PCT WORLD INTELLE

INTERNATIONAL APPLICATION PUBLISH

WO 9603574A1

(51) International Patent Classification 6 : F01P 5/10 A1

(11) International Publication Number: WO 96/03574

(43) International Publication Date: 8 February 1996 (08.02.96)

(21) International Application Number: PCT/KR94/00099

(22) International Filing Date: 26 July 1994 (26.07.94)

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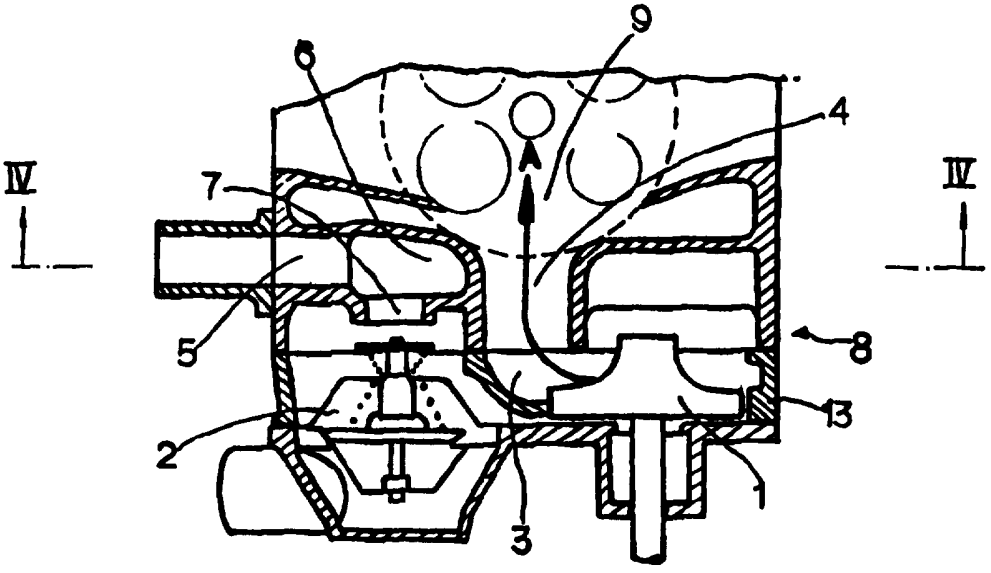
(81) Designated States: DE, JP, KR, US.

Published

With international search report.

With amended claims and statement.

(54) Title: COOLING SYSTEM OF AN INTERNAL COMBUSTION ENGINE



(57) Abstract

A cooling system of an internal combustion engine wherein a water pump (1), a thermostat (2), a water pump exit port (3), a water jacket entrance passage (4), an exit passage (5), a bypass passage (6) and a bypass opening (7) are located in the rear (transmission side) of a cylinder head (8) of the engine. A water pump and thermostat body (13) is attached to the rear face of the cylinder head (8). The bypass passage (6) together with the exit passage (5) are cast by using a metal mold drag. The coolant flow path forms a U-path starting with the coolant from the water pump (1) in the rear of the cylinder head (8) to the front of the cylinder head (8), then down to the front of the cylinder block (10), then to the rear of the cylinder block (10), then up to the rear of the cylinder head (8).

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COOLING SYSTEM OF AN INTERNAL COMBUSTION ENGINE

TECHNICAL FIELD

The present invention relates to a cooling system of an internal combustion engine, and more particularly to an improved arrangement of a water pump and a thermostat of the cooling system.

BACKGROUND ART

A water cooling system for internal combustion engine is to cool the engine by circulating water into the water jackets provided in the cylinder head and cylinder block of the engine and comprises a radiator, a water pump, a cooling fan and a thermostat as main parts thereof.

SAE Technical Paper Series No. 920671 discloses a cooling system in which a water pump is located in the rear end of the cylinder block and driven by a left bank intake cam in order to reduce the complexity of external plumbing and ease the packaging of the accessories, and a thermostat is located directly in front of the water pump. The flow path of this cooling system is of the pattern with most of the coolant moving from the rear of the block to the front, then up to the cylinder head, then to the back of the head.

