamber 87 flows in the hydraulic chamber 88 via the orifice 90 and it flows further in the clutch 1 via the hydraulic passage 83 and the output port 71. At this moment, a differential pressure ($P_1 - P_2$) is generated between both the hydraulic chambers 87 and 88 due to the provision of the orifice 90. Here, since the pressure P_2 is approximately equal to zero, the spool 85 is displaced in the leftward direction under the effect of a force represented by $(S_2 - S_3) P_1 - k_1 x$ (where S_2 is larger than S_3) which is derived by inserting a condition of $P_2 = 0$ in the formula (2).

As a result, the flow rate detecting valve 62 is opened



so that hydraulic oil introduced into the hydraulic passage 84 flows in the hydraulic chamber 87 via the hydraulic chamber 86 and thereafter it flows further in the clutch 1 via the orifice 90, the hydraulic chamber 88, the hydraulic passage 83 and the output port 71. The flowing of hydraulic oil continues until the clutch pack is completely filled with hydraulic oil.

Here, when the spool 85 is held at the neutral position shown in Fig. 13 as well as during a period of filling time t_f in which the spool 85 is displaced leftward of the neutral position, the spool 85 is parted away from the detecting pin 94.

As long as the foregoing operative state is maintained, a potential appearing at the point c assumes a value of voltage which is derived by dividing the voltage V by the resistances R_1 and R_2 , as shown in Fig. 14(e).

When the clutch pack is filled with oil, the filling is terminated and no hydraulic oil flows any more. Thus, the differential pressure across the orifice 90 disappears. Namely, pressure P_1 becomes equal to pressure P_2 .

Consequently, the spool 85 is displaced in the rightward direction under the effect of a force derived from inserting a condition of $P_1 = P_2$ in the formula (2), that is, a force represented by the following formula, until it is returned to the neutral position.



$$F_1 = K_1 x + P_2 (S_1 + S_3 - S_2)$$

Here, since the respective pressure receiving areas S_1 , S_2 and S_3 on the spool 85 are set in accordance with a relationship represented by $S_1 + S_3 > S_2$, a force $P_2 (S_1 + S_3 - S_2)$ generated due to a difference in pressure receiving area is exerted on the spool 85 in the same direction as that of a restorable force of the spring 91 whereby the spool 85 is displaced in the rightward direction under the effect of a force which is derived by the restorable force of the spring 91 with the force due to the difference in pressure receiving area on the spool 85 added thereto.

While the spool 85 is returned in that way, a hydraulic pressure from the pump is transmitted to a hydraulic pressure for the pertinent clutch via the hydraulic passage 84, the hydraulic chamber 87, the orifice 90 and the hydraulic chamber 88, resulting in a shoot pressure as shown in Fig. 14(d) being generated.

The spring constant k_2 of the spring 92 is set to a pressure value Th larger than the initial pressure Pa but smaller than the aforesaid shoot pressure (see Fig. 14(d)).

Thus, during a period of return movement of the spool 85, the latter is displaced in the rightward direction to the neutral position as shown in Fig. 13 and thereafter it is displaced further in the rightward direction in the presence of the shoot pressure against the energizing force



$k_2 x$ of the spring 92 whereby the right end surface of the spool 85 comes in contact with the detecting pin 94.

Namely, in this case, the spool 85 is displaced in the rightward direction under the effect of a force derived by putting a condition of $P_1 = P_2$ in the formula (3).

Consequently, since the detecting pin 94 is electrically conducted to the earthed valve body 93 via the spool 85, the potential at the point c is lowered to a level of zero as shown in Fig. 14(e) and thereby no voltage appears at the point c (time t_2).

The potential at the point c is inputted in the controller 5 as a detecting signal S so that the controller 5 determines the termination of filling by an initial rising of the potential at the point c. When the termination of filling is determined, the controller 5 gradually increases the initial command electrical current I for the pertinent clutch from the initial pressure electrical current I_0 without delay (see Fig. 14(a)). Incidentally, when the controller 5 determines the termination of filling, it lowers a command electrical current for the clutch located at the previous stage to a level of zero as shown by an one-dotted line in Fig. 14(a).

As a result, a clutch pressure for the pertinent clutch is lowered from the aforesaid value of shoot pressure to the initial pressure P_a and thereafter it is gradually



increased, as shown in Fig. 14(d). Accordingly, the spool 85 is once displaced in the leftward direction toward the neutral position from the operative state in which it contacts the pin 94. Thereafter, since the clutch pressure P_2 is gradually increased, it exceeds the set pressure T_h of the spring 92 at a certain time point t_3 . Consequently, the spool 85 is displaced in the rightward direction again against the energizing force $k_2 \times$ of the spring 92 until its right end surface comes in contact with the detecting pin 94.

Thus, a potential at the point c is lowered to a level of zero again at the time t_3 and thereafter this zero level is maintained.

Specifically, since the potential at the point c is such that it becomes zero when the clutch is activated with a pressure higher than the set pressure T_h and it assumes a predetermined value of voltage when the clutch pressure is lower than the preset pressure T_h , presence or absence of the clutch pressure, that is, an engaged state of the clutch can be known by monitoring the potential at the point c. Additionally, in this case, since the potential at the point c is once lowered to a level of zero due to the shoot pressure on the termination of the feeling, the termination of the latter can be detected by detecting the first lowering.



According to this embodiment, the electronic type hydraulic pressure control valve 60 having the aforementioned sensor section 63 attached thereto is provided for the respective clutches so that outputs from the plural sensor sections 63 are inputted in the controller 5, as shown in Fig. 8. The controller 5 monitors outputs from the plural sensor sections 63 to determine the termination of filling and presence or absence of double engagement on the basis of results derived from the monitoring. Namely, the controller 5 outputs a trigger command I_0 to a clutch to be brought in an engaged state and thereafter determines the time when the filling is terminated, by detecting the first lowering of a detection signal S to be inputted therein from the sensor section 63 of the clutch. In addition, the controller 5 determines which clutch is held in an engaged state, by monitoring outputs from the plural sensor sections 63, and in a case where clutch pressure detecting signals are simultaneously outputted from two sensor sections 63, it determines that this is identified as double engagement. When the double engagement is determined by the controller 5, the latter immediately outputs a command for lowering a hydraulic pressure for one of the clutches or takes a countermeasure such that all the clutches are turned off immediately, in order to prevent associated components or instruments from



being damaged or injured due to the double engagement.

In this manner, according to this embodiment, since a spring 92 is disposed on the opposite side to the return spring 91 and a displacement of the spool 85 from the neutral position toward the spring 92 side is detected by the contact switch arrangement comprising a detecting pin 94 and resistances R_1 and R_2 , this makes it possible to detect the termination of filling and determine a clutch engaged state by the single sensor arrangement including a single spool.

