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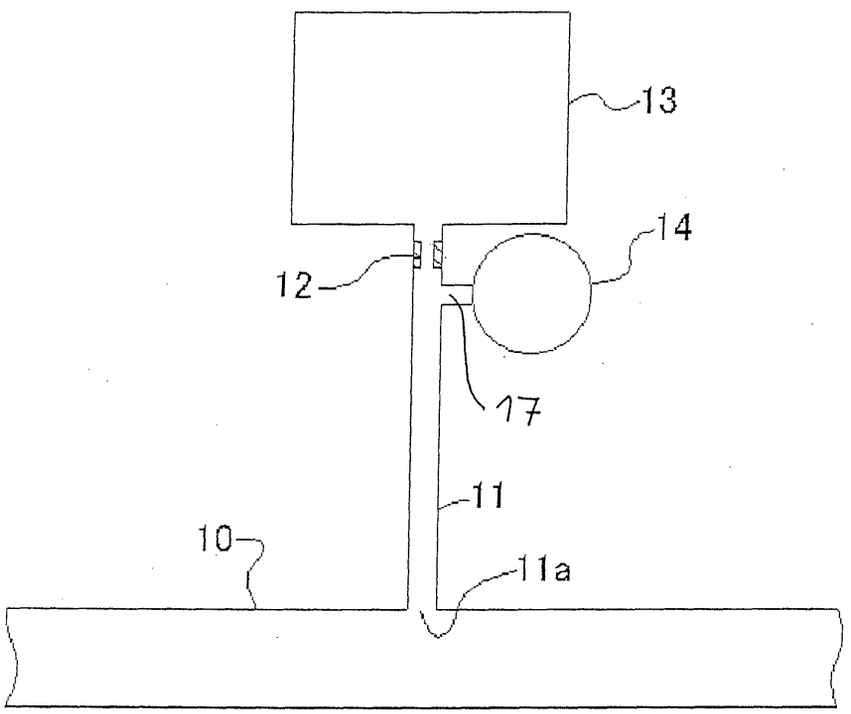
(54) Pressure sampling device for sampling an internal pressure of an intake pipe of a combustion engine

(57) In order to provide an internal pressure sampling device for an intake pipe of an internal combustion engine, capable of sampling the pressure within the intake pipe 10 in a highly precise manner even when the pressure sensor 14 is located away from the intake pipe 10, a sampling pipe 11 is provided on the intake pipe 10 of the internal combustion engine and communicates with the intake pipe 10 of the internal combustion engine, a damper 12 is fitted to one end of the sampling pipe 11, and a pressure sensor 14 is provided on the sampling pipe 11 further towards the side of a pressure takeoff or equalisation opening 11a of the sampling pipe 11 than the damper 12. An absorber 13 communicating with the sampling pipe 11 via the damper 12 is provided at one end of the sampling pipe 11.

Fig. 1



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Description

Technical Field of the Invention

[0001] The present invention relates to a device or an arrangement for sampling an internal pressure of an intake pipe of a combustion engine, and more particularly relates to an internal pressure sampling device or arrangement, respectively, for an internal combustion engine intake pipe wherein a pressure sensor for detecting the pressure within the intake pipe is located away from the intake pipe, in accordance with claim 1.

Description of the Related Art

[0002] The prior art will now be discussed with reference to Figures 16, 17 and 18.

[0003] Conventionally, it is necessary to measure an amount of air flowing within an intake pipe, in order to regulate the air/fuel ratio of an internal combustion engine. In order to achieve this, a pressure sensor is provided on the intake pipe, and the amount of intake air is then calculated by taking the pressure within the intake pipe detected by the pressure sensor as a parameter.

[0004] When the pressure within the intake pipe is detected using this kind of pressure sensor, a pressure sensor 1 is preferably located as close as possible to the intake pipe 2 in order to give good detection response and detection precision, as shown in Figure 16.

[0005] However, situations occur in which it is necessary to position the pressure sensor 1 away from the intake pipe 2, for instance if the pressure sensor 1 is positioned within the engine control unit in order to achieve a more convenient layout of the surroundings of the intake pipe, etc.

[0006] In this case, as shown in Figure 17, a sampling pipe 3 is connected to the intake pipe 2 and the pressure sensor 1 is installed via the sampling pipe 3.

[0007] When the pressure sensor 1 is arranged via this sampling pipe 3 and the sampling pipe 3 is long, the frequency of oscillation of the pressure within the intake pipe 2 determined by the engine speed and the length of the intake pipe 2, and the columnar oscillation frequency of the pressure within the sampling pipe 3 determined by the length of the sampling pipe 3 between the intake pipe 2 and the pressure sensor 1, are drawn close to each other. Pressure oscillations therefore occur within the sampling pipe at this frequency. This then influences the detected sampling pressure, and the precision with which the intake amount is measured therefore decreases.

[0008] As shown in Figure 18, a method for resolving this drawback has been proposed, in which a damper 4 formed by an orifice, etc. is provided in the vicinity of a part connecting the sampling pipe 3 to the intake pipe 2. This prior art is acknowledged in the preamble of claim 1.

[0009] However, even with this method, the influence of the damper 4 causes the responsiveness of the pressure sensor 1 to changes in pressure within the intake pipe 2 to deteriorate, which causes detection precision to decrease.

[0010] In order to resolve the aforementioned problems of the related art, the present invention sets out to provide an internal pressure sampling device for an intake pipe of an internal combustion engine which is capable of sampling the pressure within the intake pipe in a highly precise manner, even when the pressure sensor is located away from the intake pipe.

Summary of the Invention

[0011] In order to resolve at least some of the aforementioned problems, a pressure sampling device of the present invention comprises the features set forth in claim 1. Useful embodiments of the invention are defined by the sub-claims. In accordance with the invention, there can be arranged: a sampling pipe communicating with the intake pipe of the internal combustion engine; a damper fitted to one end of the sampling pipe; and a pressure sensor provided on the sampling pipe further towards the side of a pressure takeoff or equalisation opening of the sampling pipe than the damper, and which can in particular have an absorber communicating with the sampling pipe via the damper provided at an end of the sampling pipe.

[0012] The damper can be an orifice.

[0013] The damper can be made of a porous material provided with successive or adjacent air holes.

[0014] The absorber can be formed by providing an extension of the sampling pipe on the far side of the pressure takeoff or equalisation opening of the sampling pipe, beyond the damper, i.e. beyond a pressure sensor opening.

[0015] The pressure sensor, the damper and the absorber can be formed integrally with an engine control unit for carrying out the drive control of the internal combustion engine.

Brief Description of the Drawings

[0016]

FIG. 1 is a view showing an outline of a configuration for a first embodiment of the present invention.

FIG. 2 is a view showing a waveform for sampling the pressure detected by the first embodiment of the present invention.

FIG. 3 is a view showing a waveform for sampling the pressure detected by the first embodiment of the present invention.

FIG. 4 is a view showing a waveform for sampling the pressure detected by the first embodiment of the present invention.

FIG. 5 is a view showing a waveform for sampling the pressure detected by an example of the related

art.

FIG. 6 is a view showing a waveform for sampling the pressure detected by an example of the related art.

FIG. 7 is a view showing a waveform for sampling the pressure detected by an example of the related art.

FIG. 8 is a view showing a waveform for sampling the pressure detected by another example of the related art.

FIG. 9 is a view showing a waveform for sampling the pressure detected by a further example of the related art.

FIG. 10 is a view showing a waveform for sampling the pressure detected by a further example of the related art.

FIG. 11 is a view showing a waveform for sampling the pressure detected by a further example of the related art.

FIG. 12 is a view showing a waveform for sampling the pressure detected by a further example of the related art.

FIG. 13 is a view showing a waveform for sampling the pressure detected by a further example of the related art.

FIG. 14 is a view showing an outline of a configuration for another embodiment of the present invention.

FIG. 15 is a view showing an outline of a configuration for a further embodiment of the present invention.

FIG. 16 is a view showing an outline of a configuration for an example of the related art.

FIG. 17 is a view showing an outline of a configuration for another example of the related art.

FIG. 18 is a view showing an outline of a configuration for a further example of the related art.

