Workshop manual

for

HERCULES

1934

Söderström's Motor Workshop

Kil – Wermland - Sweden

Söderström - HERCULES 1934

Straight 16-Cylinder

Introduction

“This has been done to the best of my ability, only the best is good enough”

P. Söderström

1 Introduction - Hercules 1934

A story about building a car that would be like one from the 30s, with a very long hood.

So I have built the world's first and only straight 16-cylinder automobile engine. There has never been such an engine before. As a basis I have used four engine blocks from a Volvo B20, but I have not "put four engines together", I have built an engine from **its parts.**

For me, this journey began eons ago with the advent calendar *Herkules Jonsson's Great Works.* As a technically interested 12-year-old, I was fascinated by the kid tinkering with an old car and countless hours, and countless projects later, I have built... a completely unreasonably long automobile engine.

On several occasions I have tried to calm myself down and at least settle for 12 cylinders, but every time I came to the same conclusion: *I have to do this..!*

In the model name HERKULES 1934 one might be tempted to assume that it would be an engine from the year model –34. It has also been my intention to let people draw that conclusion for themselves, since the idea is that the engine could have been built at this time. With the exception of certain electronic components.

I have also chosen to use the name ***"Söderströms Motor Werkstad"*** solely because it amuses me, and because it gives a resonance of what it might have been called 80 years ago.

I hope that the manual you hold in your hand will be of use to you when repairing and maintaining the engine. My ambition is that the content will reflect as much as possible of the knowledge I have gained during the course of the project, long after I have taken my hand off it. This has been the project of my life.

Construction of the engine started in August 2012.

Kil 2015

Pelle Soderstrom

2 General information

2.1 Hercules 1934 – Specification:

• Engine Type	Rack
• Number of cylinders	16
• Cylinder volume, Liters	8,1
Cubicity	494
• Fuel	Ethanol/Gasoline
• Number of carburetors, Make	4 / Zenith Stromberg
• Number of Distributors	2
• Length: Pressure Plate – Front Pulley 2464 mm	
• Weight: Incl. Cooling fan, Dynamo, Flywheel, Starters, Carburetors, Coolant and Lubricating oil	xxx Kilogram

2.2 Repair – Knowledge level

This manual is not complete in the sense of attributing to a novice knowledge of the noble art of engine restoration. A large measure of basic knowledge is necessary for the work to be carried out in a reliable manner. However, more information is attributed in this manual regarding the special mechanical components which cannot be derived from general engine knowledge.

2.3 Repair – Working methods

I have taken the liberty here to quote selected passages from *Reparationsteknik för Motorcyklar, Teknografiska Institutet 1955,* in revised form . In cases where the author has used the words "motorcycles" and the like, I have chosen to replace them with a more appropriate term in this context.

"Although repair work can be carried out with relatively modest resources, *great demands are made on the quality and care of the work and on the judgment with which it is carried out. Service work is for the most part purely manual work, and the result therefore depends above all on the hand and the brain, to a much greater extent than on the equipment. The virtue that the repairman should primarily strive for is therefore the ability to use ordinary simple hand tools and assembly tools in a sensible and sometimes ingenious way. In its most beautiful form, service can thus be said to be an art and craft, where individual performance has great potential to leave its mark on the final result.*

The main guiding principle in repair work is ***accuracy.*** *Temporary, makeshift repairs are part of the road and can certainly be interesting and test imagination and dexterity. However, their only purpose is to help the driver and his vehicle get home so that the repair can then be carried out in a reliable manner. In the long run, accuracy and care still pay off for the owner.*

One requirement that cannot be stressed enough is ***cleanliness.*** *Do not disassemble any parts until the machine has been thoroughly cleaned. The basic cleaning should be done in a place that is separate from the assembly workshop, so that it can later be kept impeccably clean. Also store clean, dismantled parts in a safe way so that they do not get dirty or damaged. Of course, there are quite a few parts and details on a machine that can tolerate a little dirt, and which do not really need to be given that much care. However, dirt has an incredible ability to spread to places where it is not desirable, for example via such simple means of transport as the assembler's hands. Cleanliness must therefore be general. In addition,* cleanliness gives the work a better "finish" and a greater guarantee *of quality. It also provides significantly more pleasant working conditions and therefore increases the feeling of satisfaction with the work, a factor whose indirect importance for the work result cannot be valued in numbers but which* is certainly very large.

C. Borgenstam

2.4 Labeling of components

A large part of the engine's components are marked with an electric engraving pen to ensure correct assembly. Some of the markings are not very visible, but can be detected if the part is held so that light falls on the surface.

The marking follows the following system:

- *The cylinders* are counted from the front of the engine with cylinder 1, towards the rear end where they end with cylinder 16.
- *Engine blocks* are marked from the front with the first block as 1-4, the second the block as 5-8 etc. referring to the cylinder number.
- *The engine blocks* also have letter abbreviations which refer to the places they originally came from. (1-4/PLE, 5-8/LSE, 9-12/ANL, 13-16/TRE
- A number of parts are marked from the front and end after the number of parts that are included. Examples include *Steering pins* between *Block* and *Trough,* which are eight in number, and consequently marked 1 to 8 starting from the front. *Valve parts* can therefore, to the extent that they are marked, be engraved from 1 to 32.
- Parts belonging to the Tilt *Arm Bridges* are marked PLE, LSE etc. with the associated serial number starting from the front. They can of course be re-marked with serial numbers 1 to 32 if desired.
- Some components are marked **L** for left and **H** for right. They are intended to be seen as the engine is positioned in the car and thus as from the driver's field of vision. For some components, such as *the main bearings,* the fitter stands facing the opposite direction, which can easily cause some confusion as to which is Right and which is Left. However, the components are **always marked from the engine's** Right/Left, not the fitter's.

2.5 Screws – Strength class

The choice of screw quality has been made with regard to its length, yield strength and the machine element that the screw is to fasten. On several occasions, the choice of a screw with lower strength has been made solely in order to be able to stretch the screw sufficiently to obtain a good preload.

2.6 Screws – Locking

Screws should always be locked with some form of locking device or locking fluid.
For Herkules 1934 there are several different alternatives in the form of folding washers, castle nuts, locking nuts, etc. Other screw connections should, unless otherwise stated, be locked with **LocTite medium** and **LocTite weak.** The latter applies to screws that are exposed to less stress.

2.7 Information – Wear etc.

The information described in the manual, such as wear, measured values, etc., refers **to the time the engine was built** and thus shows the current status of the various components and values at that time. This has nothing to do with the service and wear values, etc. recommended by, for example, Volvo, unless this is stated.

2.8 Important points in the Workshop Manual

On most pages concerning the actual assembly, there are warning and information boxes with yellow text.

NOTE! There are very good souls who want these boxes to be respected, as there is a lot of experience and a lot of thought behind their creation. Major engine damage can be at stake!

2.9 Units

The **Units** used to measure **quantities** in this manual are a
a mixture of the older system and the newer ISO system. Many values are shown with older values, all to reflect the time the engine is thought to have been built. An example of this is the engine plate, which, among other things, shows torque in Kilopond meters (Kpm), instead of Newton meters.

Kilopond meter (kpm) is often also written kilogram meter (kgm).

Some of the units shown are primarily:

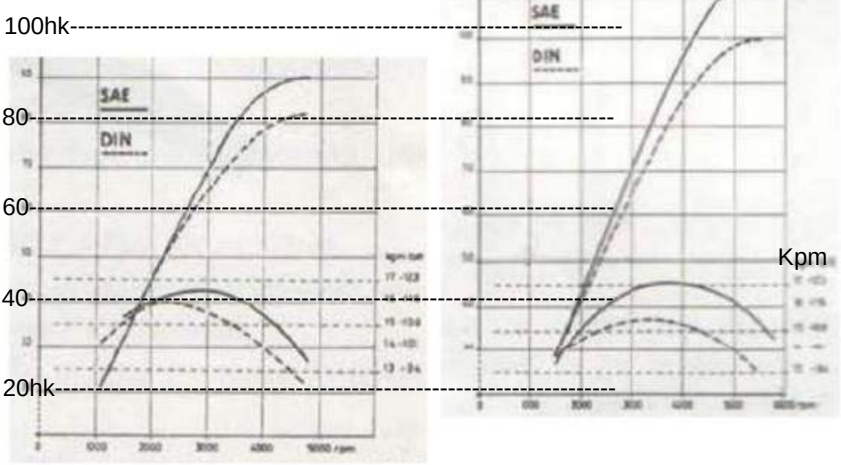
Older device		**Newer unit**	
1 Kilogram meters	Kgm = 9,807	Newtonmeter Nm	
1 Kilopondmeter	Kpm = 9,807	Newtonmeter Nm	
1 Atmosphere overpressure Atm = 1.013		Bar	Bar
1 Kg/cm2	= 98,07	kiloPascal	kPa
1 Bar	Bar = 100	kiloPascal	kPa

2.10 Technical specifications – Measurement values

For technical specifications and measurements, such as volumes, tightening torques and the like, see the respective sections.

