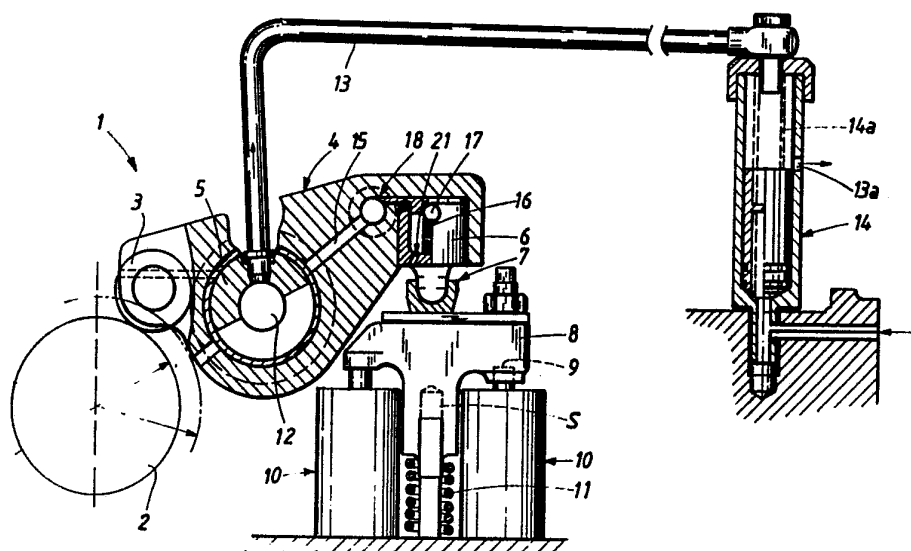




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/SE90/00784 (22) International Filing Date: 28 November 1990 (28.11.90) (30) Priority data: 8904060-4 1 December 1989 (01.12.89) SE (71) Applicant (for all designated States except US): AB VOLVO [SE/SE]; S-405 08 Göteborg (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : HÅKANSSON, Olof [SE/SE]; Flintakroken 12, S-443 60 Stenkullen (SE). (74) Agents: GRAUDUMS, Valdis et al.; Albiñ West AB, Box 142, S-401 22 Göteborg (SE).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), BR, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i></p>

(54) Title: VALVE ARRANGEMENT



(57) Abstract

A method and device for taking up valve clearance in the valve mechanism (1) of an internal combustion engine, which mechanism includes rocker arms (4) arranged on at least one rocker arm shaft (5). The take-up occurs by means of an actively adjustable, hydraulically operated take-up means (6) operable between two positions, i.e. a withdrawn position and an extended position, which take-up means (6) is arranged at the operating end of the valves rocker arms whose valve clearance is to be taken-up. The hydraulic pressure for operating the take-up means is achieved by a somewhat increased lubrication pressure in the rocker arm shaft (5) for this type of engine, which pressure for said extension of the take-up means (6) is increased by wholly or partially blocking the oil's normal drainage.

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5 Title:
Valve arrangement

Technical field:

10 The present invention relates both to a method to take up
valve clearance in the valve mechanism of an internal
combustion engine, which mechanism includes rocker arms
arranged on at least one rocker arm shaft, by means of an
actively adjustable, hydraulically operated take-up means
operable between two positions, i.e. a withdrawn position
15 and extended position, and by means of a control arrange-
ment with which the take-up means is switched between its
respective positions, and to a device for controlling the
take-up of valve clearance which, since a take-up means is
arranged at the operating end of each rocker arm which is
20 operated by a hydraulic unit included in the engine,
permits an active take-up of the clearance in the
mechanism.

Background and problem:

25 Known methods and devices for valve clearance take-up have
up until now above all been used specially for this
purpose, that is the take-up of clearance both so as to
achieve a quieter running of the engine and to reduce the
stresses therein.