Preferred Embodiments of the Invention

[0017] In general, in order to provide a pressure sampling device to measure the pressure in an intake pipe of an internal combustion engine, capable of sampling the pressure within the intake pipe 10 in a highly precise manner even when the pressure sensor 14 is located away from the intake pipe 10, a sampling pipe 11 is provided on an intake pipe 10 of an internal combustion engine and communicates with the intake pipe 10 of the internal combustion engine via an opening 11a. A damper 12 is fitted to one end of the sampling pipe 11, and a pressure sensor 14 is provided on the sampling pipe 11, further towards the side of a pressure takeoff or equalisation opening 11a of the sampling pipe 11 than the damper 12. An absorber 13 communicating with the sampling pipe 11 via the damper 12 is provided at one end of the sampling pipe 11.

[0018] It is also possible to leave the end of the pressure sampling pipe 11 directed towards the damper 12 open, such that the damper volume can be deemed to be infinite, i.e. the environment of the combustion engine.

[0019] The damper 12 can be a passive damper, e.g. a sponge or a sieve, or it can comprise an active element, e.g. a piezoelectric element, a piezoelectric nozzle, or the like, which can be controlled to be opened or closed according to the sampled pressure in the sampling pipe 11 and thus in the intake pipe 10. The person skilled in the art is aware of other means for constantly or adjustably dampening an oscillation in gas columns.

[0020] The following is a description, with reference to the drawings, of the embodiments of the present invention.

[0021] The internal pressure sampling device for an intake pipe of an internal combustion engine of the embodiment shown in Figure 1 comprises: a sampling pipe 11 communicating with the intake pipe of the internal combustion engine (said engine not shown in the drawings); a damper 12 fitted to one end of the sampling pipe 11; a pressure sensor 14 provided on the sampling pipe 11, further towards the side of a pressure takeoff or equalisation opening 11a of the sampling pipe 11 than the damper 12; and an absorber 13 communicating with the sampling pipe 11 via the damper 12 at one end of the sampling pipe 11. Although the pressure sensor 14 is provided close to the end of the sampling pipe 11 in this embodiment, it may also be provided anywhere on the sampling pipe 11 between the damper 12 and the intake pipe 10.

[0022] In this embodiment, the damper 12 is formed by an orifice, and the absorber 13 is formed by a box-shaped container.

[0023] The capacity of the absorber 13 is set according to the characteristics etc. of the internal combustion engine. The damper 12 may be made of a porous material provided with successive or adjacent air holes, such as sponge.

[0024] A speed of 7500 rpm is maintained for the internal combustion engine employing the internal pressure sampling device for an intake pipe of an internal combustion engine of the embodiment constructed in the above manner, and detection results for the sampling pressure at low loads, medium loads and high loads at this frequency are shown in Figures 2 to 4.

[0025] By way of comparison, detection results for the sampling pressure when the sampling device shown in Figure 16 is used are shown in Figures 5 to 7, detection results for the sampling pressure when the sampling device shown in Figure 17 is used are shown in Figures 8 to 10, and detection results for the sampling pressure when the sampling device shown in Figure 18 is used are shown in Figures 11 to 13.

[0026] In this respect, the sampling results obtained for the sampling device of this embodiment are substantially the same as those obtained when the pressure sensor 1 is arranged close to the intake pipe 2 as shown in Figure 16.

[0027] In view of this, the pressure waveform for the sampling device shown in Figure 17 fluctuates more, due to the influence of the columnar oscillations of the sampling pipe 3 at high loads, while poor responsiveness is obtained with the sampling device shown in Figure 18 due to the influence of the damper 4, and the influence of this poor responsiveness is more prominent at higher loads.

[0028] In the present embodiment, detection results can be obtained which are close to the waveform for the pressure within the intake pipe 10 when there is little transmission delay, even when the pressure sensor 14 is positioned away from the intake pipe 10.

[0029] The air/fuel ratio of the air/fuel mixture supplied to the internal combustion engine can therefore be precisely controlled.

[0030] The damper 12 close to the pressure sensor 14 absorbs the air vibrations of the intake pulsations transmitted to the sampling pipe 11. Therefore, intake pulsations from the intake pipe 10 are not reflected, and air oscillations within the sampling pipe 11 do not occur.

[0031] Even if the length of the sampling pipe 11 changes, the waveform of the pressure detected by the pressure sensor 14 itself can be input as substantially the same waveform as the waveform sampled directly at the intake pipe 10.

[0032] When the air resistance of the damper 12 is too large, the air oscillations are reflected at the damper 12 so as to come back, and air oscillations then occur within the sampling pipe 11.

[0033] It is therefore necessary for the air resistance of the damper 12 to be sufficiently large that air oscillations are not reflected.

[0034] It is necessary to provide the absorber 13 with sufficient capacity to take into consideration the fact that the damper 12 may become unable to absorb the intake pulsations due to the fluctuations in pressure within the absorber due to the absorber 13 having a small capacity.

[0035] The shape and dimensions etc. of each of the structural components shown in the above embodiments are given merely as an example, and various modifications based on design requirements, etc. are possible.

[0036] For example, the above embodiments show an example in which the absorber 13 is a box-type container but, as shown in Figure 14, the absorber 13 may also be formed by extending the sampling pipe 11 past the damper 12 and sealing its end with a sealing member 15.

[0037] A sampling hose or tube alone may then combine the functions of both the sampling pipe and the absorber.

[0038] As shown in Figure 15, it is also possible to integrate the damper 12, the absorber 13 and the pressure sensor 14 into an engine control unit 16 for controlling the driving of the internal combustion engine.

[0039] In accordance with the internal pressure sampling device for an intake pipe of an internal combustion engine of the present invention, detection results close to the waveform for the pressure within the intake pipe when there is little transmission delay can be obtained even when the pressure sensor is positioned away from the intake pipe.

[0040] The air/fuel ratio of the air/fuel mixture supplied to the internal combustion engine can therefore be precisely regulated.

Claims

1. A pressure sampling device for sampling a pressure within an intake pipe of an internal combustion engine, said device comprising:

   a sampling pipe (11) being connected to the intake pipe (10) via a communication orifice (11a);
   a damper (12) being arranged to act in the sampling pipe (11);
   a pressure sensor (14) being arranged to sample the pressure in the sampling pipe (11);

   characterised in that
   the pressure sensor (14) communicates with the sampling pipe (11) at a location which is closer to the communication orifice (11a) than the location or arrangement of the damper (12).

2. The pressure sampling device according to claim 1, wherein the sampling pipe is sealed on the far side of the damper (12) and the pressure sensor (14), by means of a sealing member (15).

3. The pressure sampling device according to claim 2, wherein the sampling pipe (11) is sealed by means of an absorber (13).

4. The pressure sampling device according to any one of claims 1 to 3, wherein the damper (12) is either a passive damper, e.g. a porous body like a sponge or a sinter body, or an active damper, e.g. a piezo-mechanic or piezo-electric element, to be opened or closed, respectively, in accordance with the sampled pressure, for the purpose of adapted dampening.

5. The pressure sampling device according to any one of claims 1 to 3, wherein the damper (12) is an orifice.

6. The pressure sampling device according to any one of claims 1 to 3, wherein the damper (12) is of a porous material provided with successive or adjacent air holes.

7. The pressure sampling device according to any one

of claims 3 to 6, wherein the absorber is formed by providing an extension (13) of the sampling pipe (11) on the far side of the pressure sensor opening (17) of the sampling pipe (11), beyond the damper (12).

8. The pressure sampling device according to any one of claims 1 to 7, wherein the pressure sensor (14), the damper (12) and the absorber (13) are formed integrally with an engine control unit (16) for carrying out the drive control of the internal combustion engine.