3 Engine power – Torque

3.1 Effect cure



Power-Torque curves for B20A

Power-Torque curves for B20B

The above curves are taken from Volvo's manual. They show the difference at which rpm the increased power is extracted for the two models.

ALLMÄNT

Typbeteckning	B 20 A	B 20 B
Effekt, hk vid varv/min. (SAE)	90/4800	118/5800
(DIN)	82/4700	100/5500 (105/5500)*
Max. moment, kgm vid varv/min. (SAE)	16,5/3000	17/3500
(DIN)	16/2300	15,5/3500 (16/3500)*
Kompressionstryck (varm motor) vid kringvridning med startmotor, 250–300 varv/min. kg/cm²	11–13	12–14
lbs/sq.in	155–185	170–200
Kompressionstal	8,7	9,5

3.2 Hercules 1934 – Effect:

As can be seen from the above specifications, the B20A engine in the original version developed 90hp SAE. The following changes were made to the 1934 Herkules:

- Flattened top of *Engine Block*
- Flattened underside of *Cylinder Head*
- Thinner *Cylinder Head Gasket*
- *Intake valves* such as B20B, i.e. Ø44mm (Isf Ø42mm)
- Double *Distributors* of 50kV and IRIDIUM Spark Plugs

An assumption can therefore be made that each *Engine Block* develop about 105 horsepower.

Furthermore, by studying the above torque curves, it can be assumed that the torque is approximately 17 kilopound meters at 2800 revolutions per minute.

The relationship between torque and power:

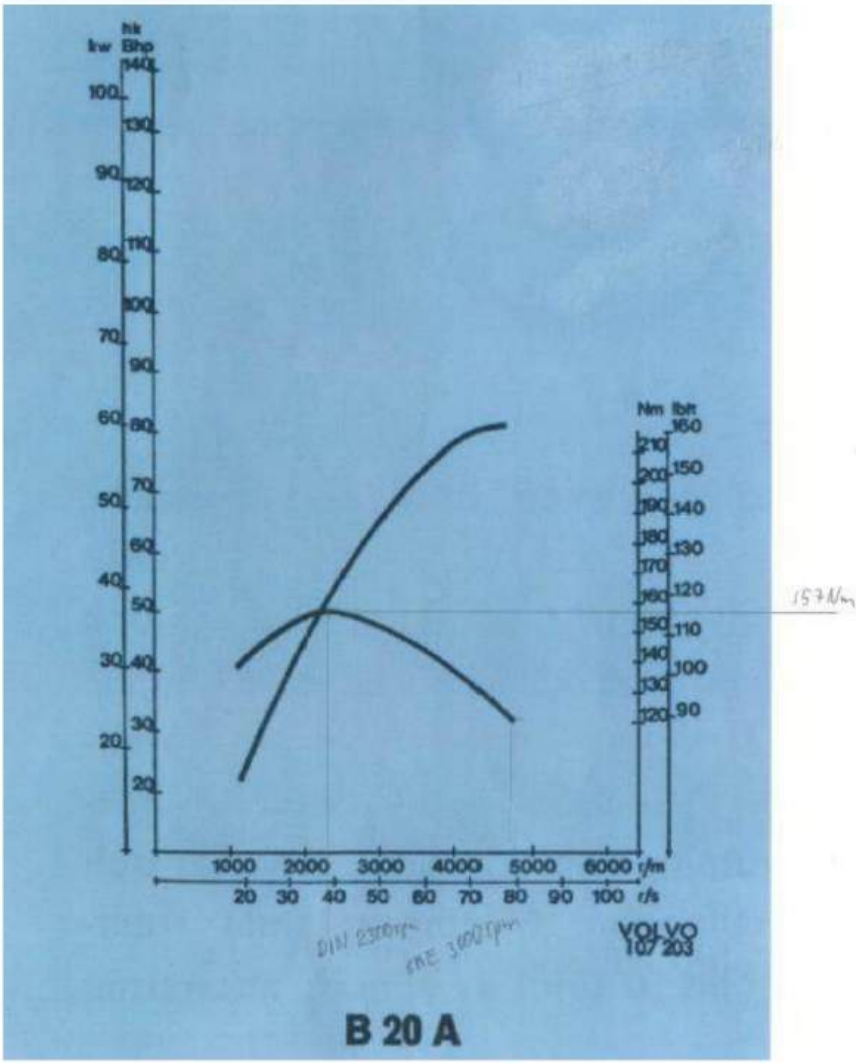
$$\frac{\text{Torque} \times \text{RPM}}{716{,}2} = \text{horsepower}$$

Adoption:

$$\frac{16{,}5\text{kpm} \times 2800}{716{,}2} = 64\ \text{hk} \qquad \frac{\mathbf{17kpm} \times 2800}{716{,}2} = \mathbf{66\ horsepower}$$

Thus, Hercules in 1934 would develop:		
4 x 66	=	264 horsepower at 2800 rpm
4x 105	=	420 horsepower at 4800 rpm
4x 17	=	68 kilopound meters at 2800 rpm

3.3 Power / Torque curve B20 A

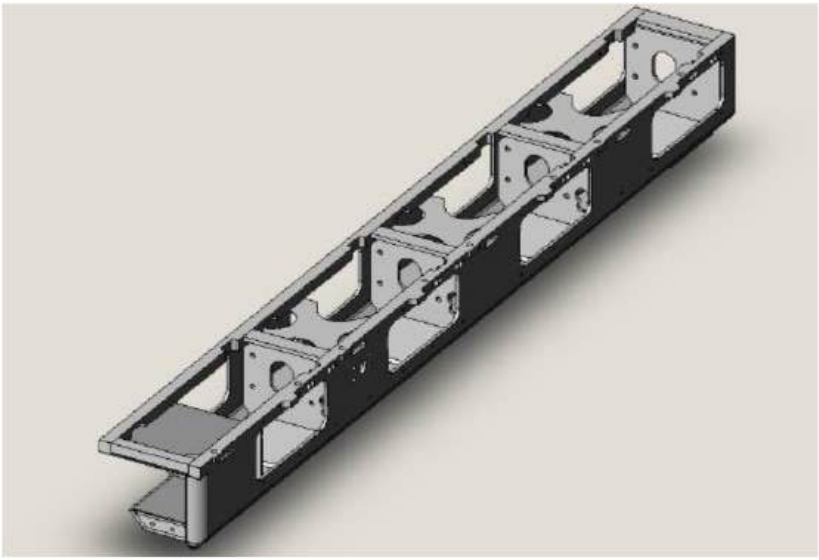


4 Bottom frame – Trough / Frame

4.1 Welded Trough – Frame

4.1.1 Trough – General information

The trough is made of bent 8mm sheet metal whose yield strength corresponds to 35 kp/mm². Laser cutting and bending were carried out by Kils Verkstads AB. The trough has been welded, among other things, to partitions, double bottoms and reinforcements. On the top there are two square irons 30x30mm (24 kp/mm²). The square irons are flattened after welding, also by Kils Verkstads AB. Other work: welding, drilling, reaming, threading etc. was carried out by ***Söderströms Motor Werkstad.***



At the bottom of *the Trough* there are a number *of plugs* mounted seemingly for no reason. Their task is to seal the sweaty compartments after each compartment has been filled with sound-absorbing polyurethane foam. This in the form of wood glue.