This conventional cooling system has a coolant flow path with higher friction losses contributing to the long warm-up period and is of complicated design, which are troublesome.

In the German Patent No. 2706954 granted to Audi NSU Auto Union AG, a water pump and a thermostat are arranged at the side of the cylinder block in a housing combined with a coolant casing. The housing is formed with a lateral opening for inserting thereinto the thermostat.

However, such arrangement of the water pump and thermostat has a drawback in that the warm-up period is long and a sand core for a water pump chamber is needed.

Also, a cooling system disclosed in the SAE Technical Paper Series No. 920673 adopts reverse flow cooling starting with water from a water pump entering the engine block and immediately detouring the cylinder head. The major portion of the coolant still flowing through the cylinder head enters the cylinder block.

This reverse flow cooling is, however, complicated and also results in long warm-up period.

Further, MTZ Motortechnische Zeitschrift 51 (1990) 11 proposes another cooling system wherein a coolant exit port and a thermostat are located on the rear end of the cylinder head, and a water pump is located in the area of the longitudinal member.

With such installation in the above-referred MTZ 51 (1990) 11, the cooling system is disadvantageous in that the distance between water pump and thermostat is long, contributing to negative influence on the overall length of the engine and difficult flow control.

DISCLOSE OF INVENTION

It is therefore an object of the present invention to provide a cooling system of an internal combustion engine which is capable of reducing the overall length of transversely mounted engine.

Another object of the invention is to provide a cooling system of an internal combustion engine which is capable of reducing the frictional losses during the warm-up period and shortening the warm-up period.

A further object of the invention is to provide a cooling system of an internal combustion engine which is capable of reducing the manufacturing costs by using a metal mold drag for bypass and exit passages.

A still further object of the invention is to provide a cooling system of an internal combustion engine which is capable of improving accessibility to the water pump and thermostat.

To achieve these objects, a cooling system according to the present invention is characterized in that a water pump as well as flow control means such as a thermostat, a water pump exit port, a water jacket entrance passage, and the like are located on the rear face of a cylinder head of the engine, and in that the water jacket entrance passage is directly connected with the water pump exit port.

Further, a cooling system of this invention is characterized in that a bypass passage and/or an exit passage may be cast by using a metal mold drag.

The advantages of this configuration reside in the fact that due to the direct connection of the water pump with the water jacket of the cylinder head, with the engine in cold condition, the heat of higher temperature on the hot spots such as exhaust ports or exhaust valve bridges of the cylinder head is transferred from the cylinder head to the cylinder block, thereby to shorten the warm-up period and to allow a higher compression ratio. And, it

is possible to reduce the overall length of a transversely mounted engine in the critical region of the longitudinal member.

It is also possible to reduce the manufacturing costs of the flow control means by virtue of using the metal mold drag. Further, an easy accessibility to the water pump and thermostat can be achieved because of their arrangement to the rear of the cylinder head.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and other features of the present invention will be more apparent by describing the preferred embodiment thereof referring to the accompanying drawings, in which :

FIG. 1 is a schematic perspective view showing a cooling system with the coolant flow path, in accordance with the present invention;

FIG. 2 is a rear view of a cylinder head with a water pump installed thereto, showing a part of a cylinder block;

FIG. 3 is a cross-sectional view of the rear part of the cylinder head, taken along line III - III of FIG. 2; and

FIG. 4 is a longitudinal-sectional view of the cylinder head and cylinder block, taken along line IV - IV of FIG. 3.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Figs. 1 to 3, a water pump 1 together with flow control means comprising a thermostat 2, a water pump exit port 3, a water jacket entrance passage 4, an exit passage 5, a bypass

passage 6 and a bypass opening 7 are located in the rear (transmission side) of a cylinder head 8 of the engine. The water pump 1 is belt-driven by a camshaft 21.