Further, since a relationship as represented by $S_1 + S_3 > S_2$ and $S_2 > S_3$ is provided for the respective pressure receiving areas S_1 , S_2 and S_3 on the spool 85, a force generated by a difference in pressure receiving area with a restorable force of the return spring 91 added thereto is exerted on the spool 85 when the latter is displaced in the rightward direction after the termination of filling whereby the spool 85 can be returned to the neutral position at a high speed. Incidentally, when returning of the spool 85 is achieved only by a resilient force of the spring 91, the spool 85 has a reduced return speed with the result that an overshoot pressure as represented by a dotted line in Fig. 14(d) is generated on the termination of filling and this gives rise to a factor of causing a shock due to speed changing. In this case, the overshoot pressure can be



reduced by increasing the return speed of the spool by the aforementioned difference in pressure receiving area.

It should of course be understood that the present invention should not be limited only to these embodiments but various changes or modifications may be made in a suitable manner. For instance, structural arrangement for detecting a filling time may be arbitrarily made in any other fashion, provided that the termination of filling can be detected by a movement of the spool 21.

In addition, the pressure detecting switch 50 may be located at other suitable position within the interior of the valve body, provided that the position assures that a hydraulic pressure usable for the pertinent clutch can be detected.

INDUSTRIAL APPLICABILITY

The present invention is advantageously applicable to a transmission for a construction machine such as truck, wheel loader or the like as well as a passenger car.



The claims defining the invention are as follows:

1. An apparatus for controlling a hydraulic pressure usable for a clutch comprising;
 - a first valve including a spool with an orifice formed at an output port leading to said clutch, said first valve being opened under the effect of a differential pressure appearing across said orifice and closed under the effect of a restorable force of a first spring disposed on one end of said spool,
 - a second valve in the form of a pressure control valve adapted to be activated in response to an electric signal, said second valve functioning to open said first valve by feeding to the latter a hydraulic oil delivered from a pump during a period of changing speed and gradually increasing a hydraulic pressure for the clutch after the termination of filling,
 - a second spring disposed on the other end side of said spool for said first valve, and
 - filling and clutch pressure detecting means for detecting the termination of filling and a clutch pressure on the basis of a displacement of said spool for said first valve against a resilient force of said second spring.
2. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 1, wherein a spring constant of said second spring is determined larger than that of said first spring.
3. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 1, wherein a spring constant of said second spring means is set larger than an initial pressure for the clutch on the termination of filling and smaller than a shoot pressure generated when the spool for the first valve is closed in response to the termination of filling.
4. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 3, wherein said filling and clutch pressure detecting means is adapted to detect the termination of filling during a period of first displacement of the spool against a resilient force of said second spring for the spool after a speed changing command is produced.



5. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 1, wherein said filling and clutch detecting means comprises a member disposed on the housing of the apparatus and contact and non-contact detecting means for detecting contacting of the spool for the first valve with said member and parting of the former away from the latter.

6. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 5, wherein said member comprises an electrically conductive detecting pin disposed on the housing of the apparatus with an electric insulating material used therefor and said contact and non-contact detecting means is such that contacting of the spool for the first valve with said detecting pin and parting of the former away from the latter are represented in the form of an electrical ON or OFF signal.

7. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 6, wherein said contact and non-contact detecting means comprises voltage applying means for applying a predetermined magnitude of voltage to said detecting pin and voltage detecting means for detecting a voltage appearing on said detecting pin when the spool for the first valve comes in contact with the detecting pin and the former is parted away from the latter.

8. An apparatus for controlling a hydraulic pressure usable for a clutch as claimed in claim 1, wherein the spool for the first valve is such that a pressure receiving area of the spool located on the side where the first valve functions in the direction of closing is determined larger than that of the spool located on the side where the first valve functions in the direction of opening.