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Bottenram – Stomme

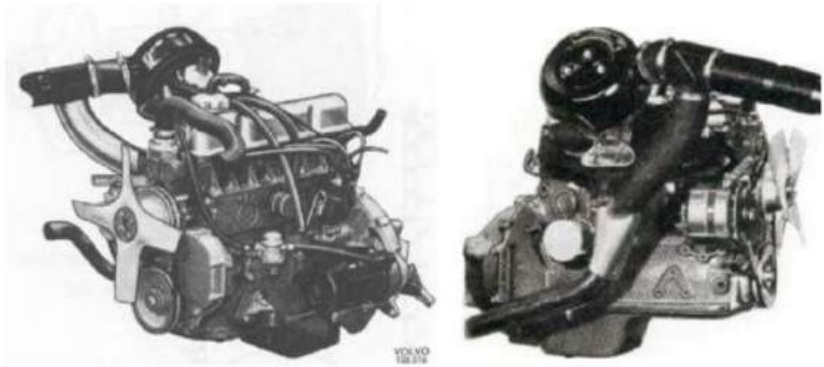
For your own notes:

5 Engine components

5.1 Volvo B20 engine block - Information

5.1.1 General information

The basis, the four *Blocks,* are taken from the Volvo B20 from the late 60s. early 70s.



The B20 engine is based on the 1.8-liter B18 engine, but with a larger bore, 88.9 mm, which together with the retained stroke of 80 mm gives the engine a displacement of 2.0 liters (1986 cm3). The B20 made its debut in 1969 in the Amazon, Volvo P1800 and Volvo 140 models and was installed in the Volvo 240 series until 1976. The design is a pushrod engine with a block and cylinder head made of cast iron. The B20 is known for its high quality and reliability. It is considered by many to be one of the most durable engines ever manufactured. One of the designers of the B18 engine was honorary doctor Per Gillbrand.

5.2 Hercules engine block 1934 - Information

- *The blocks* have been drilled to Volvo's 3rd oversize (Ø89.66-Ø89.67mm) and equipped with pistons from Mahle.
- The top sides of *the blocks,* i.e. towards *the cylinder head,* have been leveled on all blocks to the same height measured from the frame bearing position.
- Main bearing positions have been line honed.
- The above engine work was carried out at LJ-trim AB Hammarö by the owner Jan “Biss” Eriksson and Tommy Johannesson. Other work was carried out by *Söderströms Motor Werkstad.*

- Crank and frame bearings replaced, Manufact. GLYCO.
- Camshaft bearings replaced, Manufact. DURA-BOND.
- Gearbox mounts including starter motor mounts cut away.
- The threaded holes that the trays are normally screwed into from below have been reamed and grinding has been carried out so that the blocks can be screwed from above into the supporting *frame* manufactured by *Söderströms Motor Werkstad ,* the so-called *Tray.*

- Hole where the dipstick was previously located has been drilled and threaded M12 x 1.25
- Note: Volvo's older B20 engine blocks almost exclusively have inch threads. UNC (Unified Coarse) and UNF (Unified Fine)

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

5.2.1 **Measured Cylinder Dimensions**

Below is a table with the cylinder dimensions measured after machining at the time of the engine's construction. The bore is made to Volvo's third oversize 0.75mm / 0.030".

According to the older Volvo manuals, the nominal measurement is 89.66 – 89.67

Pistons from Mahle specify nominal cylinder diameter to **89.670mm**

Cylinder dimensions **HERKULES 1934**

CYLINDER	Diameter ca 10mm ner	Diameter ca 50mm ner	Diameter ca 90mm ner	Difference
Cyl 1	89,67	89,67	89,68	0,01
Cyl 2	89,67	89,68	89,685	0,015
Cyl 3	89,665	89,675	89,685	0,02
Cyl 4	89,665	89,67	89,68	0,015
Cyl 5	89,67	89,675	89,69	0,02
Cyl 6	89,66	89,675	89,68	0,02
Cyl 7	89,66	89,675	89,68	0,02
Cyl 8	89,67	89,68	89,69	0,02
Cyl 9	89,675	89,68	89,685	0,01
Cyl 10	89,665	89,67	89,675	0,01
Cyl 11	89,665	89,665	89,675	0,01
Cyl 12	89,68	89,67	89,68	0,01
Cyl 13	89,68	89,675	89,68	0,005
Cyl 14	89,675	89,675	89,68	0,005
Cyl 15	89,675	89,675	89,68	0,005
Cyl 16	89,675	89,67	89,68	0,01

The measurement was performed with a Cylinder Indicator purchased from Biltema AB. The indicator has been reference checked against a measurement ring which was provided on loan from Myka AB.

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Straight 16-Cylinder

Engine components

For your own notes:

5.3 Cylinderlock

5.3.1 Cylinder head – General information

The cylinder heads for the B20 models have two sizes of *intake valves.* The early models (B20A) have Ø42mm *intake valves,* while the later ones (B20B) have Ø44mm *intake valves.*

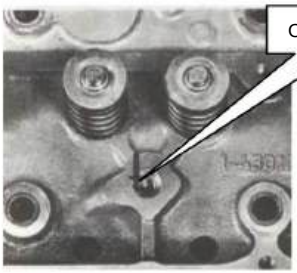
The exhaust valves are the same size for both models. *Valve guides* (loose, as a spare part) and valve seats (directly in the cylinder head) are made of cast iron. The combustion chambers are machined.

Herkules 1934 has the latter type of *cylinder head* with Ø44mm *intake valves. The cylinder heads* are flattened by LJ-Trim and fitted with recessed, hard, valve seats for *the exhaust valves ,* which means that the engine can be run on unleaded petrol.

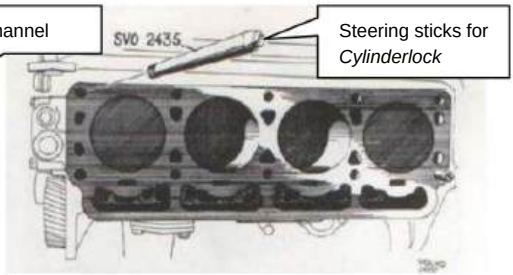
5.3.2 Cylinder head – Tightening

Inspect *the engine block* and *cylinder head* sealing surfaces carefully and clean if necessary before starting the assembly work. *The cylinder head* and *cylinder head gasket* are then centered during assembly using guide pins in two of the screw holes. Also ensure before assembly that the oil channel for lubricating the rocker arms is not blocked due to a faulty or incorrectly installed cylinder head gasket. Then lubricate *the cylinder head screws* with engine oil, install them in the holes and first tighten them lightly so that the guide pins can be removed. After all screws are in place, *the cylinder head* can then be tightened in the specified order as shown in the picture.

next page view.



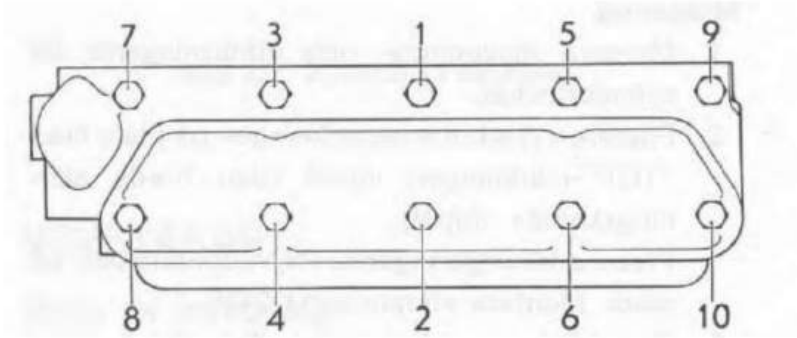
Make sure the oil channel is clear.



Guide pins for *Gasket* and *Cylinder Head*

Tightening the Cylinder Head should be done in three steps as follows:

- 1st draw, according to the order described below 3kpm +/-0.5kpm
- 2nd draw, 6kpm +/-0.5kpm
- 3rd draw, 9kpm +/-0.5kpm



Tightening sequence for cylinder head bolts

Retightening of Cylinder Head

When starting the engine with a new cylinder head gasket, the engine should be run for about 10 minutes, then shut off. After cooling down, the cylinder head should be retightened. Loosen each screw only slightly to overcome the resting friction before final tightening according to the specification above.

5.3.3 Cylinder Head Gaskets – General Information

The cylinder head gaskets for the B20 models have been of different thicknesses over the years (2 - 1.4 - 1.2 - 0.8mm). The earlier B20A models had 2mm, the B20B 1.4mm and the later ones down to 0.8mm.

In the original version there were rubber seals between *the Cylinder Head* and *Water Pump,* where in our case there are now *Intermediate Parts.* In the case of the Herkules 1934, these surfaces (i.e. between *the Cylinder Head* and *Intermediate Parts)* are sealed with engine silicone iff rubber seals. This applies to both the main cooling loop and the loop which is activated when the engine is cold.