A water pump and thermostat body 13 is detachably attached to the rear face of the cylinder head 8 so as to dispose the water pump 1 and thermostat 2 at the rear of the cylinder head 8. As shown in Fig. 3, the water pump exit port 3 is provided at the downstream of the water pump 1 disposed in the water pump and thermostat body 13. The water jacket entrance passage 4 is defined in the rear end of the cylinder head 8 and is directly connected with the water pump exit port 3 so as to communicate with each other.

The thermostat 2 is located parallel to the water pump 1 at the rear end of the cylinder head 8. The outlet of the thermostat 2 is communicated with the bypass passage 6 through the bypass opening 7 and with the exit passage 5 in the cylinder head 8, as shown in Fig. 3.

In Fig. 1, a cylinder head gasket 12 is provided with a plurality of differently-sized openings 11 to allow the flow stream to reach a cylinder block 10.

According to the embodiment of the present invention, the bypass passage 6 is cast by using a metal mold drag. Also, the exit passage 5 may be cast by using a metal mold drag together with the bypass passage 6.

Hereunder, description of the coolant flow path of the cooling system of this invention will be given, with reference to Figs. 1 and 3.

The coolant flows, as shown by an arrow A in Fig. 3, from the water pump 1 directly to the water jacket 9 in the cylinder head

8 through water jacket entrance passage 4, cooling first the hot combustion chambers, exhaust ports and exhaust valve bridges (not shown). The coolant flows through the cylinder head 8 in the longitudinal direction before entering the cylinder block 10. Then the coolant enters the cylinder block 10 through the openings 11 in the cylinder head gasket 12, cooling critical regions between cylinder bores.

During the warm-up period the coolant transports the heat from the hot cylinder head 8 to the cold cylinder block 10, warming up the oil and the cylinder bores. The higher oil temperature in the main oil duct and in the liners reduces the frictional losses and shortens the warm-up phase. The coolant flows back to the rear of the cylinder block 10 and leaves the cylinder block 10 through an outlet 15 in the cylinder head gasket 12 to flow into the exit passage 5 and bypass passage 6 in the rear of the cylinder head 8. From the exit passage 5 the coolant, with the thermostat 2 opened, flows into a radiator 23 and a heating system 25.

With cold engine and closed thermostat 2 the coolant flows directly into the water pump 1 through the bypass passage 6.

Thus, the flow path forms a pattern starting with the coolant from the water pump 1 in the rear of the cylinder head 8 to the front of the cylinder head 8, then down to the front of the cylinder block 10, then to the rear of the block 10, then up to the rear of the cylinder head 8, completing a U-path.

CLAIMS

1. A cooling system of an internal combustion engine comprising a water pump (1) and flow control means, said flow control means including a thermostat (2), a water pump exit port (3), a water jacket entrance passage (4), an exit passage (5), a bypass passage (6) and a bypass opening (7), CHARACTERIZED IN THAT said water pump (1) and said flow control means are located on the rear face of a cylinder head (8) of the engine.

2. The cooling system according to claim 1, CHARACTERIZED IN THAT said water jacket entrance passage (4) is directly connected with said water pump exit port (3).

3. The cooling system according to claim 1, CHARACTERIZED IN THAT a water pump and thermostat body (13) is detachably attached to the rear face of said cylinder head (8).

4. The cooling system according to claim 1, CHARACTERIZED IN THAT said bypass passage (6) is cast by using a metal mold drag.

5. The cooling system according to claim 1, CHARACTERIZED IN THAT said bypass passage (6) together with said exit passage (5) are cast by using a metal mold drag.