Fig. 1

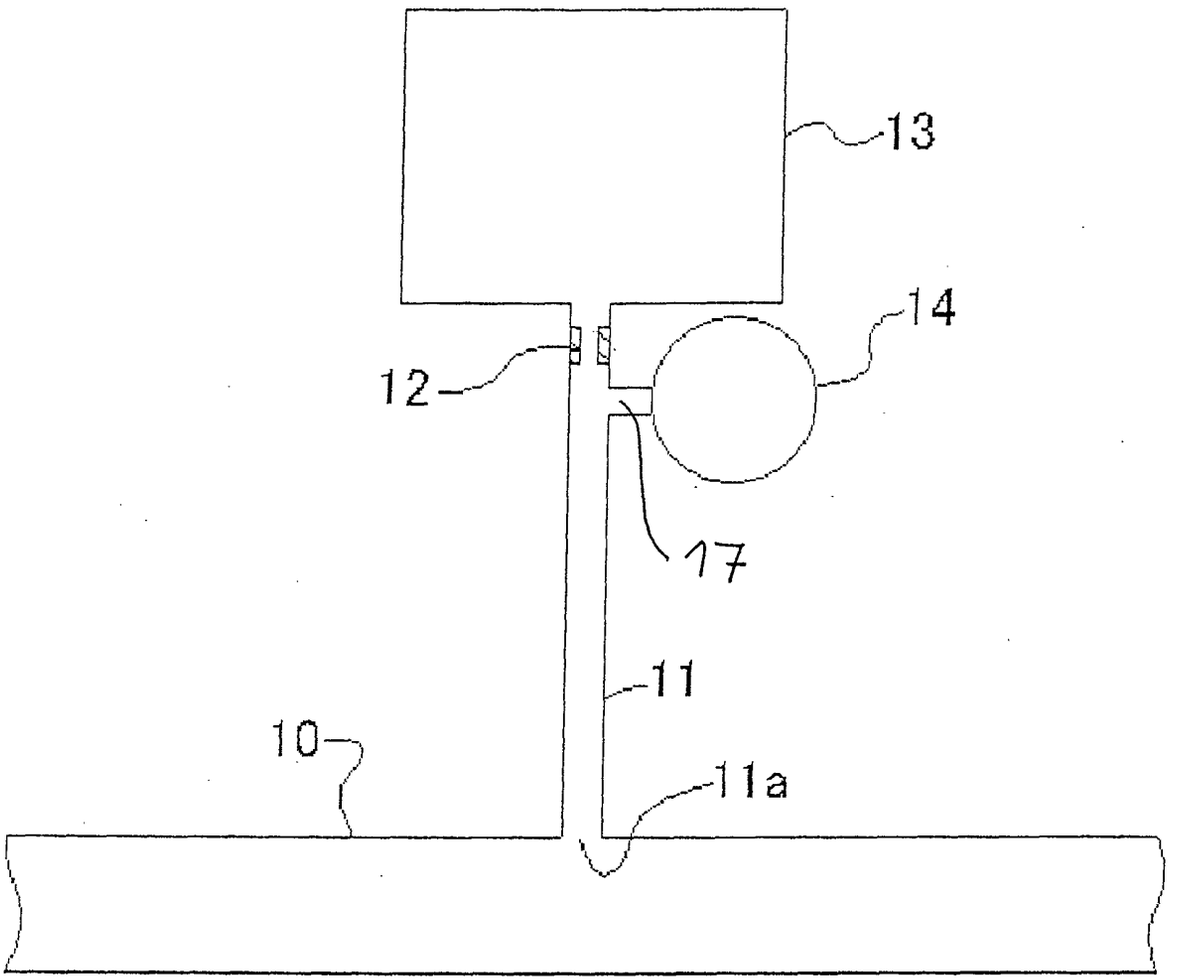
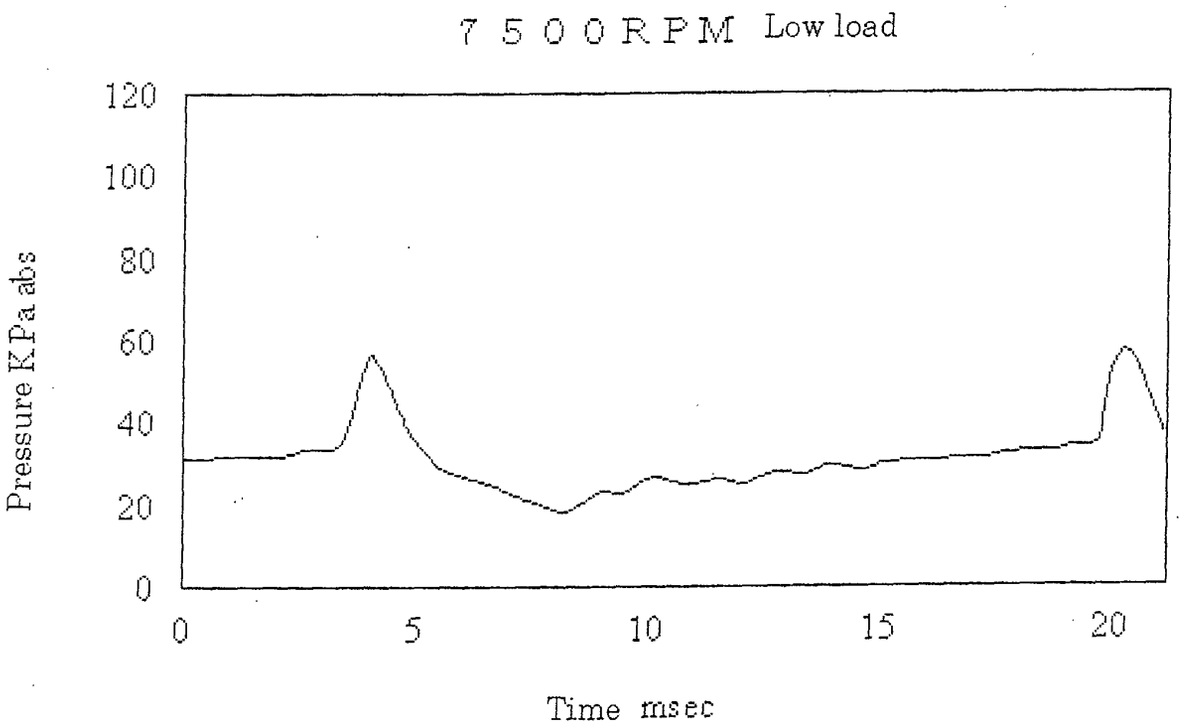


Fig. 2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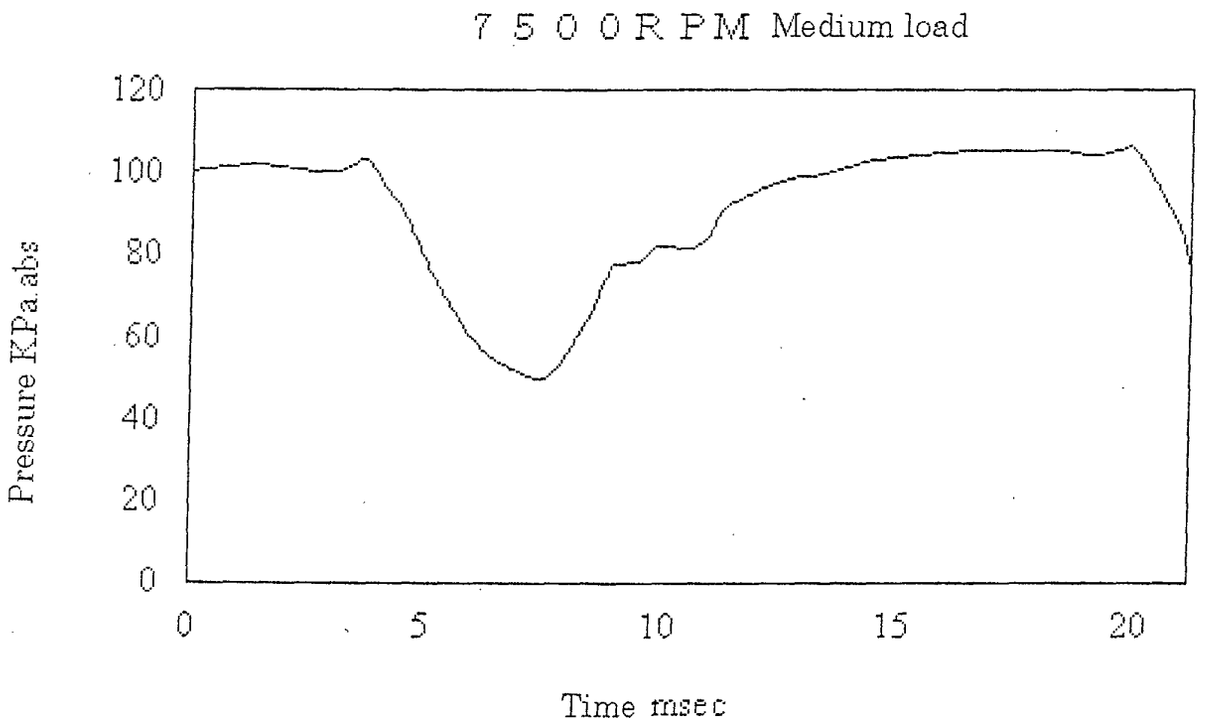
80
60
40
20
0
Pressure KPa abs
0
5
10
15
20
Time msec