30 The ever growing demands over the last few years for more
effective auxiliary braking systems on commercial vehicles
has led to ever more advanced solutions to satisfy the
demands. One of these is described in Swedish patent
35 application 8900517-7. According to this document the
camshaft of the engine's valve system is used to obtain
negative work from the engine instead of positive work

which it is normally intended to achieve. This is achieved with the aid of extra lobes on the camshaft which open a connection between the engine's combustion chambers and its exhaust system during the latter portion of the inlet stroke (four-stroke motor) and by closing this connection at the first portion of the corresponding compression stroke. In this way, a large portion of the compression work is lost as braking. The said additional lobes on the camshaft are so small that in terms of size they fall into the category which can be called normal clearance in an engine of this type. Known methods and devices for actively adjustable valve clearance take-up include separate systems for the activation and de-activation, controlled either by electrical systems or by separate hydraulic systems. No matter which type is chosen, a relatively high grade of complexity is required, particularly with the implementation of a separate hydraulic system. In addition to the fact that this means almost a doubling of the number of hydraulic components in the valve system, a result thereof is the reduced reliability and a larger production cost per unit.

Solution:

A principal object of the present invention is to provide a method and a device whereby the engine's existing pressurized oil system is used in order to guarantee the above mentioned function with minimal modification using essentially already existing components.

At the same time it is an object to facilitate a comparatively lower production cost per unit with maintained or improved reliability of the function by means of said optimisation of the use of the engine's existing components.

Advantages:

5 Practical trials have shown that, with the invention described by way of introduction, exceedingly good operation in all respects is achieved. The method according to the invention is characterized in that the control arrangement operates by selectively at least partially hindering drainage of the lubricant which is fed to the valve mechanism via its rocker arm shaft, whereby the pressure of the lubricant in its feed conduit to the rocker arm's operating end where the take-up means is arranged is increased to such a level that the take-up means is expanded to its extended position. The device according to the invention is characterized in that the drainage of the oil fed to the rocker arm shaft and thence to the rocker arms and respective take-up means is arranged such that only a small quantity of the oil, i.e. that which is necessary for the bearing surfaces of the rocker arms, is drained via normal leakage flow between the rocker arms and their shafts, whilst the rest is drained via a specially arranged conduit from the rocker arm shaft back to the engine oil reservoir, which conduit's outlet orifice is blockable by means of a pneumatically operable piston cylinder unit which is arranged close to the outlet orifice, such that the pressure in the rocker arm shaft and associated rocker arms is increasable so that the take-up means can be extended.

30 An advantage with the invention is that additional machining or assembling of oil conduits can, in the main, be avoided on a so called base engine with which at the start of production it is not yet known whether the engine will definitely be equipped with actively controlled valve clearance or not.

Brief description of the drawings:

The invention will be described in the following in more detail with reference to a preferred embodiment and attached drawings in which

Fig. 1 shows an internal combustion engine's valve mechanism with a device for valve clearance take-up according to the invention.

Fig. 2 shows a rocker arm according to figure 1 seen in partial cross-section as it is mounted in an engine, seen from above.

In figure 1 a valve mechanism 1 for a (not shown) internal combustion engine is schematically shown. The mechanism 1 includes a camshaft 2 which, via a cylindrical roller 3, transmits its rotational movement to a rocker arm 4. The rocker arm 4 is arranged on a hollow rocker arm shaft 5 which is intended to be mounted to a cylinder head (not shown) by means of bolts (not shown). The rotational movement is imparted to the camshaft by conventional means via a transmission from the engine's crank shaft (not shown). From the figures it can be seen that the rocker arm 4, via means 6 and a hemispherical guide 7 thereon, acts directly on a yoke 8 which is moveable up and down on a guide 5 in the cylinder head. The yoke 8 acts in turn on two valve stems 9 on whose ends, in a conventional way, valve heads (not shown) are arranged. Each rocker arm 4 accordingly operates two valves which simultaneously move up and down. In order for this to be possible, each valve stem 9 is surrounded by a valve spring 10, which, in a conventional manner with the aid of a locking means and a washer (not shown) on each one, is held in a controlled position against the valve's closed position.

In addition to both the valve springs 10, there is a spring 11 which is arranged beneath the yoke 8. The purpose of this spring is to maintain the yoke 8 in such a position that the clearance which always arises in a valve mechanism of this type occurs between the respective valve stems 9 and the underside of the yoke 8. The spring 11 has a further purpose which will be referred to in more detail below.