AMENDED CLAIMS

[received by the International Bureau on 21 November 1995 (21.11.95); original claims 1-3 amended; original claims 4 and 5 cancelled (1 page)]

1. A cooling system of an internal combustion engine comprising:

a cylinder block having one or more cylinders and a water jacket therein;

a cylinder head fixed integrally to the cylinder block putting a gasket therebetween and having a water jacket therein;

a water pump attached to one side of the cylinder head, the water pump being driven by a cam shaft mounted on the cylinder head and circulating coolant through the cooling system; and

a thermostat controlling a flow of the coolant to a radiator in accordance with a temperature of the circulating coolant,

wherein a flow path of the circulating coolant forms a pattern starting with the coolant from the water pump to a front portion of the cylinder head, down to a front portion of the cylinder block, to a rear portion of the cylinder block, up to a rear portion of the cylinder head, to the thermostat and to the water pump completing the pattern.

2. A cooling system of an internal combustion engine according to claim 1, wherein the water pump is attached to the one side of the cylinder head in such a manner that an exit port of the water pump is directly communicated with an entrance passage of the water jacket formed in the cylinder head.

3. A cooling system of an internal combustion engine according to claim 1 or 2, wherein the thermostat is attached to the cylinder head parallel to the water pump.

STATEMENT UNDER ARTICLE 19

The claim 1 especially points to the flowing path of the circulating coolant as seen in the application as filed on page 5, line 36 to page 6, line 9 and page 6, line 24-30. Thereby the warm-up phase of the engine can be shortened as described in the application as filed on page 6, line 11-21.

The claim 2 especially restricts how the water pump is attached to the cylinder head as seen in the application as filed on page 5, line 7-15.

The claim 3 especially restricts how the thermostat is attached to the cylinder head as seen in the application as filed on page 5, line 17-18.