Fig. 3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Pressure KPa abs
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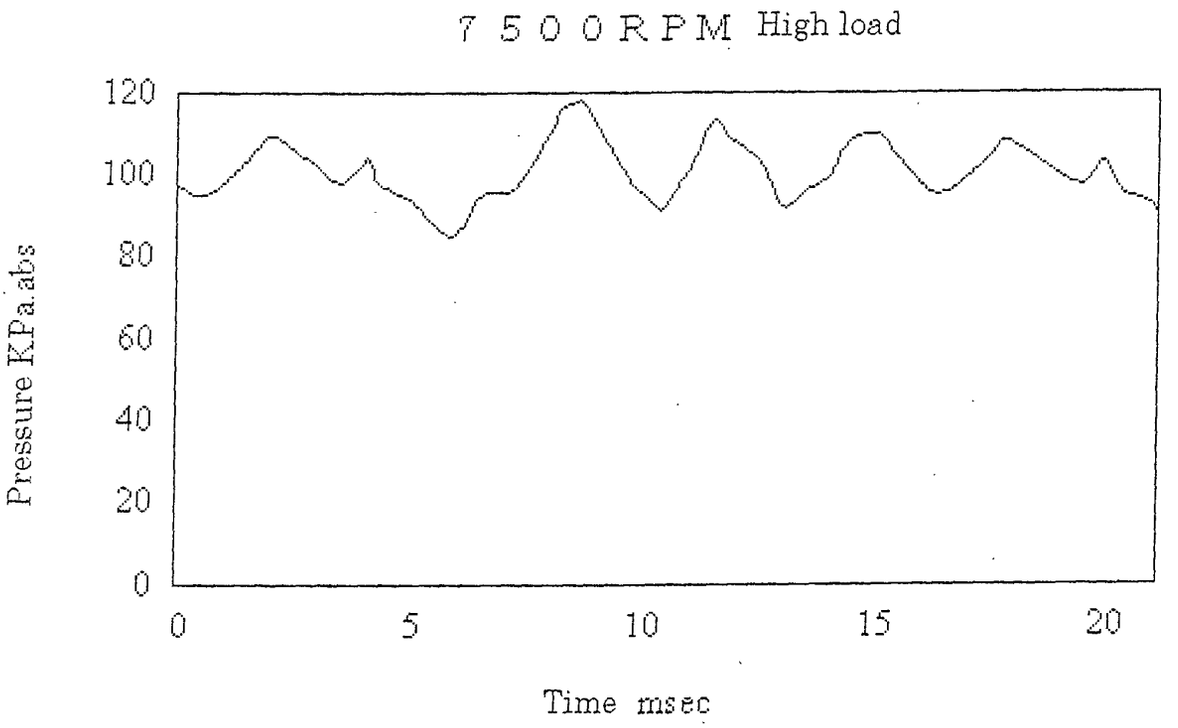
Time msec

Fig. 4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Pressure KPa.abs
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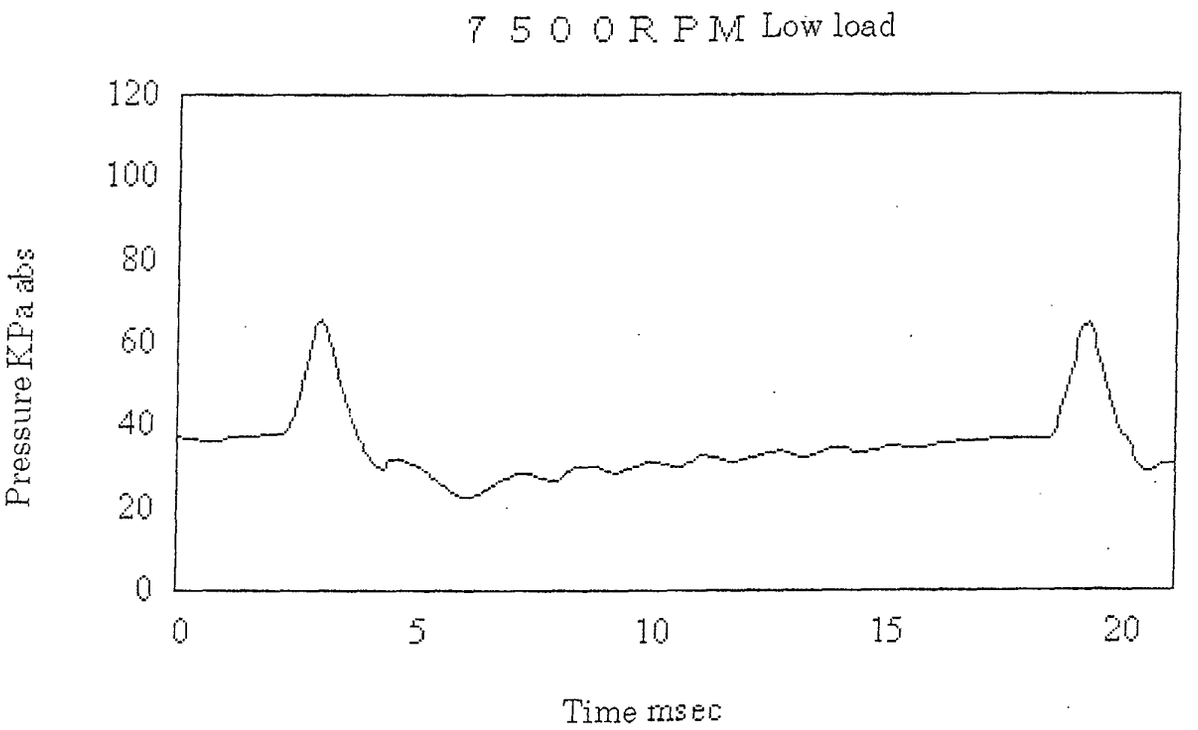
Time msec

Fig. 5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Pressure KPa abs
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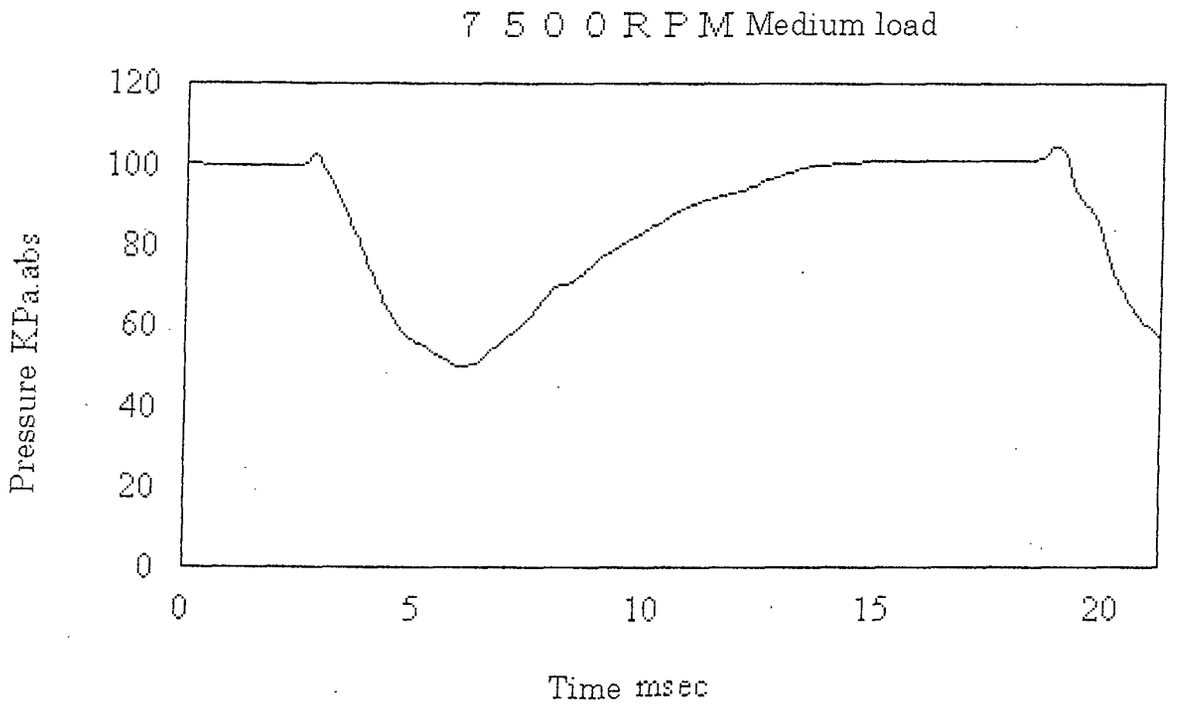
15
20
Time msec