10 The described valve mechanism is pressure lubricated by oil which is supplied via conduits in the cylinder block and cylinder head of the engine to the hollow interior of the rocker arm shaft 5. The plain bearings of the rocker arms 4 are lubricated by a certain leakage flow between the shaft 5 and the bearings. Under normal circumstances this is, however, not large and a drainage of a portion of the lubricant also occurs via a special conduit 13. According to the invention, a pneumatically, or alternatively mechanically, operated piston-cylinder device 14 is introduced into the return conduit 13, which device during normal operation maintains the oil pressure at a pre-determined low value by means of the resiliency of a spring 14 which facilitates the drainage of the oil to the lubricant reservoir via an outlet 13a and which, when activated, prevents the pressure oil from being drained via the outlet 13a. The only remaining outlet for the oil after activation is hereby between the shaft 5 and the plain bearings (according to the above), whereby a considerable pressure increase is achieved to a pressure in the oil approaching the engine's feed pressure. Since the oil is also fed to the working end of the rocker arm 4 via a conduit 15 and to the means 6 arranged there, the following occurs; the means 6 which in principle is of piston cylinder type is activated and as soon as the pressure in the means 6 climbs to such a level that it overcomes the force of the spring 11 it will act as a clearance take-up

means. The force from the means 6 is however never so large that it can affect any of the valve stems 9.

5 For the sake of safety, as can be seen in figure 1, the means 6 also has a ball valve 17 influenced by a spring 16. This valve assures that the oil pressure can never become too high in the cavity at the means 6 so that various components in the valve system become damaged. In the event that the valve 17 opens, the oil is drained back to the motor via one or more conduits 21 via normal drainage in the engine back to the engine's lubrication reservoir.

10 In figure 2 the rocker arm 4 is shown in partial section, as mentioned earlier. In addition, it can be seen that the oil in the oil conduit 15 must pass through a check valve arrangement 18 before it reaches the means 6. The purpose of this arrangement is that, during operation of the engine without valve clearance according to the earlier description, "pumping" is prevented, which means that the pressure from the springs and other valve forces should give a return pressure in the conduit 15. The check valve is of the spring/ball type 22 resp. 23 and solves the pumping problem. The check valve arrangement 18 does however prevent the overriding of the operation of the valve take-up means 6 when so desired. In order for this to be able to occur, a piston 19 is arranged in a cylinder right behind the ball bearing 23 of the check valve arrangement 18, which piston has a plunger-shaped prong 24 at its end towards the ball bearing which, at low oil pressure, presses the ball bearing from its seat under the influence of a spring 20. The plunger-shaped prong 24 extends in a tubular conduit 25 which, despite the prong 24, permits a flow of oil in both directions. At high pressure, the piston's 19 effect on the ball bearing is overcome since the spring 20 cannot overcome the oil pressure on the end of the piston 19 provided with the prong.

With the accordingly described device, a method as described in the introduction can be attained which solves the stated problems.

5 Naturally the invention is not restricted to the above described embodiment, and changes can be made within the scope of the appended claims. By way of example, the piston-cylinder arrangement 14 can be dimensioned such that during operation it gives a temporarily increased back
10 pressure in the drainage conduit whereby a faster clearance take-up is achieved.

5 Claims:

1. A method to take up valve clearance in the valve mechanism (1) of an internal combustion engine, which mechanism includes rocker arms (4) arranged on at least one rocker arm shaft (5), by means of an actively adjustable, hydraulically operated take-up means (6) operable between
10 two positions, i.e. a withdrawn position and an extended position, and by means of a control arrangement with which the take-up means is switched between its respective positions, c h a r a c t e r i z e d i n t h a t t h e
15 control arrangement operates by selectively at least partially hindering drainage of the lubricant which is fed to the valve mechanism (1) via its rocker arm shaft (5), whereby the pressure of the lubricant in its feed conduit (15) to the rocker arm's (4) operating end where the take-up means (6) is arranged is increased to such a level that
20 the take-up means (6) is expanded to its extended position.