5.3.4 Cylinder Head Gaskets – Herkules 1934:

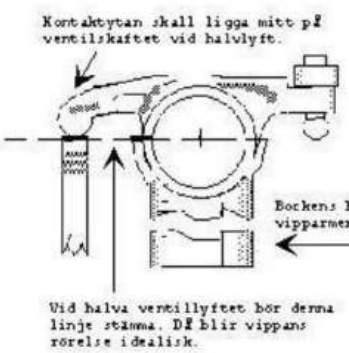
- *Cylinderlockspackning* 1,2mm – KG-Trim
- Seal between *Cylinder Head* and *Intermediate Piece* – LocTite SI 5910

5.3.5 Vipparmsbryggor

Tilting boom bridges – General information

Complete *rocker arm bridges* are taken from 4 different engines whose running time has been approximately the same. Allowed play according to Volvo's instruction manual 0.10mm but this is probably not critical.

Measured rocker arm play for all rocker arms was approximately 0.07mm during engine build.



På en stötstångsmotor är vipparmens läge och dess kurvatur mot ventilen mycket viktiga. De är förutsättningen för riktiga och lika ventillyft och -tider på alla ventilerna.

Excerpt from Ståhl engine

Note!

After grinding the valve lifter, check that the rocker arm's profile matches the adjacent picture.

5.3.6 Valves

Valves – **General information**

The valves for the Herkules 1934 are made by Intervalves, delivered together with *Valve Controls* by KG-Trimning AB in Södra Sandby.
The valve locks are equipped with three bars and the valve stems with corresponding grooves, which hold *the valve* but allow for appropriate rotation.

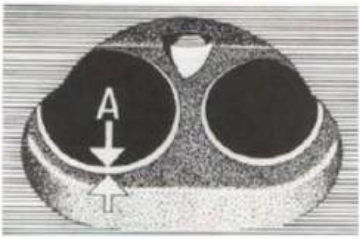
• Valve inlet +IVS+ #1403.032	InterValves KG Trimning AB
• Valve outlet +IVS+ #1179.036	InterValves KG Trimning AB

Specification Inlet valve:

• Plate diameter	44mm
• Spindle diameter	7,955 – 7,970mm
• Valve seat angle	44,5°
• Cylinder head seat angle	45°
• Seat width in the Cylinder Head	2mm
• Valve clearance, both hot and cold engine	0,40 – 0,45mm
• Wear tolerance Valve stem / Steering: • Valve stem,	0,15mm
permissible wear Max	0,02mm

Specification Outlet valve:

• Plate diameter	35mm
• Spindle diameter	7,925 – 7,940mm
• Valve seat angle	44,5°
• Cylinder head seat angle	45°
• Seat width in the Cylinder Head	2mm
• Valve clearance, both hot and cold engine	0,40 – 0,45mm
• Wear tolerance Valve stem / Steering: • Valve stem,	0,15mm
permissible wear Max	0,02mm



Ventilsätesbredd. A= 2mm

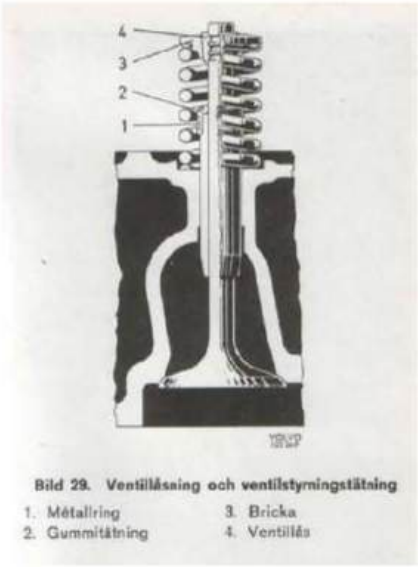


Bild 29. Ventillåsning och ventilstyrningstätning

1. Metallring
2. Gummitätning
3. Bricka
4. Ventillås

5.3.7 **Valve adjustment – B20 general**

Valve clearance is best adjusted with the engine at a standstill, equally cold or warm. The clearance is the same for both the outlet and inlet. When adjusting, two feelers should be used - **0.40mm and 0.45mm respectively.** The clearance is set so that the thinnest gauge can be easily inserted, while the thicker one should not be inserted.
in.

When **the "first piston per block"** is at top dead center/compression stroke, the *cylinder head* valves number: **1, 2, 3 and** 5 are adjusted.

When **the "last piston per block"** is at top dead center/compression stroke, the *cylinder head* valves number: **4, 6, 7 and** 8 are adjusted.

5.3.8 Valve adjustment - Hercules 1934

To most easily adjust the valves for the Herkules 1934, the following system can be used.

The starting position is that *Cylinder* 1 is at top dead center/compression stroke, and that the degree number is read on the crankshaft's protractor. This may be seen on the flywheel instead!

Crankshaft degrees:	Adjust valve no.:	Remark
0° - OD compression	**1, 2, 3, 5**	
45° - Varv1	**17, 18, 19, 21**	
90° - Varv1	**25, 26, 27, 29**	
135° - Varv1	**9, 10, 11, 13**	
0° - OD Exhaust	**4, 6, 7, 8**	
45° - Color2	**20, 22, 23, 24**	
90° - Color2	**28, 30, 31, 32**	
135° - Color2	**12, 14, 15, 16**	

5.3.9 When disassembling the Cylinder Head

When removing *the Cylinder Head,* turn and twist the *Cover* to hear if the installed Cooling Water *Distribution Pipe* is loose. If so, the rear frost plug must be drilled/broken out and the necessary fastening made.
If this measure is overlooked, cooling may be compromised and engine damage may result.

5.3.10 Valve controls

Valve controls – **General information**

Valve guides are mounted in *the cylinder head* with a press fit. When pressing in, so-called "pig grease" was used, which is probably the same thing as Ister.
Guides are made of gray iron.

• Valve control Inlet	011317 1M1 Metelli KG Trimning AB
• Valve control Outlet	011318 1F2 Metelli KG Trimning AB

Specification Valve control:

According to Volvo

• Length of valve guide for Inlet valve	52mm
• Length of valve guide for Outlet valve	59mm
• Inner diameter	8,000 – 8,022
• Height above the top plane of the lid	17,5mm
• Clearance, Valve Stem – Control, Inlet Valve	0,030 – 0,067
• Outlet valve	0,060 – 0,067

Reamer diameter for valve control according to KG Trimning AB 7.99 – 8.00.

When compared to Volvo's specification, **Reamer Ø8 H7** (8.00 – 8.015) would be more appropriate.

Checking the wear *of the valve guide* can be done with the advantage of using **a new valve** as a measuring device. The play against the stem of the new *valve* should, measured with a dial gauge, not exceed 0.15mm.

5.3.11 Valve springs

• Length: *Valve springs* without load	ca 46mm
• *Valve springs* with 29.5 +/- 2.3 kp load	ca 40mm
• *Valve springs* with 82.5 +/- 4.3 kp load	about 30mm

During inspection and control measurements, none of the Herkules 1934's measured *valve springs* showed any signs of defect.

5.3.12 Valve seats

The cylinder heads have been supplemented with hard valve seats for *the exhaust valves* , all to enable the engine to run on alcohol or unleaded petrol. *The cylinder head* was originally designed for leaded petrol, with the seat for *the exhaust valve* directly in the cast iron *of the cylinder head* . For *the inlet valve,* the valve seat is still milled directly in the cast iron *of the cylinder head* , as the stresses on these valves are not as severe. This is because the inlet valves are constantly cooled by the incoming fuel.

/luftblandningen.

Replacement of valve seats and milling and surface grinding of *the cylinder head* have been carried out by the engine renovation company LJ Trim AB.

• Ventilsäte SBI 1008 B – 1417 E – 1 Ø27/36 x 9 LJ Trim AB

Assembly process:

The valve seat has been given a press fit of 0.15 – 0.17 mm during assembly. Prior to pressing, the parts have been coated with LocTite 128 467, both to reduce friction during the pressing process and to provide a secure grip afterwards.

The seat's profile has then been given its shape using Mira milling by the engine renovation company LJ Trim AB.

5.4 Vevaxlar, Vevstakar

5.4.1 Crankshaft – General information

The crankshaft is made of forged steel, with surface-hardened and ground bearing journals. It is supported by five frame bearings, of which the rear one functions as a guide bearing in the axial direction. There are channels drilled through the shaft for the distribution of lubricating oil. The shaft is of extremely strong construction.