DATED this TWENTY-SEVENTH day of JUNE 1990
K K Komatsu Selsakusho

Patent Attorneys for the Applicant
SPRUSON & FERGUSON



KEN/24871

1/14

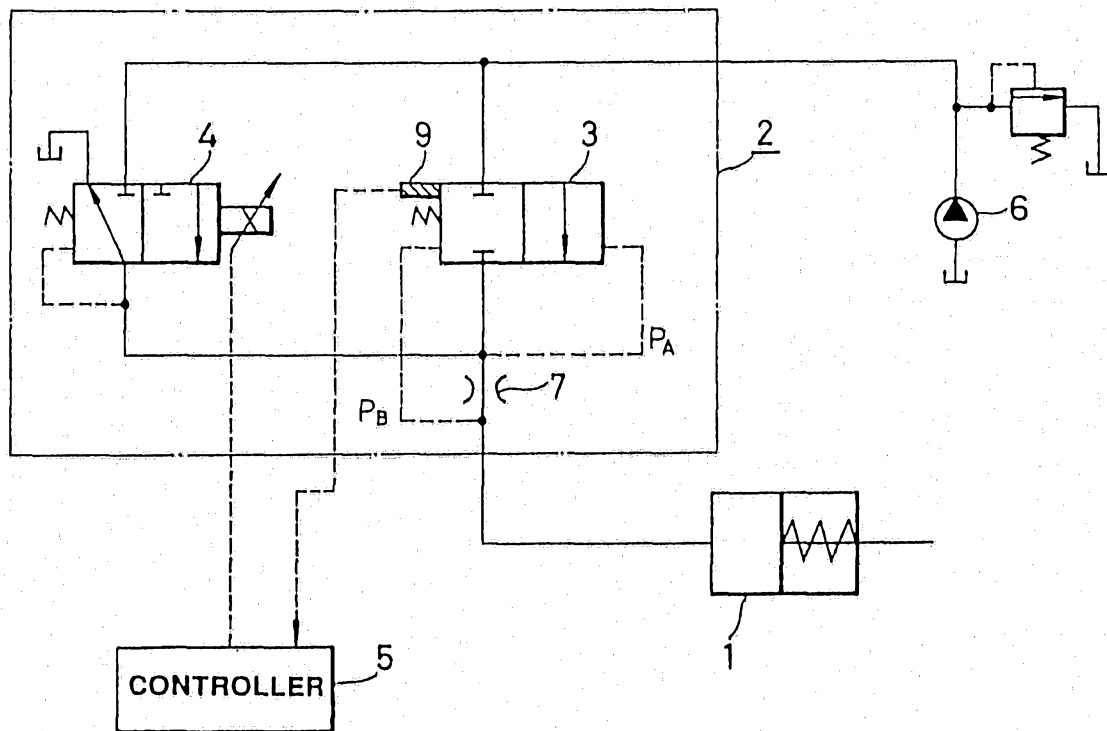


FIG.1

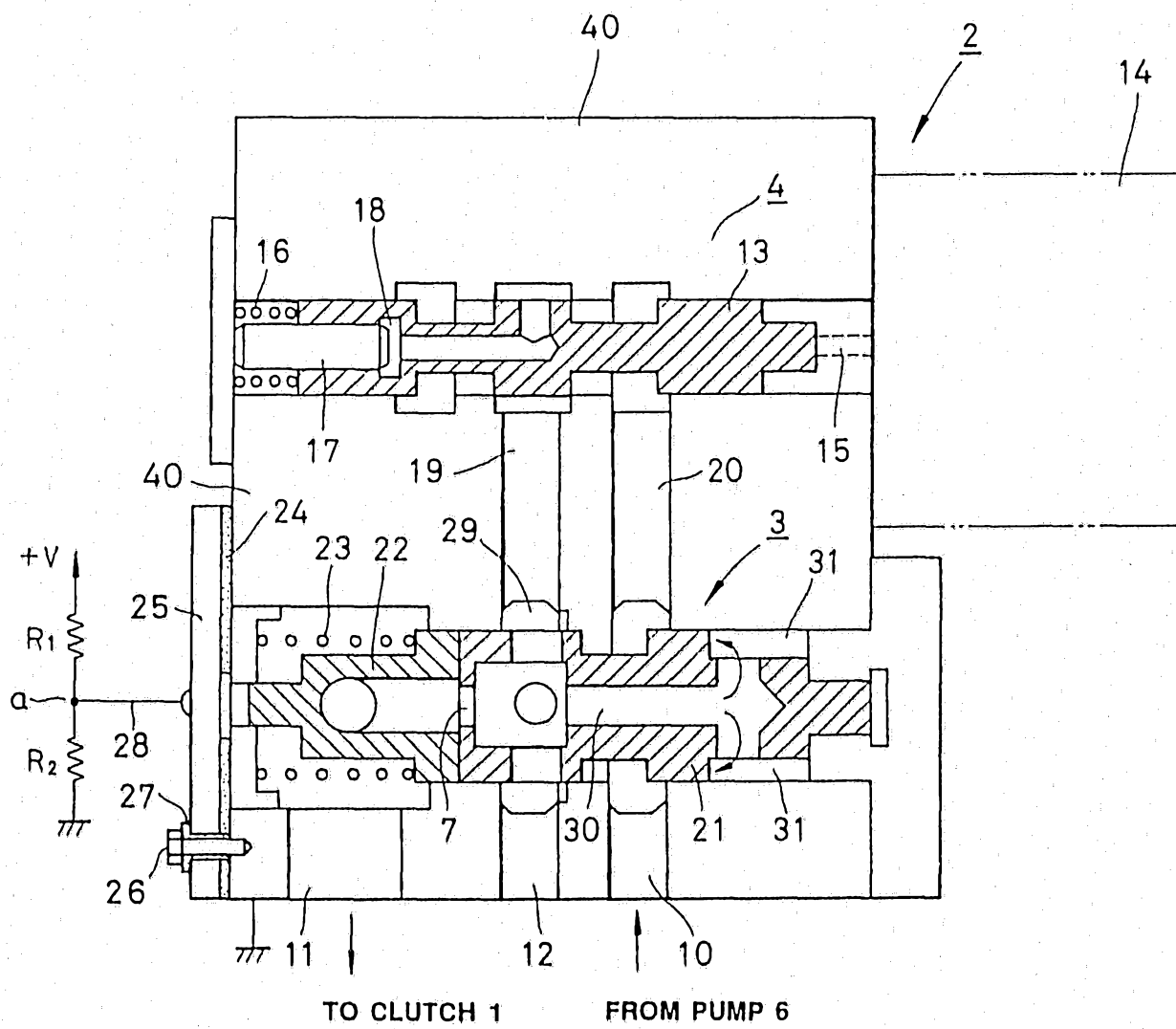


FIG. 2

3/14

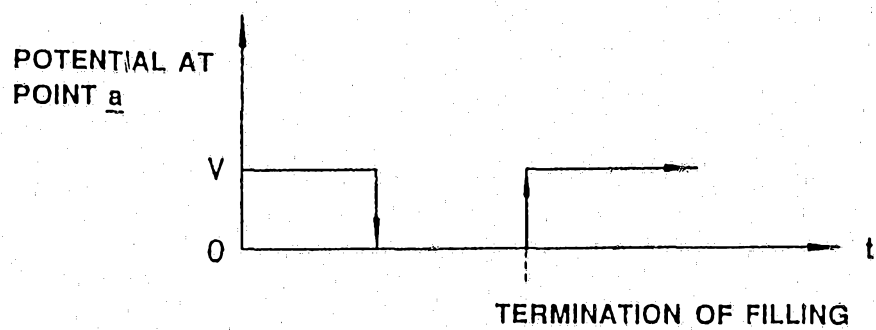


FIG.3

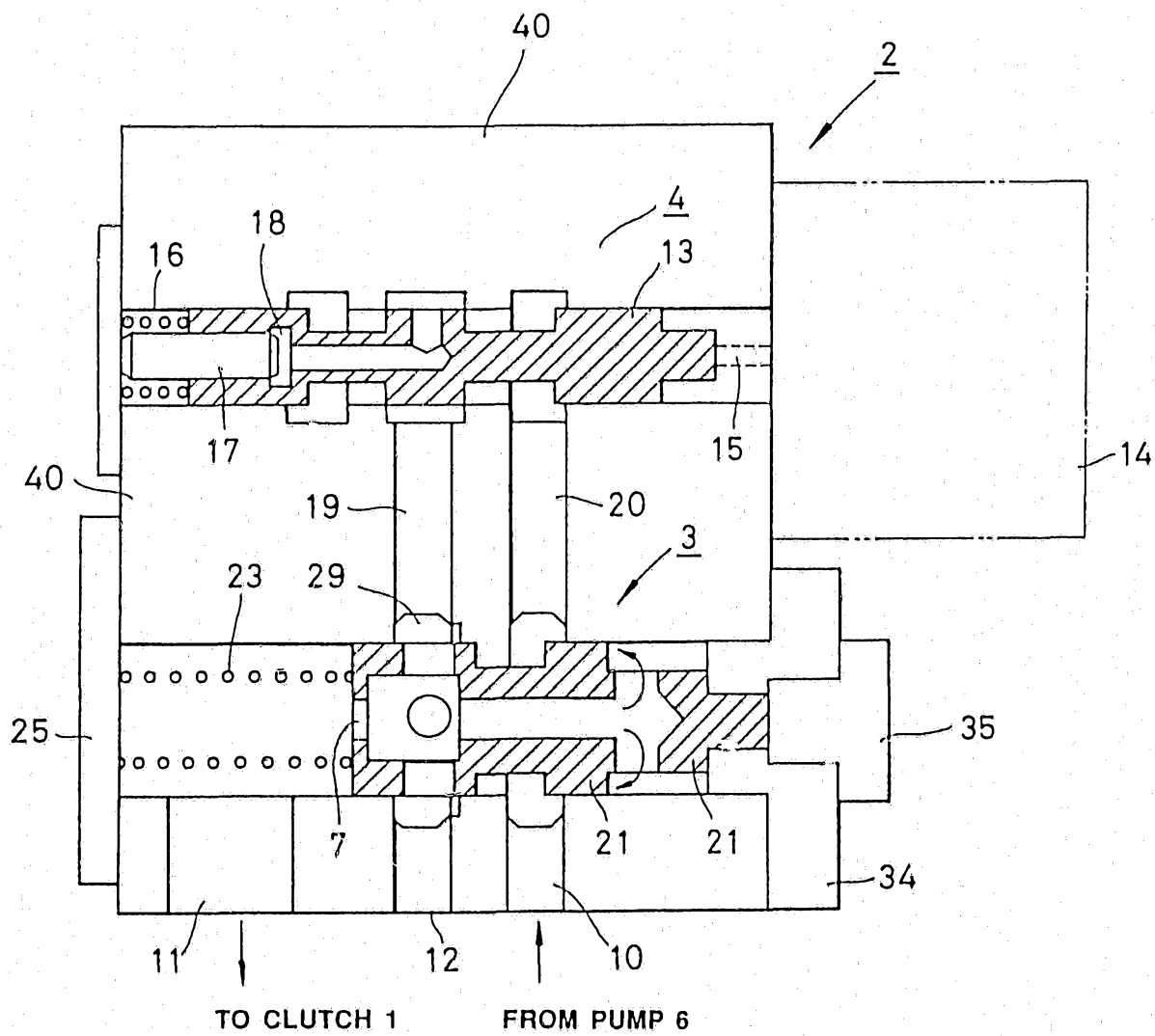


FIG. 4

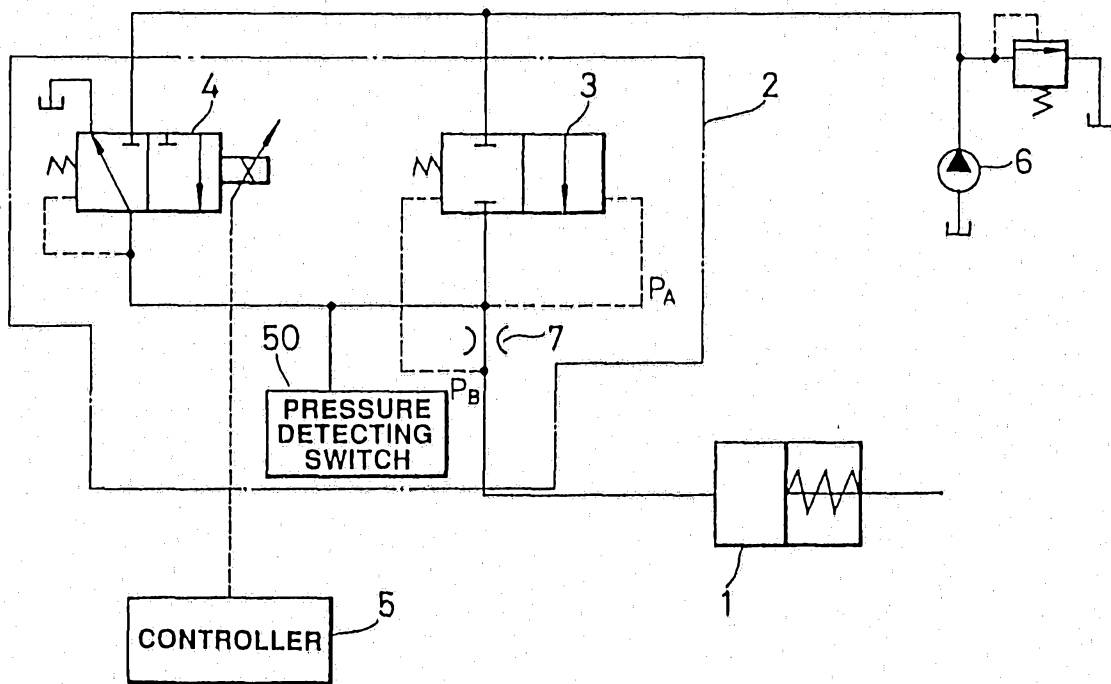


FIG.5

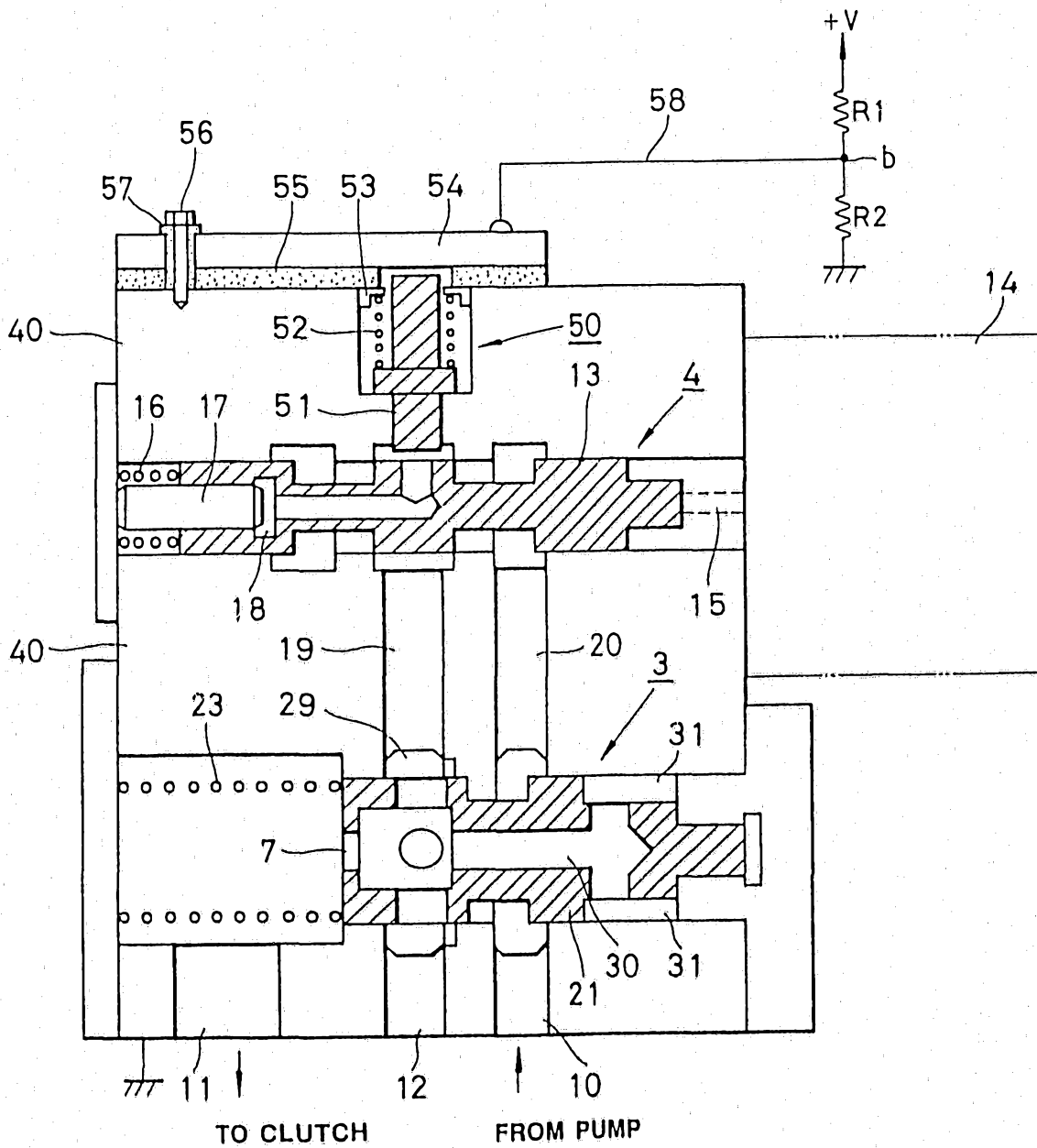


FIG. 6

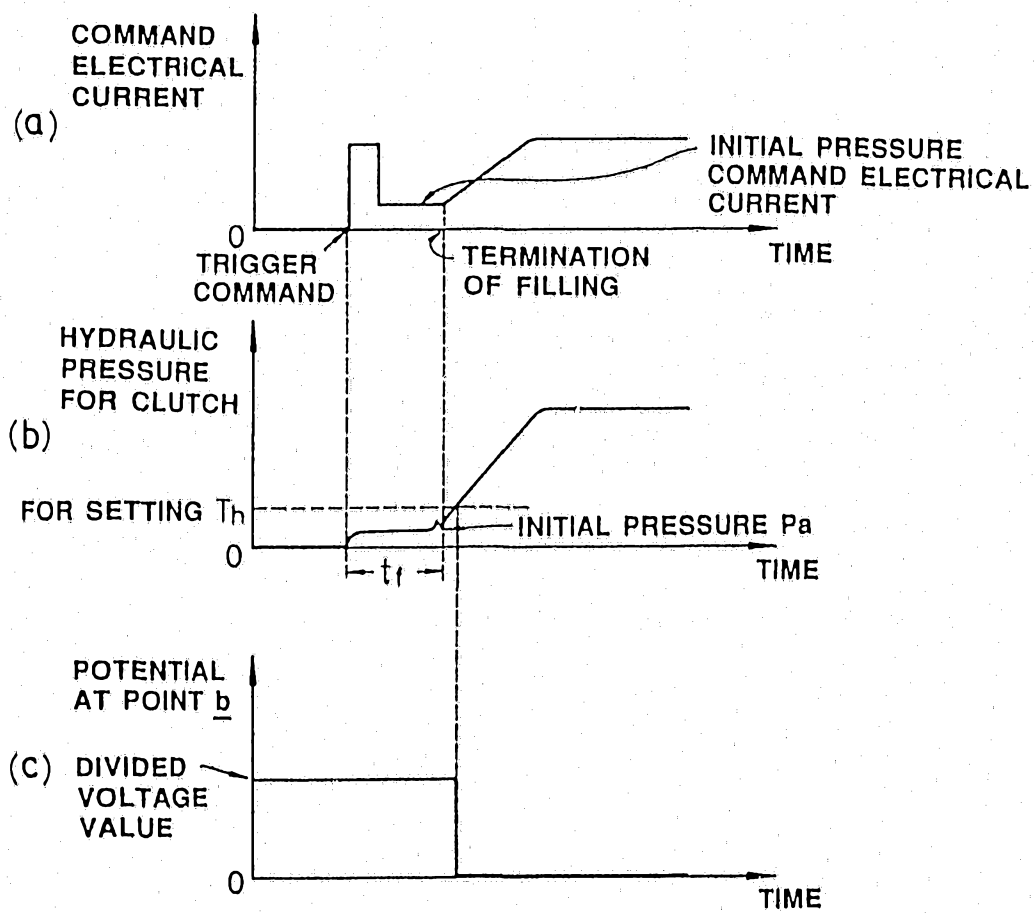


FIG. 7

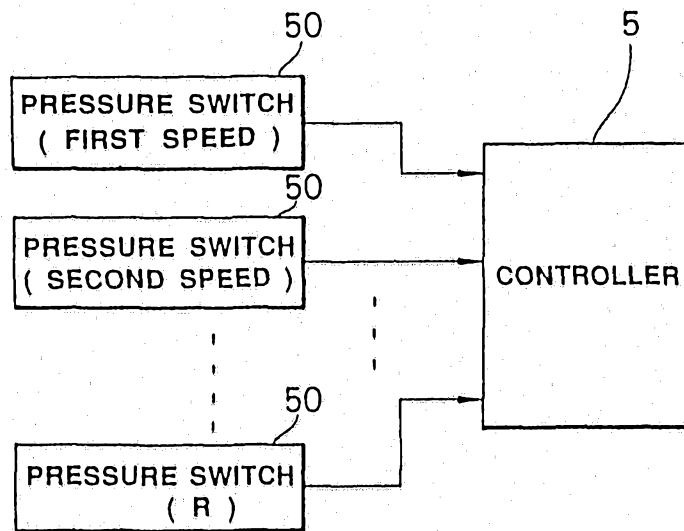


FIG. 8

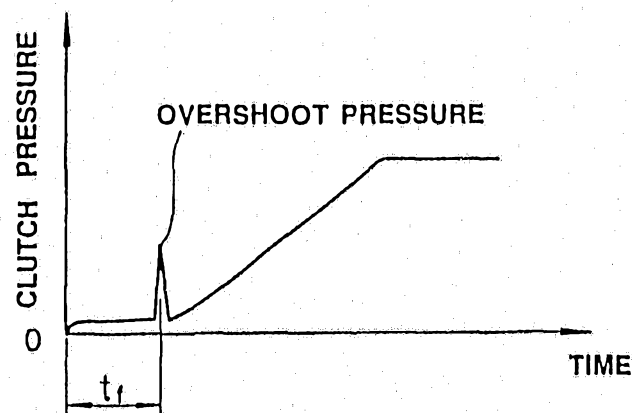


FIG. 9

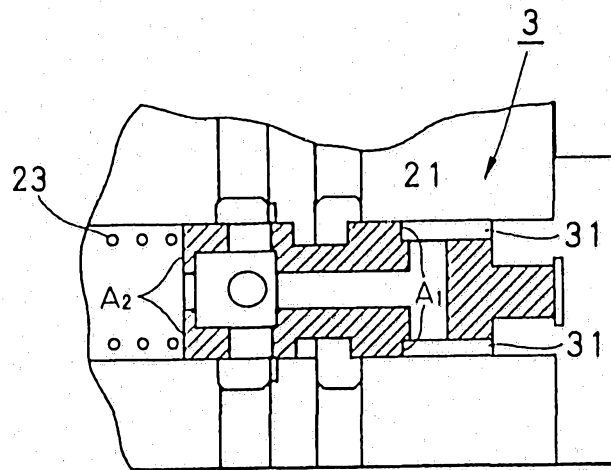