Fig. 6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60
40
20
0
Pressure KPa abs
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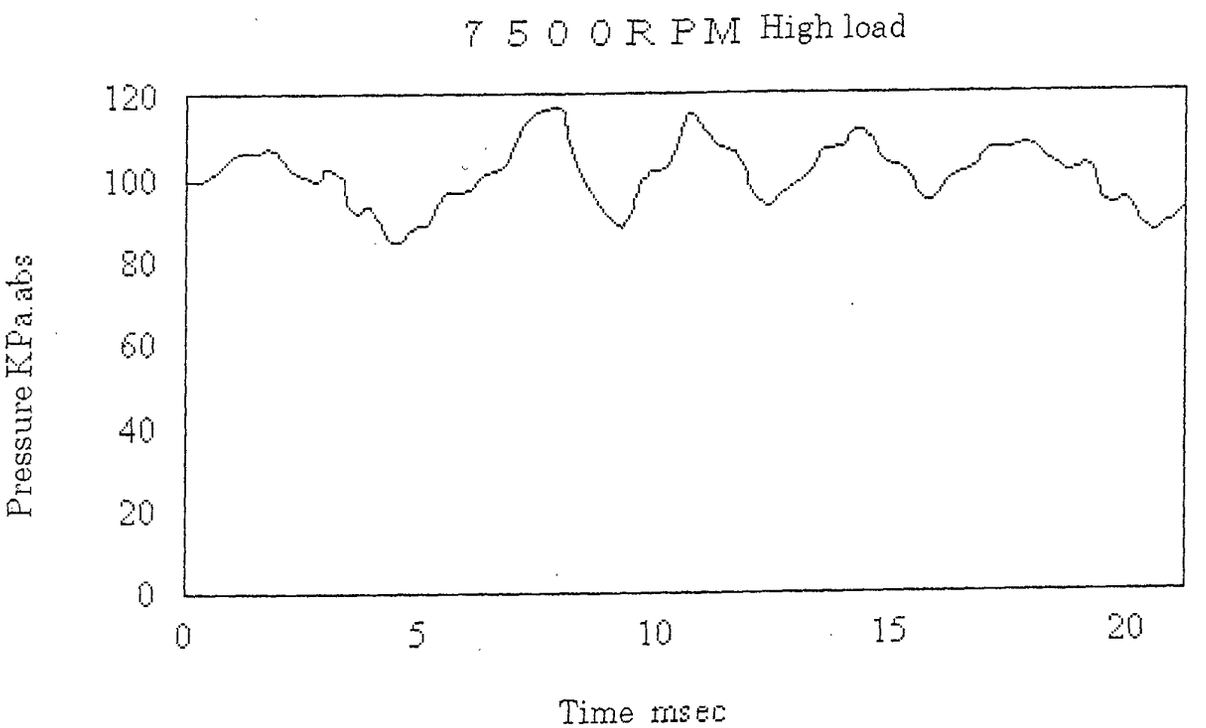
15
20
Time msec

Fig. 7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60
40
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Pressure KPa abs
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15
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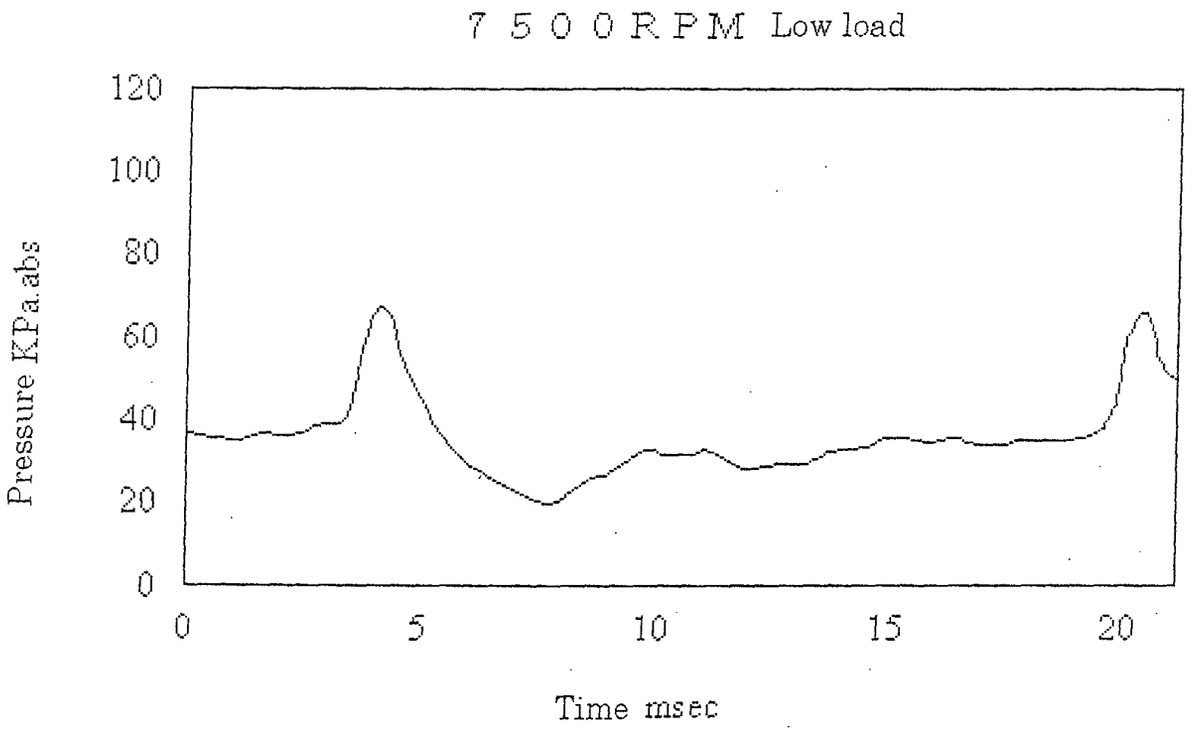
Time msec

Fig. 8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Pressure KPa abs
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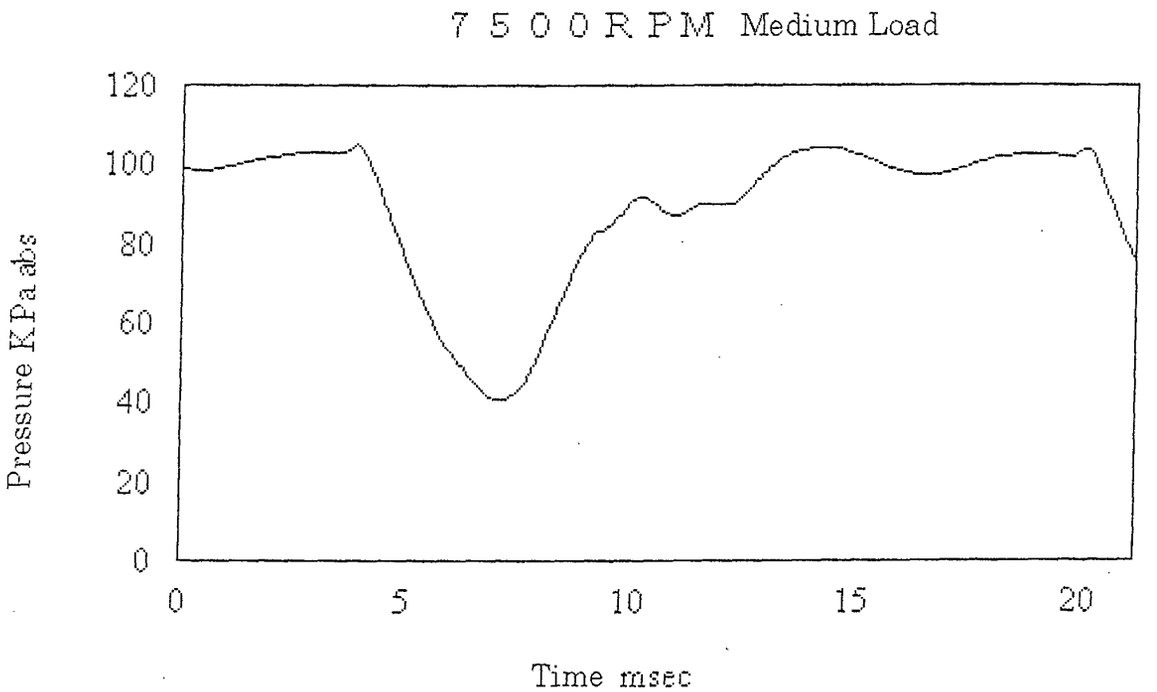
Time msec