5.4.2 Crankshaft – Specification

Crankshaft

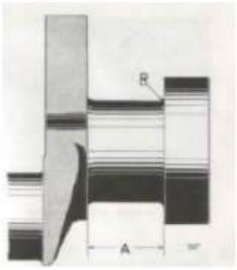
• Crankshaft,	Axialspel	0,047 – 0,138
• Crankshaft bearings,	Radial clearance	0,039 – 0,081
• Main bearing, radial clearance		0,038 – 0,089

Main bearing journals on crankshaft

• Diameter, Standard		63,441 – 63,454
•	Underdimension 0,010”	63,187 – 63,200
•	Underdimension 0,020”	62,933 – 62,946

Width measurement of crankshaft for flange bearing cup

• Standard	38,930 – 38,970
• Oversize 1 (Undersize, bowl 0.010”)	39,031 – 39,072
• 2 (Undersize, Bowl 0.020”)	39,133 – 39,173



Width measurement for headset.

Main bearing cups

• Thickness, Standard	1,985 – 1,991
• Underdimension 0,010”	2,112 – 2,118
• Underdimension 0,020”	2,239 – 2,245

Dimensions for Crankshaft journals, see Connecting rods

5.4.3 Crankshaft – Tightening torque

• Frame layer	12 – 13 kilopondmeter

For other tightening torques, see the respective sections.

5.4.4 **Crankshaft – Wear tolerance**

• Permissible ovality for main bearing journals, max. •	0,05mm
Permissible conicity, max.	0,05mm
• Axial play for *Crankshaft,* max.	0,15mm

For Crankshaft journals, see Connecting Rods / Crankshaft journals

5.4.5 **Crankshaft: Frame- Crankshaft Bearings – Procedure according to Volvo**

Crankshaft

After cleaning *the crankshaft ,* measure its journals with a micrometer. The measurement should be carried out in several places around the circumference and along the length. The ovality of *the main bearing journals* should not exceed 0.05mm, of *the crank bearing journals* 0.07mm. The taper should not be greater than 0.05mm for any of the pins.

If the measured values are close to, or exceed the wear specified above, *the crankshaft* should be ground to an undersize. Suitable *bearing shells* are available in two undersizes. The dimensions can be found in the specification section.

Check that *the shaft* is straight within 0.05mm by indicating it. *The shaft* is then placed in two V-blocks and an indicator is placed against the center *pin,* after which *the shaft* is turned. If necessary, *the shaft* is aligned in a press.

Crankshaft grinding

Before grinding *the crankshaft ,* it must be straight, which is checked according to the previous instructions. Grinding is carried out in a special machine, whereby *the main* and *main bearing journals* are ground to equal dimensions. These dimensions, which are stated in the specification, must be carefully followed in order to obtain the correct bearing clearance together with the finished bearing shells.

There must be absolutely no abrasion of *bearing shells* or filing.

The radii at the ends *of the pins* should be 2.0-2.5mm for all *pins.*
The width measurement (A) for *the guide bearing* depends on the dimension of the pin and is ground to obtain the correct dimension.

After grinding, the oil channel openings should be carefully deburred and all *pins* should be lapped with fine grinding paste to the best surface finish, after which *the shaft* should be washed.
All oil channels are cleaned particularly carefully so that all residues of chips and abrasives are safely removed.

Frame and Bottom Brackets

In addition to the standard dimensions, *bearing cups* are available in sub-dimensions 0.010" and 0.020".
The rear *frame bearing cups* are equipped with flanges and have larger width dimensions in relation to the dimension.

If *the crankshaft* has been ground to the correct dimensions, the correct bearing clearance is obtained when the corresponding *bearing cup* is installed.

The bearing shells must not be scratched and the bearings must never be filed to make the bearings fit more tightly.

The screws should be tightened with a torque wrench.

See specification for tightening torque information.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

5.4.6 **Connecting rods / Crank pins – General information**

The connecting rods, made of forged steel, are fitted with a finely machined bushing for the piston pin. However, in the 1934 Hercules the bushings have not been replaced and thus show a smaller clearance.

5.4.7 **Connecting rods / Crank pins - Specification**

Vevstakar

• Connecting rods, axial play against crankshaft	0,15 – 0,35
• Connecting rods, center-to-center length • Maximum	145 +/-0,1
permissible weight difference between connecting rods	6 gram

Crankshaft journals

• Width dimension of the bearing position	31,950 – 32,050
• Diameter, Standard	54,089 – 54,102
• Underdimension 0,010”	53,835 – 53,848
• Underdimension 0,020”	53,581 – 53,594

Bearing cups

• Thickness, Standard	1,833 – 1,841
• Underdimension 0,010”	1,960 – 1,968
• Underdimension 0,020”	2,087 – 2,095

Connecting rods – Tightening torque

• Connecting rod attack	5.2 – 5.8 kmph

For other tightening torques, see the respective sections.

5.4.8 **Crankshaft pins – Wear tolerance**

• Permissible ovality for crankpins, max 0.07mm

5.4.9 **Connecting rods Hercules 1934**

• Cylinder	1	148	Symbol: Oval ring with horizontal line
• Cylinder	2	102	Oval ring with horizontal line
• Cylinder	3	149	Oval ring with horizontal line
• Cylinder	4	121	Oval ring with horizontal line
• Cylinder	5	145	Oval ring with horizontal line
• Cylinder	6	145	Oval ring with horizontal line
• Cylinder	7	107	Oval ring with horizontal line
• Cylinder	8	107	Oval ring with horizontal line
• Cylinder	9	108	Oval ring with horizontal line
• Cylinder	10	141	Oval ring with horizontal line
• Cylinder	11	137	Oval ring with horizontal line
• Cylinder	12	88	Oval ring with horizontal line
• Cylinder	13	312	B, with horizontal arrow. (Bofors)
• Cylinder 14		104	B, with horizontal arrow. (Bofors)
• Cylinder	15	312	B, with horizontal arrow. (Bofors)
• Cylinder 16		312	B, with horizontal arrow. (Bofors)

5.4.10 **Connecting rods / Crank bearings – Procedure according to Volvo**

When installing the connecting rods to the crankshaft, the connecting rod numbering must be turned away from the camshaft.

Connecting Rods – Bushing Replacement

If the old *piston pin bushing* is too worn, press it out and replace it with a new one. Make sure that the lubrication hole is aligned with the hole in *the rod.* Then ream *the bushing* to the correct fit. *The piston pin* should then slide through the hole with light thumb pressure but without noticeable play. (picture 36)

Direction

Before assembly, *the connecting rods* are checked for straightness, twisting and any S-bends. If necessary, they are straightened. (Fig. 37) Nuts and screws should be replaced in connection with renovation.

Bild 36. Kolvtappens passning

Bild 37. Kontroll av vevstake

Piston pins

Piston pins are available in an oversize 0.05mm larger than the standard dimension 22mm. If *the piston pin hole* in *the piston* is worn so that the oversize needs to be used, the hole is first reamed to the correct size. Use a reamer with a guide and take small cuts at a time.

The fit is correct when *the piston pin* can be pushed through the hole with slight resistance.

Bild 35. Byte av bussning, vevstake

5.5 Camshafts, Camshaft gears

5.5.1 Camshafts, Camshaft gears – General information

The camshaft is made of special alloy cast iron, has surface-hardened and ground cams. It is driven from the crankshaft by means of a gear consisting of a steel gear on the crankshaft, and a fiber gear on the camshaft.
The fiber gear has a steel hub, and the gear ratio is 2:1. Axial control is achieved by a bronze thrust washer at the front end of the camshaft. Axial play is determined by a spacer ring behind the camshaft gear.

The valve lifters are directly affected by *the camshaft.* They are located in holes in *the block.* directly above the shaft, and transmits the movement via pushrods and rocker arms directly to *the valves.* There are no inspection hatches, *the valve lifters* are accessible from above after *the cylinder heads* have been removed.