FIG.10

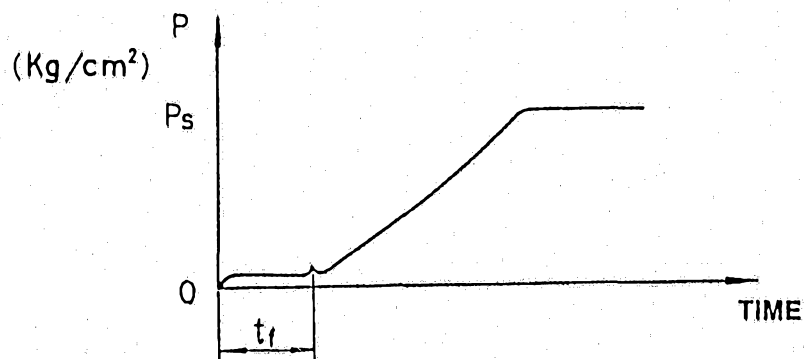


FIG.11

10/
14

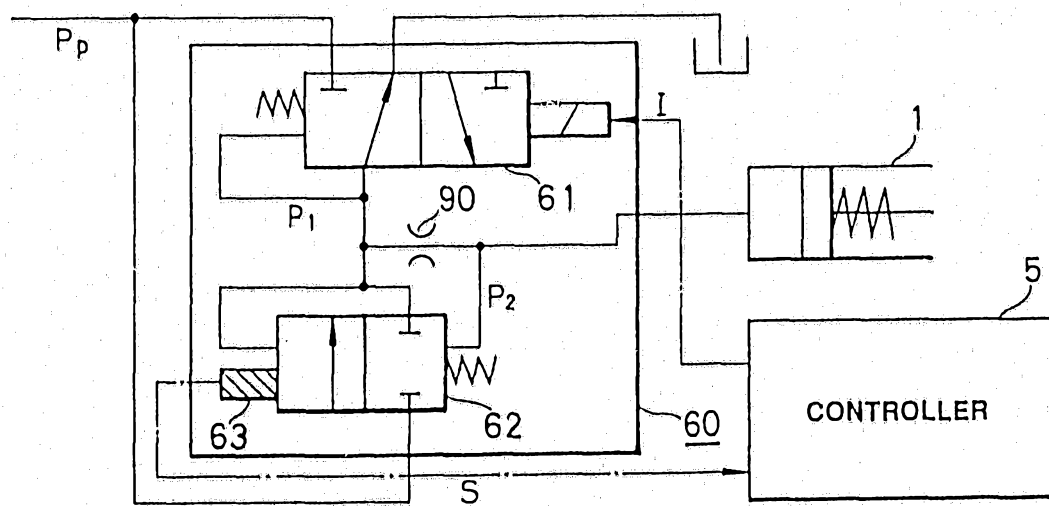


FIG.12

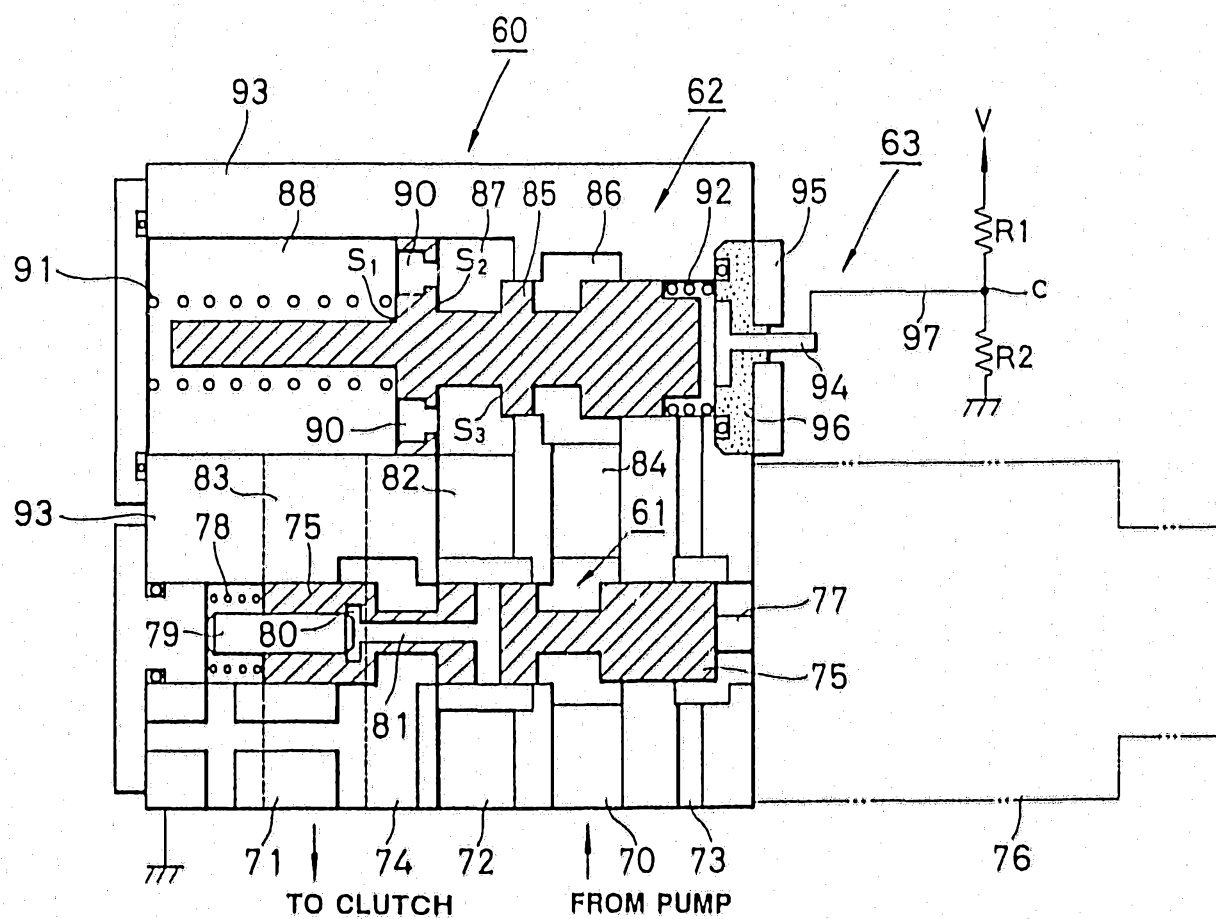


FIG.13

12/14

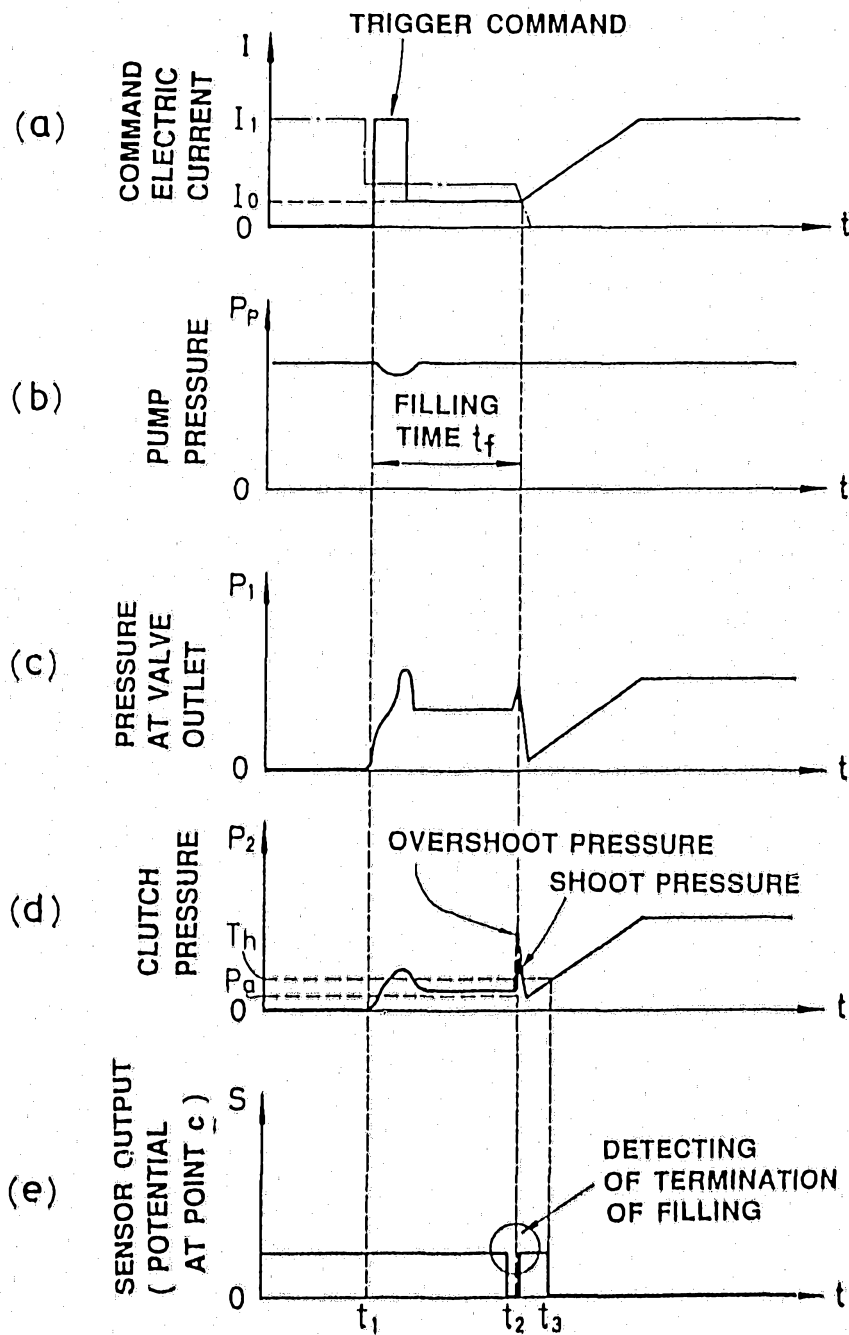


FIG. 14

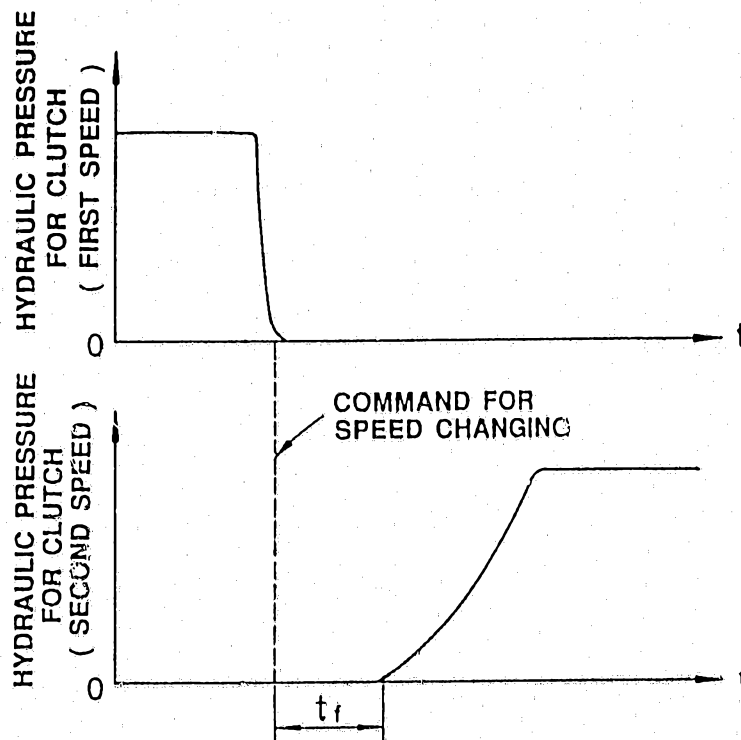


FIG.15

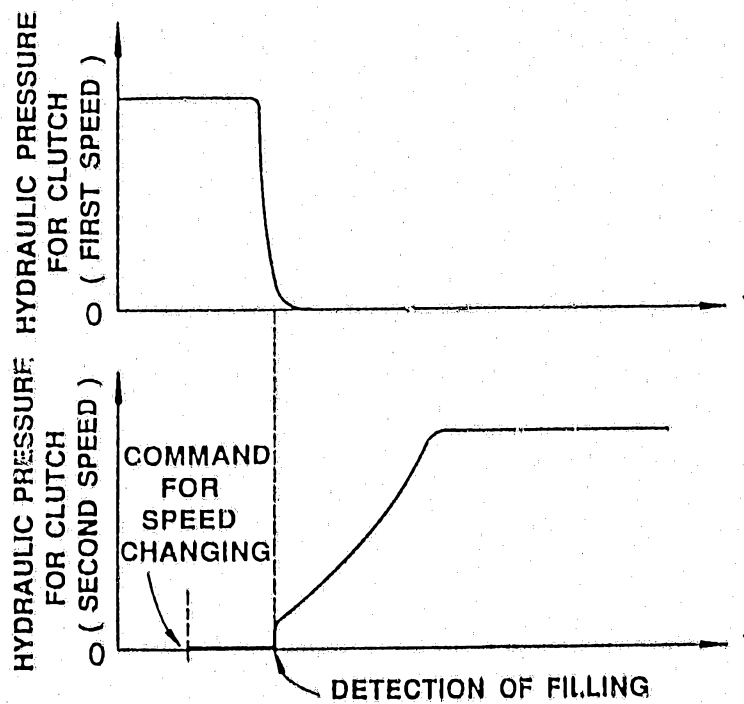


FIG.16

14/14

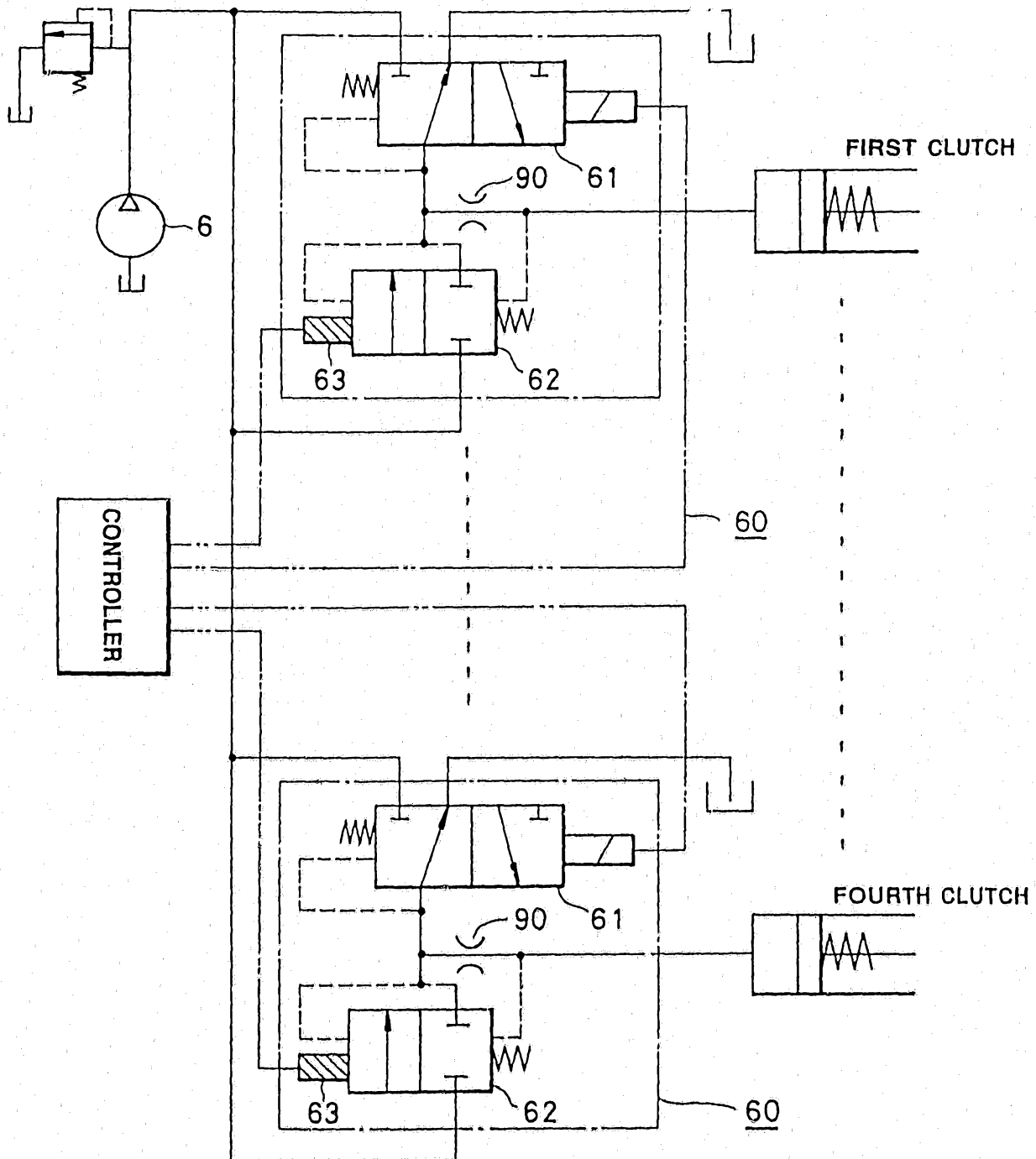


FIG.17

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP87/00929

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl ⁴	F16D25/14	
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC	F16D25/08-25/14, F15B11/08 F16K31/363, 31/383	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