2. Method according to claim 1, c h a r a c t e r i z -
e d i n t h a t t h e d r a i n a g e i s h i n d e r e d b y c a u s i n g a
25 pneumatically operated piston-cylinder unit (14) to seal a drainage hole (13a) along a drainage conduit (13) which runs from the rocker arm shaft (5) to the engine's oil reservoir.

3. Method according to claim 2, c h a r a c t e r i z -
e d i n t h a t t h e p n e u m a t i c o p e r a t i o n o f t h e p i s t o n -
cylinder unit (14) is achieved via the utilization of an
30 existing pneumatic system connected to the engine.

4. Method according to claim 3, c h a r a c t e r i z -
e d i n t h a t t h e p i s t o n - c y l i n d e r u n i t ' s (1 4) d i m e n s i o n s

are chosen such that operation of the unit means that a pressure impulse is created in the drainage conduit (13), by means of which a quicker pressure increase response is achieved.

5

5. Device for controlling the take-up of valve clearance in the valve mechanism of an internal combustion engine, comprising, on the one hand, a rocker arm system (4, 5) with at least one typically hollow-formed rocker arm shaft (5) and, on the other hand, a hydraulically operated take-up means (6) arranged in connection with the operating end of those valves whose valve clearance is to be taken up, whereby each valve's rocker arm has a conduit (15) for the supply of oil to the take-up means (6), c h a r a c -
10 t e r i z e d i n that the drainage of the oil fed to the rocker arm shaft (5) and thence to the rocker arms (4) and respective take-up means (6) is arranged such that only a small quantity of the oil, i.e. that which is necessary for the bearing surfaces of the rocker arms (4), is drained via
15 normal leakage flow between the rocker arms (4) and their shaft (5), whilst a quantity is drained via a specially arranged conduit (13) from the rocker arm shaft back to the engine oil reservoir, which conduit's (13) outlet orifice (13a) is blockable by means of a pneumatically operable
20 piston-cylinder unit (14) which is arranged close to the outlet orifice (13a), whereby the pressure in the rocker arm shaft (5) and associated rocker arms (4) is increasable so that the take-up means can be extended.

25

30

6. Device according to claim 5, c h a r a c t e r i z -
e d i n that it has an operating plunger/check valve arrangement (18) which is arranged so that at low pressure in the conduit (15) return flow of oil from the take-up means is permitted and at high pressure in the conduit said
35 return flow is prevented.

7. Device according to claim 6, characterized in that the operating plunger/check valve arrangement has two components, each acted upon by a spring (20, 22 resp.), a plunger piston (19) and a ball bearing (23), which parts' force components are opposed so that when no oil pressure forces act on the arrangement, the spring (20) of the plunger (19) can cancel the action of the ball bearing's (23).

8. Device according to claim 7, characterized in that the plunger piston (19) is substantially cylindrical except for its end region facing the ball bearing (23) which is formed into a thin plunger-shaped prong (24) connected to the cylinder body in the direction of its sleeve.

9. Device according to claim 8, characterized in that the action between the plunger piston (19) and the ball bearing occurs via a narrow tubular conduit which, in addition to said plunger prong, also permits a flow of oil in both directions.

10. Device according to claim 9, characterized in that the tubular conduit's one end is shaped as a sealing valve-seat for the ball bearing (23).