5.5.2 Camshaft gear on crankshaft

Notes for steel gears:

- *Crankshafts* 5-8, 9-12 and 13-16 are cut approximately 20mm. This was due to an earlier design solution where this was required. Later designs do not require this cutting. This means that if *the crankshaft* needs to be replaced in the future, for example due to cutting, this can be done without having to cut it.
  However, the screw for *the cam gear* must then be replaced.
- Screw UNF 9/16” for the above cam gears are cut and marked at the end due to different lengths.
- Washers are made of steel SS2541, and marked on the inside with respective crankshaft number.
- Tightening torque 7 – 8 kilopound meters.
- LocTite 270 Strong for screws in *Crankshafts* 5-8, 9-12 and 13-16. **NOT Loctite for front sprockets whose screws also hold the pulley.**

5.5.3 **Camshaft - Specification**

Camshaft

Camshaft, marking B20A		A
Camshaft, type number		1000074
Number of layers		3
Front bearing pin,	Diameter	46,975 – 47,000
Middle bearing pin, Diameter		42,975 – 43,000
Rear bearing pin,	Diameter	36,975 – 37,000
Radial clearance		0,020 – 0,075
Axialspel		0,020 – 0,060

- Valve clearance for checking camshaft setting (cold engine) 1.1mm
- The inlet valve should then open at 10° east

Camshaft bearing

Front bearing,	Diameter	47,020 – 47,050
Middle layer,	Diameter	43,025 – 43,050
Rear bearing,	Diameter	37,020 – 37,045

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

Kamhjul

• Crankshaft gear, number of teeth		21
• Camshaft Gear, (fiber) number of teeth		42
• Gear flank backlash (Measured with dial gauge such as crown wheel)		0.04 – 0.08

Valve lifter

• Valve lifter	EV-513 Double hardened	KG Trimming

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.6 Pistons – General description

The Herkules 1934 has *pistons* from the German company Mahle. Since the 1920s, they have manufactured *pistons* from aluminum and are probably considered to be one of the world's best quality products.

5.6.1 For Herkules 1934 the following applies:

• Pistons Mahle 037 31 02 (3rd oversize)	GET 91509 0.75

5.6.2 Pistons – Specification according to Volvo

Piston

• Material	Light metal
• Weight	500 +/- 5 gr
• Permissible weight difference between pistons in the same block	10 gr
• Height, total	71 mm
• Height, piston pin center to piston top	46 mm
• Piston clearance	0,02 – 0,04

Kolvringar

• Piston ring gap measured in the ring opening	0,40 – 0,55
• Oversized piston rings	0,030”

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Straight 16-Cylinder

Engine components

Compression rings

- Marked "TOPP", Upper ring chrome plated
- Number on each piston 2
- Height 1,98 mm
- Piston ring clearance in grooves 0,045 – 0,072

Oiling

- Number on each piston 1
- Height 4,74 mm
- Piston ring clearance in grooves 0,045 – 0,072

Piston pin

- Floating bearing. Locking ring at both ends of the piston.
- Fit in connecting rod: Light thumb pressure, careful running fit
- Fit in piston: Light thumb pressure, careful running fit
- Diameter, Standard 22,00
- Oversize 22,05

Measurement of pistons

- *Pistons* should be measured 2.5mm from the bottom edge of the piston, and perpendicular to the piston pin hole.

5.6.3 **Pistons – Procedure according to Volvo**

Assembly and installation of Piston and Connecting Rod

When assembling, make sure that *the piston* is turned correctly so that the groove on the piston crown points forward. (Fig. 38). If *the piston* is turned incorrectly, a loud noise will occur. *The connecting rod* The number marking is turned from *the camshaft side. The piston pin* is mounted on it, *the snap rings* are put in their places and *the piston rings* are mounted.

Use piston ring pliers for *the Rings. The compression rings* are "TOP" marked and the upper one is chrome plated. Place *the Bearing Cups* in their positions.

Turn *the rings* so that the gaps are not opposite each other and lubricate *the piston* and bearing surfaces.

Tighten *the connecting rod nuts* to the prescribed torque. *See specification.*

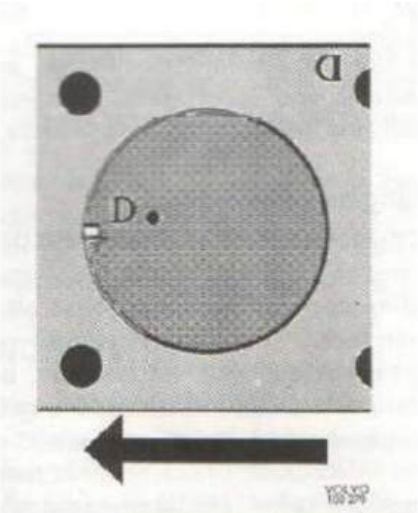


Bild 38. Märkning av kolv och block

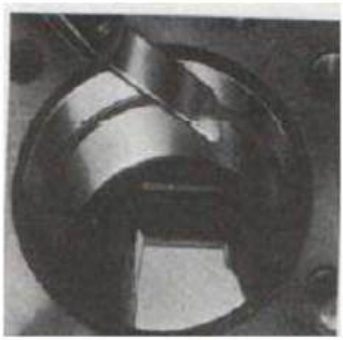
Fitting Piston Rings

In a new or newly drilled cylinder bore

1. Slide *the piston rings* down one by one into the bore. Use an upside down *piston* to ensure the ring is in the correct position.
2. Measure the gap *of the ring* with a feeler gauge. The gap should be 0.40-0.55mm. If necessary, increase the gap with a special file.
3. Test *the piston rings* in their respective ring grooves by rolling them in the groove. Also measure the play in a few places. (see picture) *For measurements, see the specification*

In worn cylinder bore

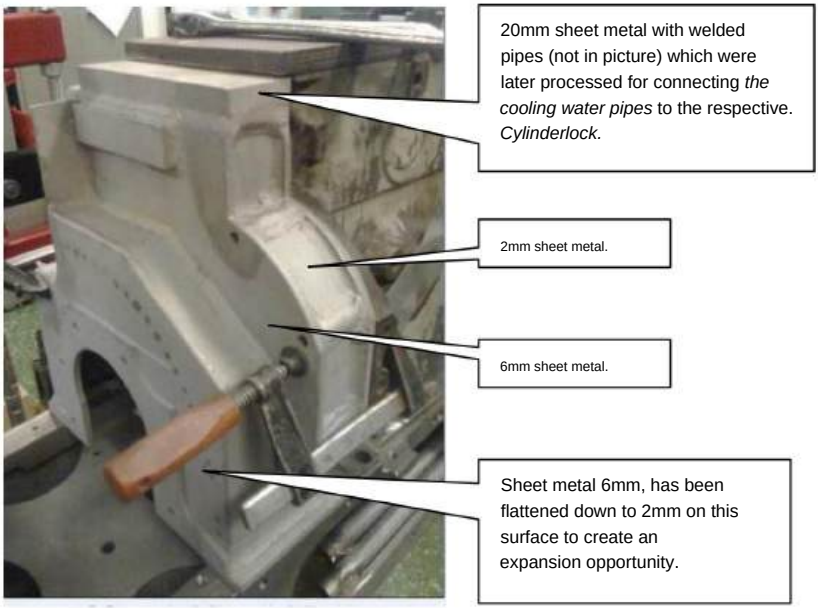
When fitting into a worn cylinder bore, *the rings* must be tested in the lower turning position because the cylinder bores have their smallest diameter there.



5.7 Spacers between Blocks

5.7.1 Spacers – General information

Intermediate pieces / Intermediate parts / Assembly of blocks / Register covers...
Dear child has many names and the vocabulary in this manual has not been entirely consistent regarding this. For the manufacture of these *spacers*
The starting material has been laser-cut 6mm sheet metal with a strength of 35 kp/mm². A number of other pieces have been welded to these, e.g. 2mm and 20mm sheet metal of 25 kp/mm² quality. Furthermore, pipe fittings have also been welded for connecting cooling water pipes etc. The end plate on the left in the picture has been machined down to 2mm on part of the surface. This is to be able to flex when the cast *engine blocks* and *the trough* do not have the same temperature and a certain expansion possibility is needed between the parts.



Intermediate pieces under production. In the picture a number of holes and machining are missing. mm.

5.7.2 **Intermediate pieces – Construction**

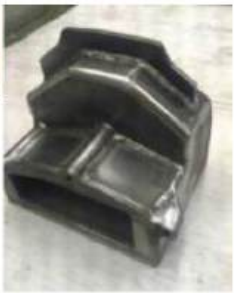
Main body

The three *intermediate pieces,* as well as the rear so-called *Register cover,* have one of the ends (the one towards the front block) milled down to 2mm on a larger part of the surface. This is to be able to flex during different length expansions of the engine, which can occur when starting up, such as when cold.