Jitsuyo Shinan Koho	1920 - 1987	
Kokai Jitsuyo Shinan Koho	1971 - 1987	
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁴ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. *
A	JP, Y2, 54-8424 (Komatsu Ltd.) 18 April 1979 (18. 04. 79) Fig. 2 (Family: none)	1-20
A	JP, Y2, 54-27622 (Komatsu Ltd.) 7 September 1979 (07. 09. 79) Drawing (Family: none)	1-20
A	JP, U, 60-84850 (Komatsu Ltd.) 11 June 1985 (11. 06. 85) Fig. 2 & DE, A, 3441853	1-20
A	JP, Y2, 55-48209 (Ikegai Tekko Kabushiki Kaisha) 11 November 1980 (11. 11. 80) Fig. 3 (Family: none)	1-20
* Special categories of cited documents: ¹⁸ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "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) "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 "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 "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "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 "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search *		Date of Mailing of this International Search Report *
February 10, 1988 (10. 02. 88)		February 15, 1988 (15. 02. 88)
International Searching Authority *		Signature of Authorized Officer *
Japanese Patent Office		

国際調査報告

国際出願番号 PCT/JP 87/ 00929

I. 発明の属する分野の分類			
国際特許分類 (IPC) Int. Cl. F 16 D 25 / 14			
II. 国際調査を行った分野			
調査を行った最小限資料			
分類体系	分類記号		
IPC	F 16 D 25 / 08 - 25 / 14, F 15 B 11 / 08 F 16 K 31 / 363, 31 / 383		
最小限資料以外の資料で調査を行ったもの			
日本国実用新案公報		1920-1987年	
日本国公開実用新案公報		1971-1987年	
III. 関連する技術に関する文献			
引用文献の カテゴリー *	引用文献名 及び一部の箇所が関連するときは、その関連する箇所の表示		請求の範囲の番号
A	JP, Y2, 54-8424 (株式会社 小松製作所) 18. 4月. 1979 (18. 04. 79) 第2図 (ファミリーなし)		1-20
A	JP, Y2, 54-27622 (株式会社 小松製作所) 7. 9月. 1979 (07. 09. 79) 図面 (ファミリーなし)		1-20
A	JP, U, 60-84850 (株式会社 小松製作所) 11. 6月. 1985 (11. 06. 85) 第2図 & DE, A, 3441853		1-20
A	JP, Y2, 55-48209 (池貝鉄工株式会社) 11. 11月. 1980 (11. 11. 80) 第3図 (ファミリーなし)		1-20
※引用文献のカテゴリー 「A」 特に関連のある文献ではなく、一般的技術水準を示すもの 「E」 先行文献ではあるが、国際出願日以後に公表されたもの 「L」 優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献 (理由を付す) 「O」 口頭による開示、使用、展示等に言及する文献 「P」 国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献 「T」 国際出願日又は優先日の後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの 「X」 特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの 「Y」 特に関連のある文献であって、当該文献と他の1以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの 「&」 同一パテントファミリーの文献			
IV. 認 証			
国際調査を完了した日 10. 02. 88		国際調査報告の発送日 15. 02. 88	
国際調査機関 日本国特許庁 (ISA/JP)		権限のある職員 特許庁審査官 森 川 元 嗣	3 J 8 2 1 1