Fig. 9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Pressure K Pa abs
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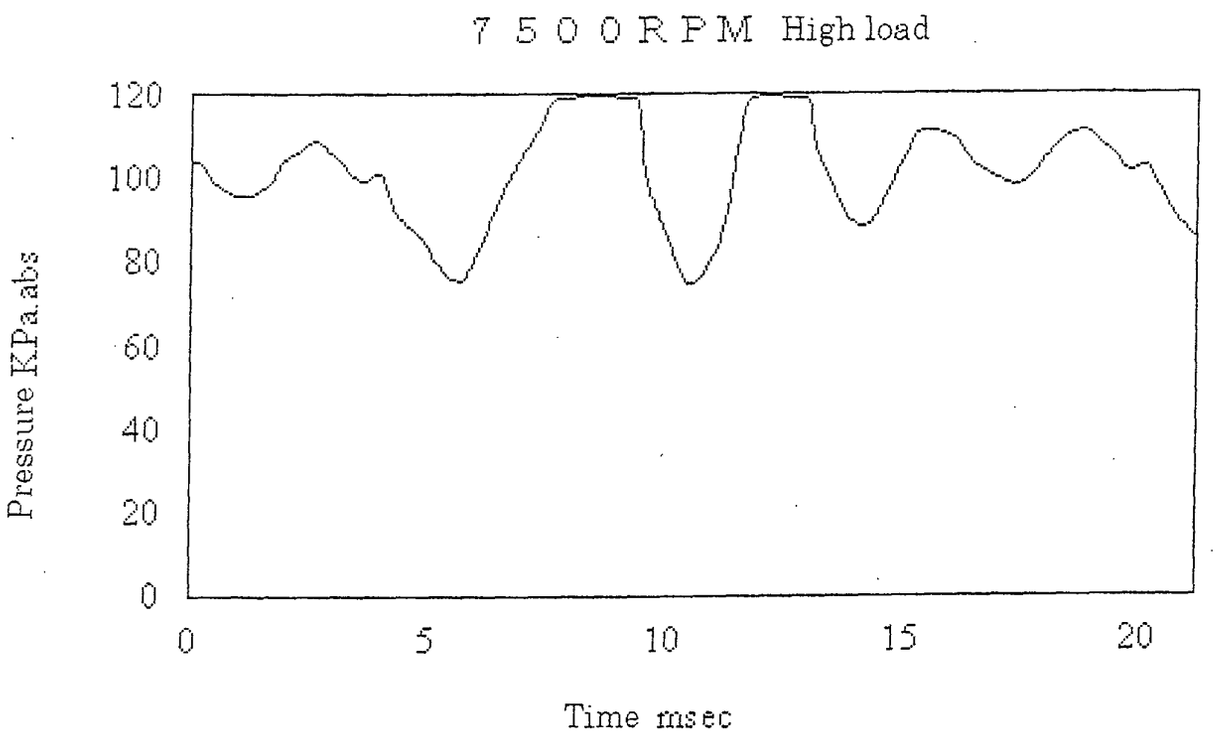
Time msec

Fig. 10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Pressure KPa.abs
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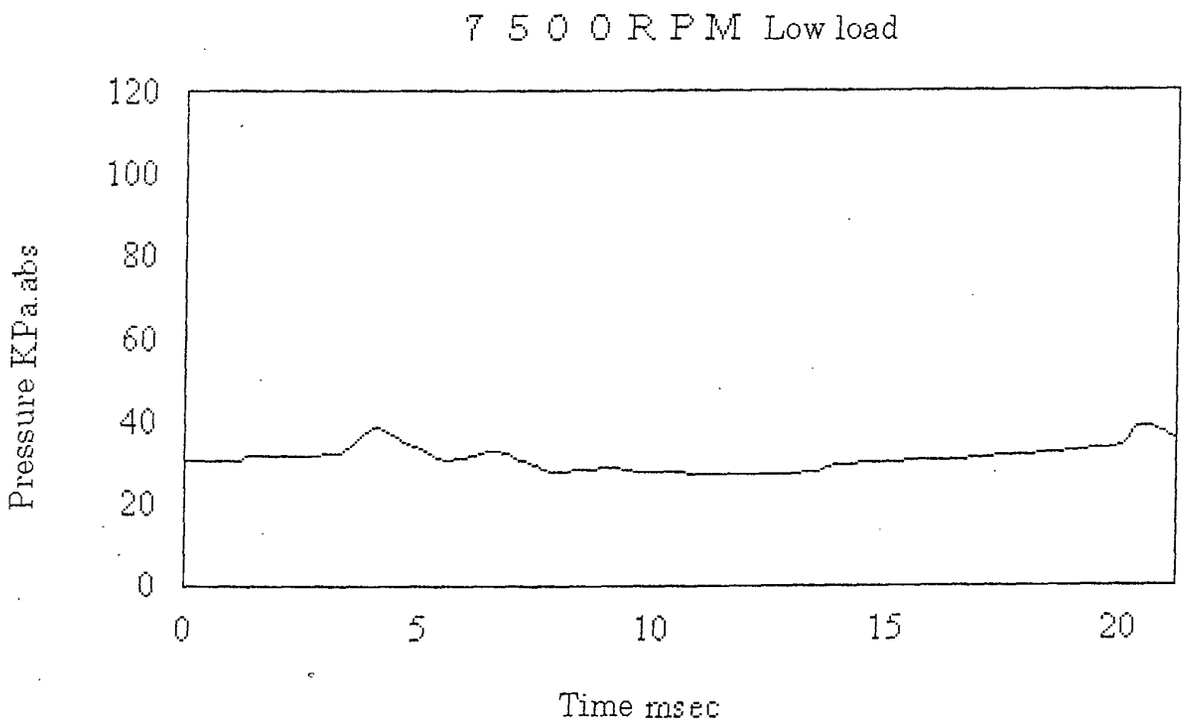
15
20
Time msec

Fig. 11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Pressure KPa.abs
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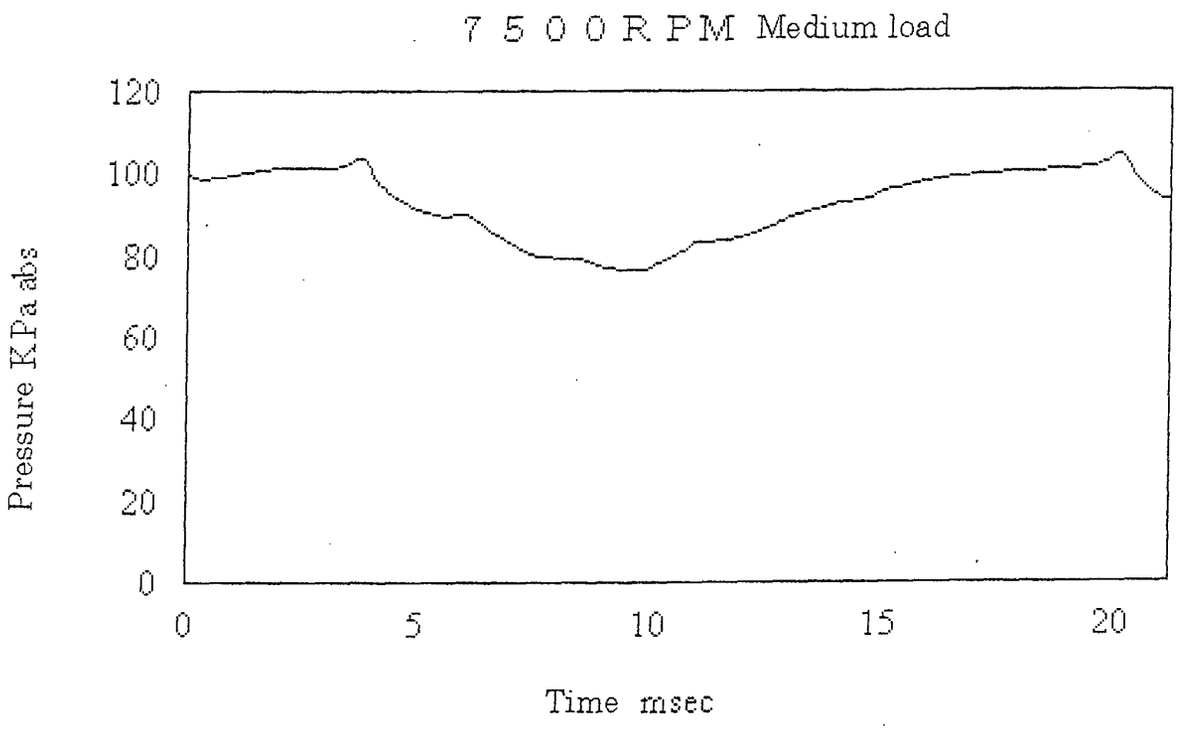
15
20
Time msec