From the structure of the three *Intermediate Pieces* we can see that there are 3 6mm plates in each, as well as a number of 2mm plates that bind them together. Drilled round rods have been used as spacers at the screw holes.

The rear *register cover* has a slightly different structure, but the basic principle is the same.

After welding, the parts are stress-relieved, blasted and machined to provide adequate sealing surfaces.



The register cover during manufacture.

Connections, Cooling water pipes.

Here you can see the pipes welded into the upper 20mm plate which is later connected to the respective cylinder head.

After the pipes have been welded to the 20mm plate, the plate is in turn welded to the Middle Plate.

The picture shows the external connection plates, which attach the flange joint into which the cooling main pipe connections are threaded. The plates are welded to the pipes with Tig.

After the top has been flattened in the 20mm sheet metal, holes have been made to connect the cooling water channels to *the cylinder head.*

5.7.3 **Creation of a sealing surface against the preceding Block.**

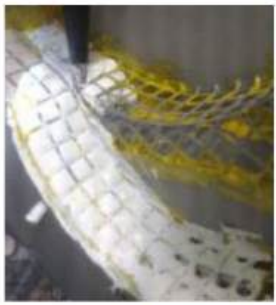
The sealing surface *of the spacers* against the preceding *engine block* has been created according to the following procedure:

1. Current Intermediate *piece* sealing surface to rear *Engine block* has been face milled
2. *The intermediate piece* has been screwed to the rear *engine block.*
3. The front *engine block* is attached to *the trough* with its ÿ14mm *guide pins.*
4. Screws, UNC ¼" with cut heads, have been threaded into the holes in the front *engine block* that normally attach the rear crankshaft seal.
5. Heat shrink tubing has been threaded onto the above screws to create clearance in the screw holes when *the Intermediate Piece* is later screwed in place.
6. A 1.5mm *sheet metal strip* has been attached to the front *engine block* with double-sided tape. The area around it and the screws have been coated with Omega grease.
7. *The intermediate piece* and *the sheet metal strip* have been filled with LocTite 3478 chemical metal. Hard filling in the blasted surfaces of both parts.
8. Rear *Engine Block* with mounted *Intermediate Piece* was pressed carefully, but with force against the front *engine block.*
9. *Guide pins* for rear *Engine Block* towards *Trough* have been fitted into their respective guide holes.
10. After the Chemical Metal solidified, the parts were disassembled and the necessary grinding was performed.

5.7.4 **Spacers** – Rubber cushioning, "Wade retro"

Vade retro is Latin and means “go backwards”, and that is exactly what had to be done in this case. After having telephoned Casco, and spoken to an “expert” about the possibility of using Casco SuperFix in hot engine oil, it was decided to use it as a noise dampening material against chain rattle in the engine’s *intermediate pieces.* After the work was done, the aforementioned Casco was telephoned again for a new consultation, whereupon a new so-called expert appeared. He strongly doubted the SuperFix’s ability to withstand the temperature at which the engine operates, but strongly recommended that this damping material be disposed of. According to his assessment, the SuperFix would dissolve and thereby seal the pores in the engine’s oil filter. A time-consuming dismantling work thus followed.

Below you can see pictures of the work that has been done.




The work of welding grilles, painting all weld joints, spraying SuperFix, etc. was later completed with the cleaning of the sheet metal surfaces.

To the minutes!

5.7.5 **Test of SuperFix**

Long-term test of Casco SuperFix in hot oil bath.

After consulting expertise at Casco's technical support, and receiving conflicting information over time, it was decided to conduct a long-term test to determine whether the case with SuperFixet's solution propensity is adequate or not.

Data:

- Sample pieces taken from dismantled pieces from *Mellanstycken.*
- There is uncertainty regarding the age of the uncured SuperFixet.

Test no:	Temperature	Time	Motv. mil vid 50km/t	Remark:
1	92ÿC - 101ÿC	2928 tim	14,700 miles	SuperFix
2	89ÿC - 112ÿC	1440 tim	7,200 km	Glued to sheet metal

Observations after Test 1:

After performing the test for so many hours over four months, the following can be concluded:

Summation:

SuperFix does not dissolve in hot engine oil. After all these hours, it still had its springiness and felt as soft as a reference piece.

Observations after Test 2:

Summary: SuperFix loosens over time from the blasted sheet metal to which it is glued.

With the experience gained from the above-mentioned tests, it was decided that the SuperFix-glued plates (double walls) in the rear register cover (facing the gearbox) may remain in place until further notice. Special supervision shall be carried out when deemed possible, by dismantling *the transmission plate* for inspection.

5.7.6 **Spacers – Damping in rear register cover**

After conducting a long-term test regarding SuperFix's ability to withstand hot engine oil, it has been decided not to dismantle this in the rear so-called *Register Cover.* (See previous section) The reasoning behind this has been that the value of avoiding a possible chain rattle in the passenger compartment outweighs.

To dismantle *the timing cover, the chain transmission* must be dismantled, and the entire rear *engine block* must also be detached. The crankshaft in the current *block*

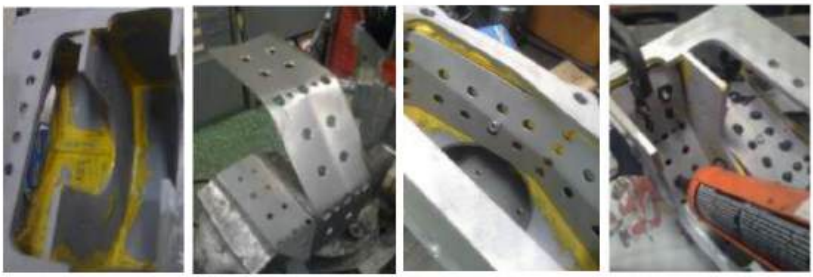
must also be dismantled, in order to loosen the screws that hold *the register cover.*

See also: *Spacers – Assembly procedure*

Timing cover in place between *Block* and *Gearbox.* To dismantle the cover, a **considerable** part of the accessories must be dismantled. *Gearbox, Chain transmission,* rear *Engine Block* etc. This therefore also includes parts of *the Cooling System, Lubrication System, Valve Cover, Air Cleaner, Throttle Position* etc. This is due to the fact that *the cover* is screwed at the end.

by *the Block.*

Spacers – **Rubber cushioning rear Register cover**



Welded joints have been painted with two-component epoxy paint, perforated sheet metal has been installed and SuperFix has been filled in behind it.

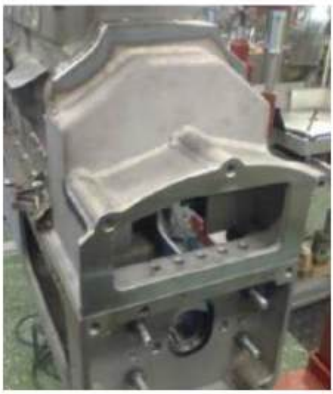
Note: SuperFix does not adhere to the Epoxy paint, which is why it is only held in place by the perforated sheet metal. Over time, it will also loosen from blasted sheet metal.

WRITE ABOUT THE COUNTERSUNK SCREWS THAT ARE RIVETTED!!!

5.7.7 **Spacers – Assembly procedure**

Mounting the *Intermediate Parts* to *the Engine Block* can be a bit of a challenge due to the complex construction. However, by reading and following the advice below, and **following them exactly,** you will
the work is considerably easier.

Intermediate piece of the type that is mounted between the first three *Engine blocks.* The picture shows *Intermediate piece* between *Blocks* two and three.



The rear end, the so-called *Register Cover.*

Note: With the front (front) and the back (rear) respectively *Block* of course means that *the engine blocks* are in a certain order. *Block* number 1 is at the front, *Block* no. 2 is behind no. 1, etc. So, one can imagine being ahead and behind in terms of placement...

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Straight 16-Cylinder

Engine components

Spacers – **Assembly procedure**

Step 1) Mount the Intermediate Piece to the Front Engine Block

- *The spacer* must be mounted against the front *engine block* **before *the crankshaft* is mounted in place.**
- Clean the steel-filled sealing surface *of the intermediate piece* , as well as the surface of *the engine block* where the rear crankshaft seal normally sits.
- Place *the Motor Block* on *the Trough,* temporarily securing it with the two ÿ14mm guide pins and a pair of mounting screws.
- Apply a **thin** layer of engine silicone, type: **LocTite 5910.**
  Please note: Too thick a layer of engine silicone will make installation more difficult.