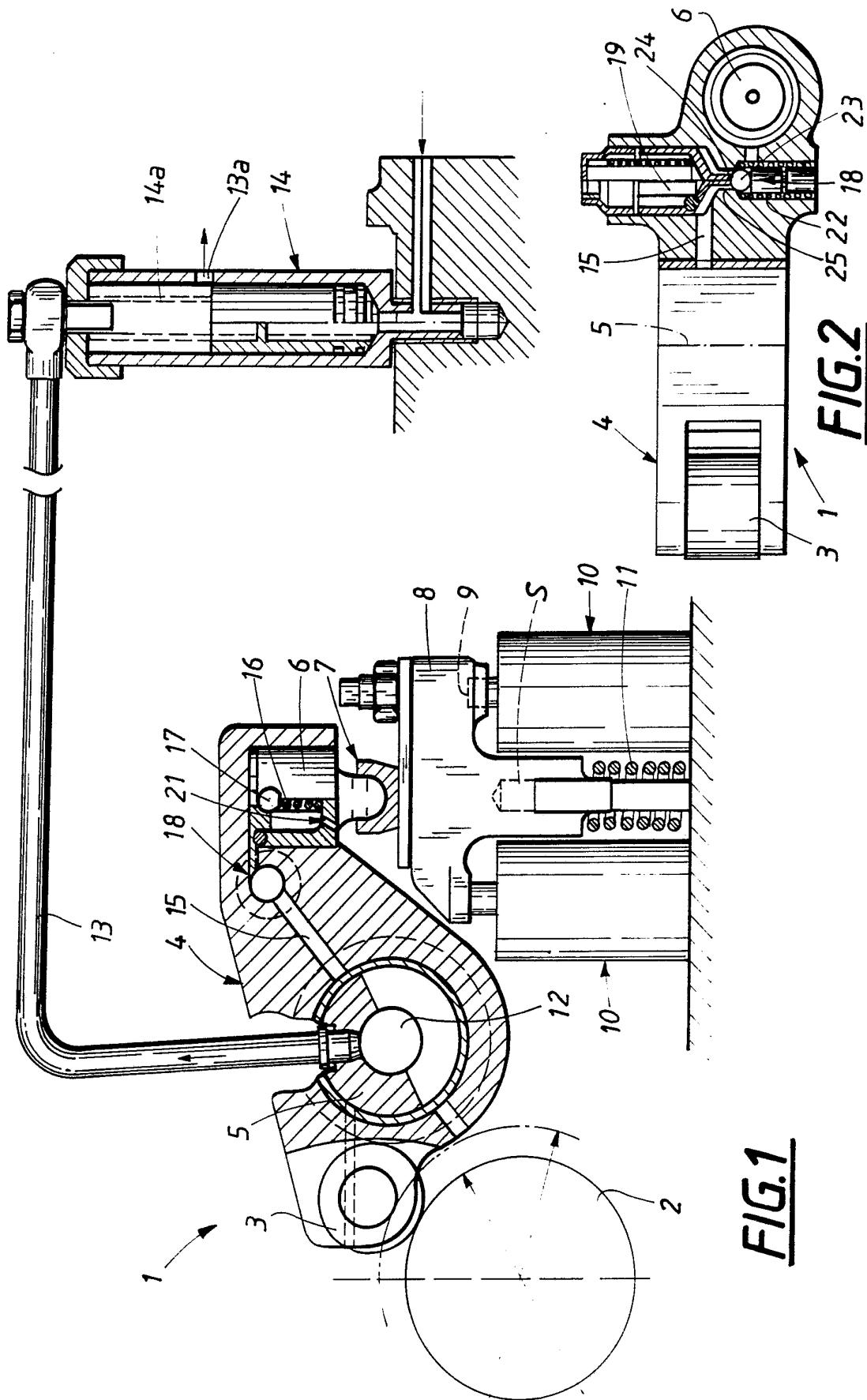
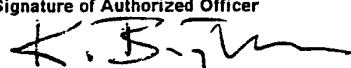


FIG. 1

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00784

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC5: F 01 L 1/24		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC5	F 01 L	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched ⁸		
SE,DK,FI,NO classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 4258671 (TAKIZAWA ET AL) 31 March 1981, see the whole document	1
A	--	2-10
A	DE, A, 892695 (DAIMLER-BENZ AKTIEGESELLSCHAFT) 16 August 1955, see the whole document	1-10
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A	EP, A2, 0212981 (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 4 March 1987, see the whole document	1-10
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A	US, A, 4452187 (KOSUDA ET AL) 5 June 1984, see the whole document	1-10
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<p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
5th March 1991	1991-03-08	
International Searching Authority	Signature of Authorized Officer	
SWEDISH PATENT OFFICE	 Krister Bengtsson	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
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ANNEX TO THE INTERNATIONAL SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on **91-01-31**. The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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