Fig. 12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Pressure KPa abs
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15
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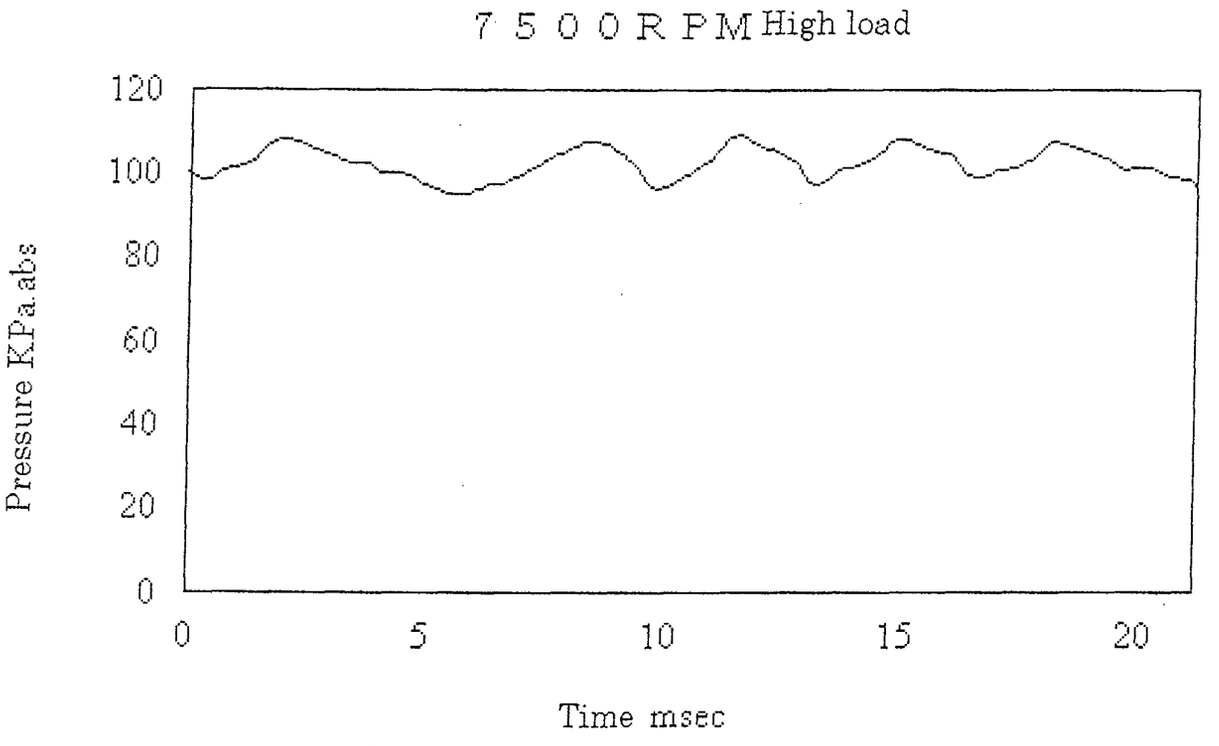
Time msec

Fig. 13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Pressure KPa.abs
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Time msec