FIG. 1

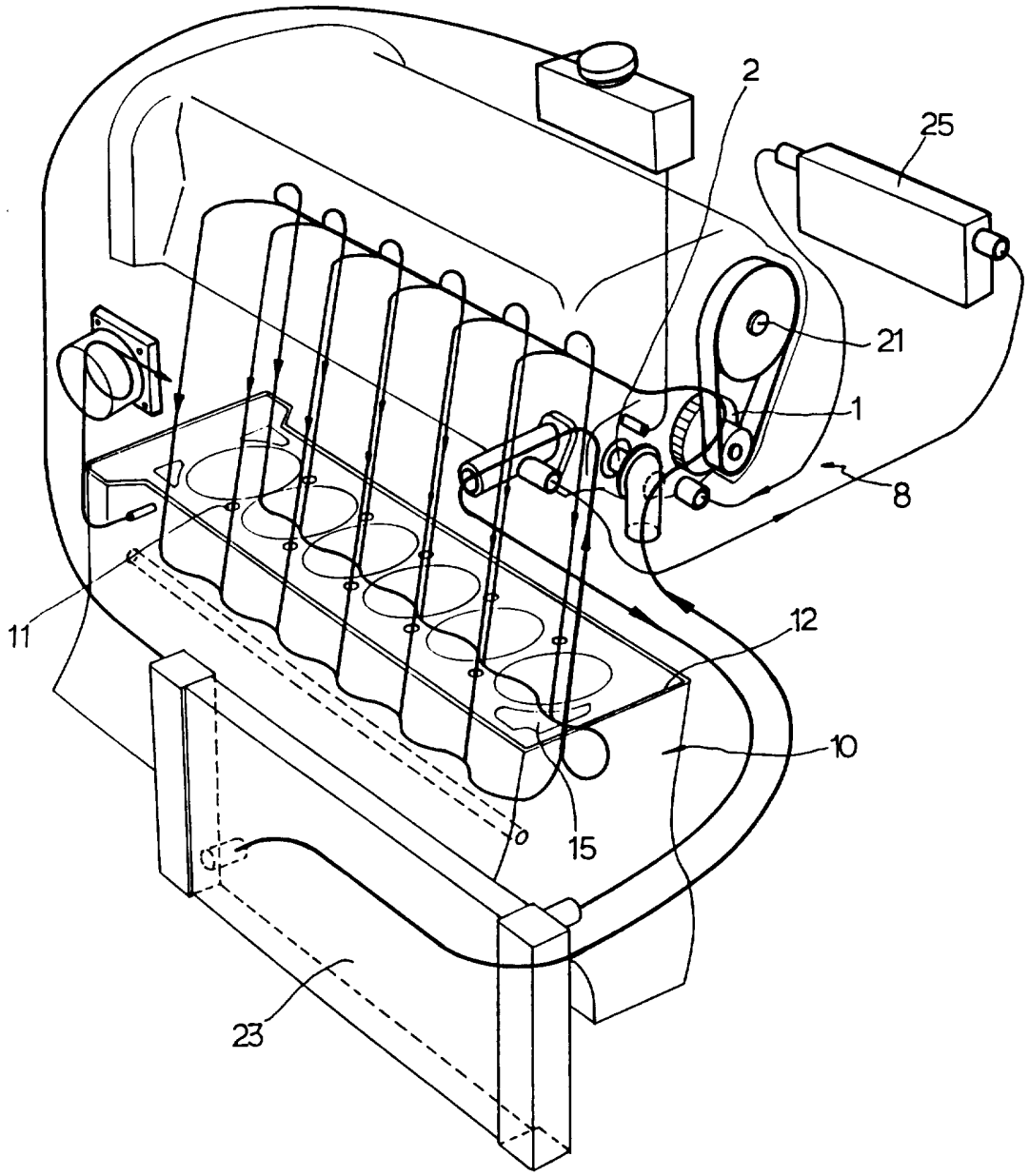


FIG. 2

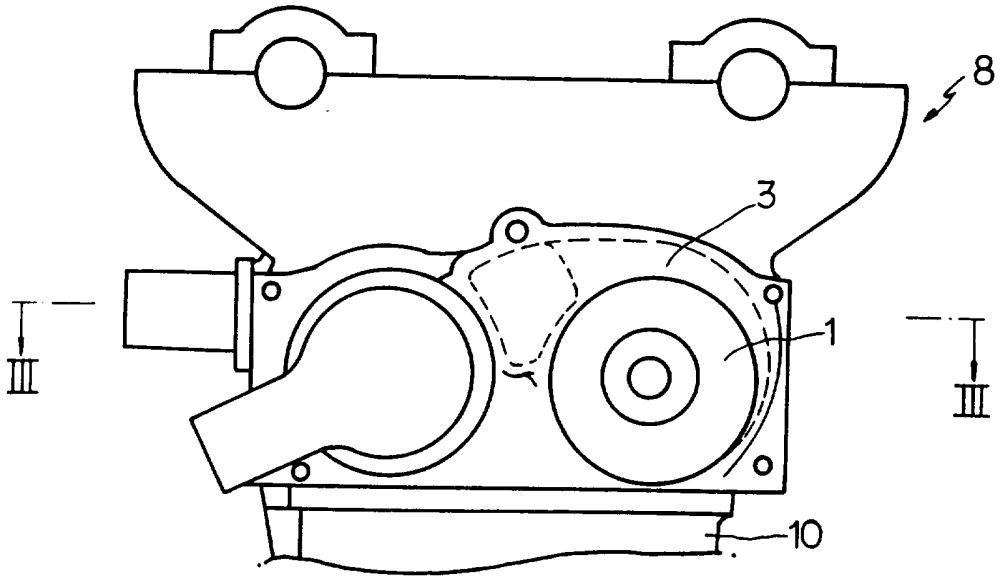


FIG. 3

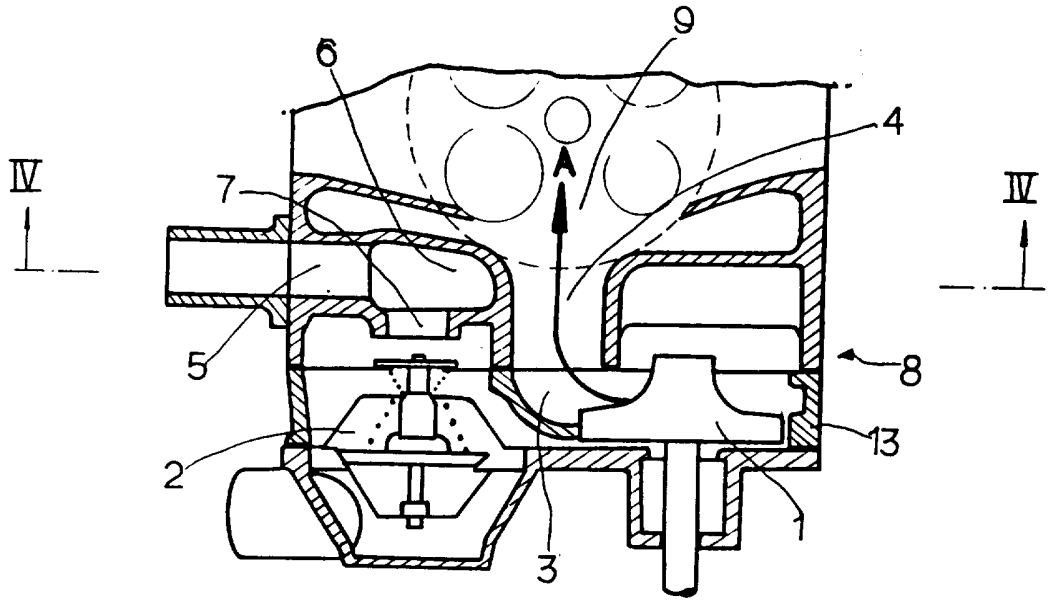
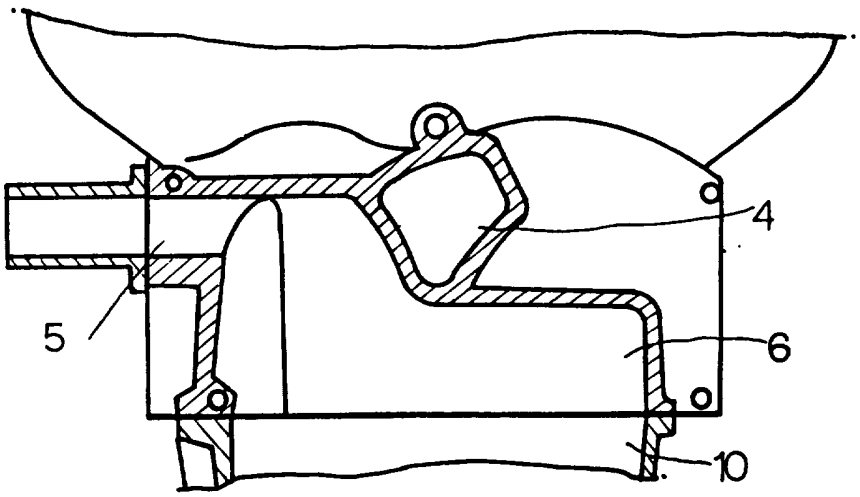


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 94/00099

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: F 01 P 5/10

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[6]: F 01 P 5/10, 5/12, 7/16; B 22 C 9/06, 9/22

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	GB, A, 2 160 588 (HONDA) 24 December 1985 (24.12.85), totality.	1-3 4,5
Y	GB, A 807 673 (G. BLAIR AND COMPANY, LTD.) 21 January 1959 (21.01.59), totality.	4,5
A	DE, C, 901 462 (DAIMLER-BENZ AG) 11 January 1954 (11.01.54), totality.	4,5

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

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Date of the actual completion of the international search	Date of mailing of the international search report
20 October 1994 (20.10.94)	31 October 1994 (31.10.94)
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
GB A 2160588		CA A1 1274435	25-09-90
		DE A1 3517002	21-11-85
		DE C2 3517002	21-09-89
		GB A0 8511959	19-06-85
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		JP A2 61001819	07-01-86
		US A 4662320	05-05-87
GB A 807673		keine - none - rien	
DE 901462		keine - none - rien	