Fig. 14

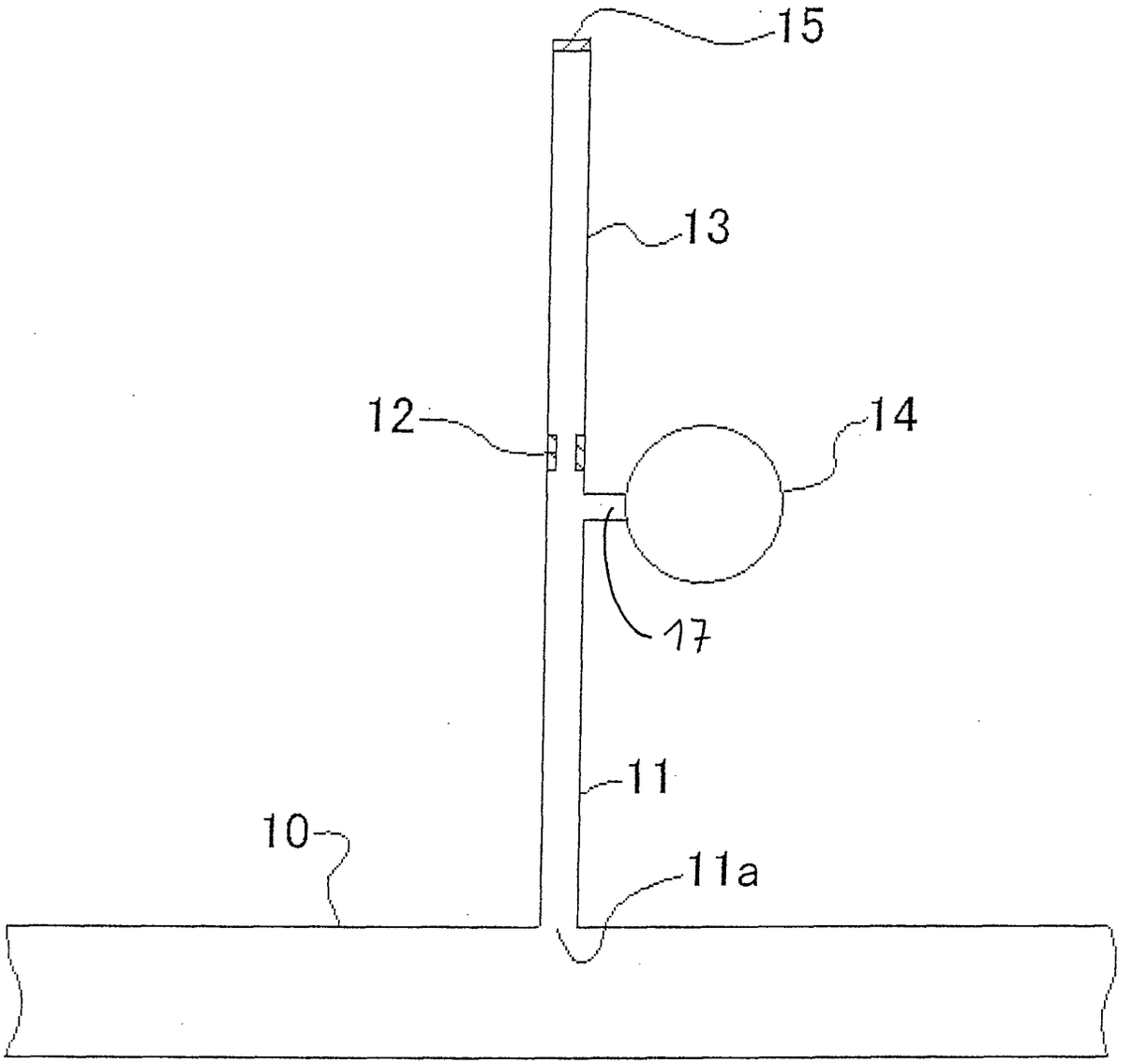

Fig. 15

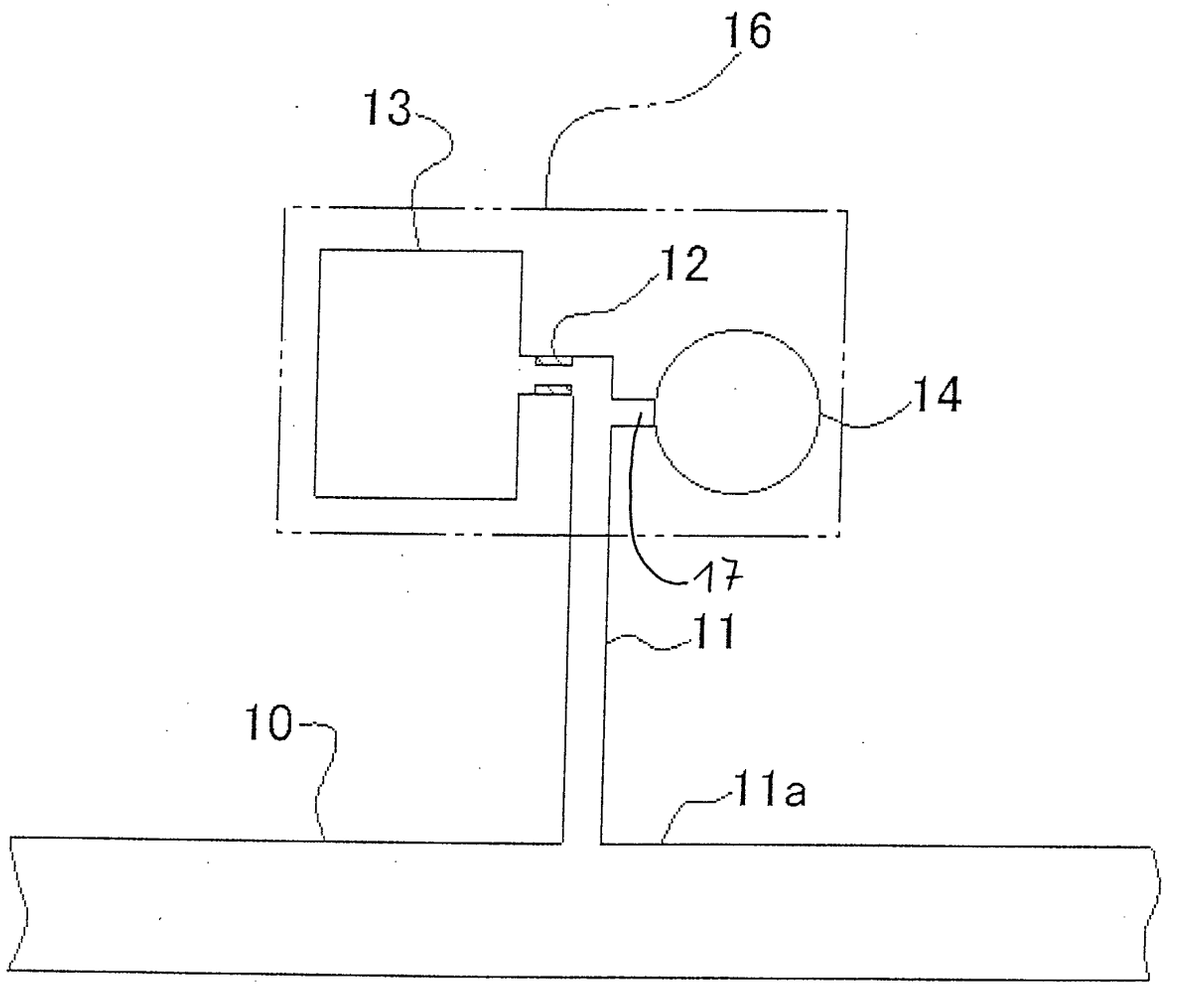

Fig. 16

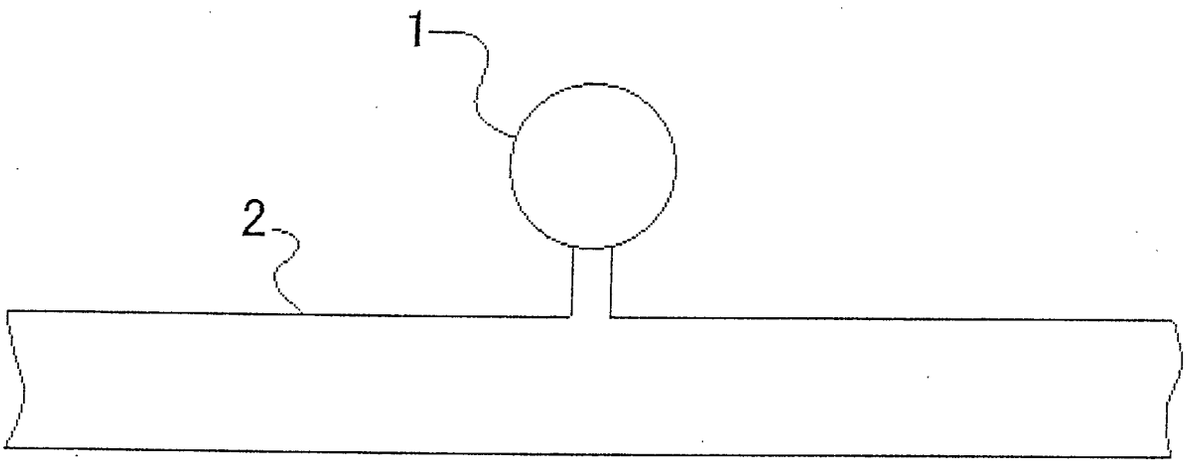

Fig. 17

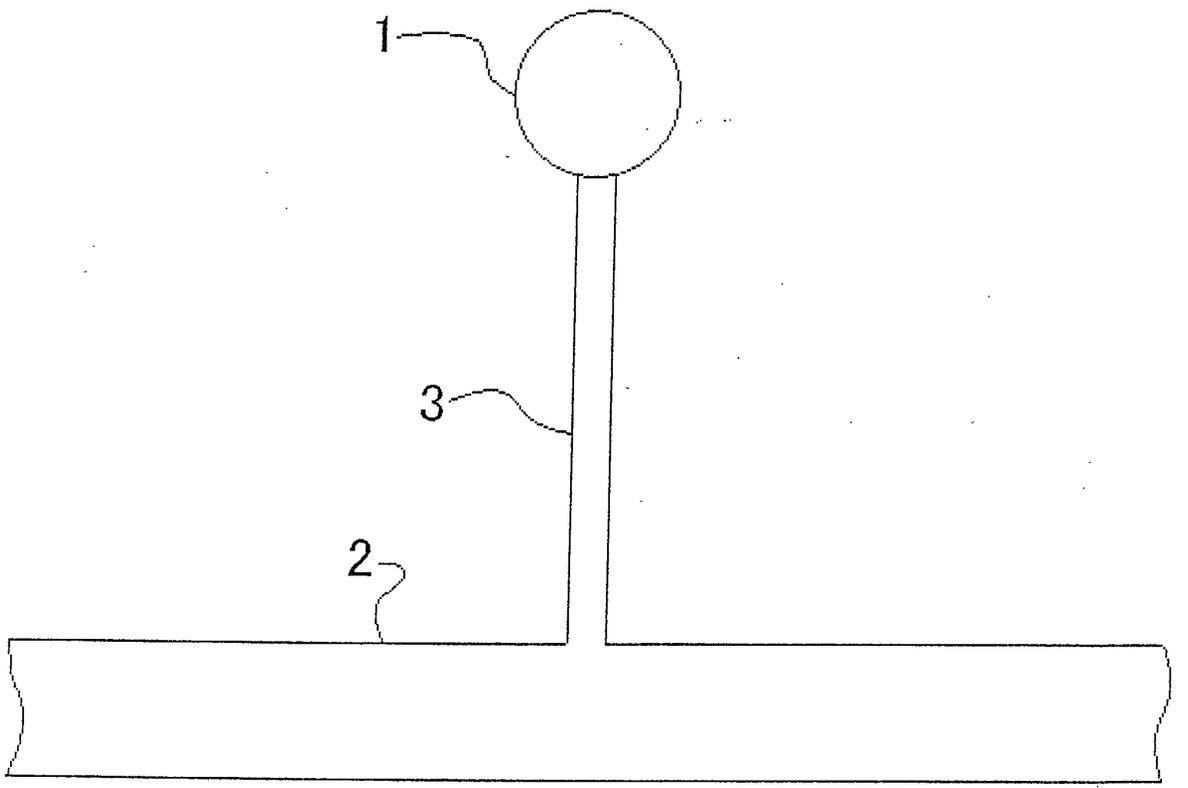

Fig. 18