  Please note! There should be no engine silicone in the sealing surface against the Trough at this stage. That will come in Step 2.
- Slide the relevant *Intermediate Piece* into place along *the Trough.* Make sure that *the Intermediate Piece* is not lifted, but that it **is in contact with *the Trough at all times.*** Otherwise, further assembly will be difficult, and there may be problems with the seal between *the Trough* and *Intermediate Piece.* • Install and tighten alternately

the 6 UNC1/4" screws that hold *the Intermediate Piece.* **MAX 1kpm (10Nm). Use LocTite Medel** as a screw lock. Do not screw too hard, otherwise the metal putty may crack. Note! Read the assembly instructions for the engine silicone.

- Loosen the temporary mounting screws and the ÿ14mm guide pins.
  Carefully lift the assembled unit and place it in a suitable location for the upcoming assembly of *the crankshaft, pistons* , etc.
- Repeat the procedure with the other *spacers* including the rear *register cover.*

Spacers – **Assembly procedure**

Step 2) Mount the Intermediate Piece and Motor Block to the Trough.

- After the usual cleaning, it is time to install *the crankshaft, connecting rods, pistons* , etc. Note! *The chain* must be placed on *the sprocket* before the crankshaft is installed. Handle the unit carefully, as the metal putty has a low strength and cannot withstand rough treatment. Therefore, place the unit on a suitable bench with a soft surface that allows installation. Do not let the weight of the unit affect *the intermediate piece* , but ensure that the load is always on *the engine block.* One way to solve this is to let *the intermediate piece* hang off the edge of the bench.

- Clean the underside *of the engine block* and *the intermediate piece* . Also the top *of the trough* . Then coat the details with engine silicone type: **LocTite 5910.** The groove, as seen in the picture, should be filled with engine silicone. This thus provides an opportunity for the silicone to flex in a more adequate way than if it were only the thin layer. Note! Read the installation instructions for the engine silicone.

- Tighten the unit against *the Trough.* For the correct procedure, see chapters: *5.7.6 – Screw between Block and Trough* and 5.7.7 *Screws – Tightening torque.*

The groove should be filled with engine silicone to allow the silicone to flex.

Spacers – **Assembly procedure**

Step 3) Mount the following unit against the preceding one.

- After cleaning all relevant sealing surfaces, it is time to mount the following unit against the previous one. Apply engine silicone type: **LocTite 5910** and handle as before.

- Position the unit so that it can be pushed down into the corner between the front *Intermediate Piece* and the Trough. Avoid pushing the parts too far, as the engine silicone can then be pushed out, resulting in leakage.

- Find a suitable smaller cylindrical breakaway pin which is placed in the rear ÿ14mm guide pin hole. Press *the Block* against the front *Intermediate Piece,* so that the guide pin can be placed in the front ÿ14mm guide pin hole. Note! Ensure that *the Motor Block* does not swing sideways, but follows a linear movement so that the front sealing surface *of the Motor Block* and the sealing surface of the front *Intermediate Piece*

  kept parallel at all times.

- Install the rear ÿ14mm steering pin.

- Tighten the screws that hold *the Intermediate Piece* to the rear *Engine Block.* In the case of *the Timing Cover,* the subsequent *Transmission Plate* is tightened according to the same principle as before.

CHANGE PICTURES FOR SCREW MOUNTING!!

Step 4) Install Anti-Rotation Plates

Intermediate pieces 1 – 3:

For *Intermediate Pieces 1 – 3 ,* install 4 screws as shown. Tighten the screws carefully, a little at a time, until the plates are fully seated.
Then tighten to full torque. **Use LocTite.**

For the register cover:

For the rear *timing cover,* install 2 screws as shown in the picture. Tighten to full torque. **Use LocTite.**

Please note! Ensure that there is a gap of at least 1mm wide in the anti-rotation *Flex bracket,* measured approximately 2mm deep downwards from the top sheet metal surface.

Screws, Anti-rotation plates – Tightening torque

- M8 2.7kpm
- M10 5.3kpm

5.7.8 **Screw between Block and Trough**

Specification regarding the screws that attach the Block to the Trough

Screws - Dimension

• Through Ø14-Steering pins	M6 x 40*	8.8	4st
• Right and Left side	M6 x 20	8.8	16st
• Right side	M8 x 30	8.8	16st
• Left side	M8 x 25	8.8	16st
• Front at *Camshaft cover*	UNC 5/16 x 50	8.8	2st
Front view of *engine block*	UNC 5/16 x 50	8.8	1st

5.7.9 **Screws - Tightening torque**

• M6	Right and Left side	1 kpm LocTite – Medium
• M8	Right and Left side	2.4 kpm LocTite – Medium

• UNC 5/16” To Front *Transmission Cover* 1.6 kpm LocTite – Medium

• UNC 5/16” To *Engine Block* Front - Right 2.2 kpm LocTite – Medium

*** NOTE! Use LocTite sparingly to avoid accidentally locking the Ø14mm Guide Pins to the Trough.**

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.8 Valve cover

5.8.1 Valve Cover – General Information

The valve cover, of Söderström's design, is bent from 2mm steel sheet. At *the mounting screws ,* so-called "nut wells" have been made, i.e. a recess where M12 *dome nuts* are placed. These recesses have been milled using a self-made radius cutter from thick flat iron, folded into *the cover,* welded and ground. The front and rear ends have also been made from 2mm sheet metal, welded and ground to the finished result.

After all welding and grinding work, the cover has been surface-treated with chemical nickel plating. This has been done by first grinding the cover with coarse emery cloth, coarsely blasting it and then polishing it with fine emery cloth. This is to remove the sharp peaks that have formed during the blasting. The nickel plating, which was carried out by Bodycote in Katrineholm, has been applied with a layer thickness of between 20 - 30µm.

On the inside, Volvo B20 original *valve covers* have been glued on with *Superfix.*
The technically best solution would have been to screw the original covers with the screws and gasket that Volvo designed. However, the negative feeling that the newly manufactured *cover* would only be a "dummy" has affected
the decision to glue.

The letters that form the name ***Söderström*** have been laser cut from 6mm
steel sheet, bent, ground, blasted and nickel-plated. They have subsequently been screwed into place with a number of M3 screws.

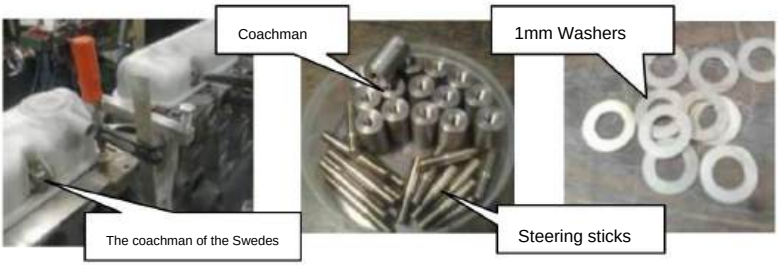
5.8.2 **Valve Cover – Manufacturing, in Pictures**

The pictures show the manufacturing process that was carried out to produce the finished *Valve Cover.* Hopefully these pictures will be of support in the event that problems arise in the future with, for example, the gluing of the original covers.

5.8.3 **Valve cover – Bonding of original covers**

Before gluing the original covers, a number of preparatory measures have been carried out.

- Threaded cylindrical balls have been welded onto the original covers. Small stainless steel, threaded *guide pins* have also been manufactured and screwed into the balls. By drilling the threaded ¼" holes that the original covers are attached to up to Ø7mm, these guide *the guide pins* into the cylinder head.



- The diameter *of the guide pins* has been chosen with the intention of being able to hold the original *Rubber/Cork gasket.* Both the thickness of the gasket and the size of the holes are just over 6mm.

- During the actual bonding process, 4.8mm spacers were placed in place of the gasket to provide support and the correct height for the original cover. These spacers consisted of standard M5 nuts. *The valve cover's* M12
  The dome nuts have now been tightened to the bottom. This procedure means that the gasket will be compressed approximately 1.5mm when *the valve cover* is later used.

- To create a reserve in case the 1.5mm that *the gasket* is squeezed together is not enough, an extra safety measure has been taken. On the M12-
  Studs holding *the valve cover* have 1mm *washers placed.*
  Normally *the Valve Cover* bottoms against these *Washers.* In the event that it turns out that *the Valve Cover* is not holding tight, these 1mm *Washers* can be removed. This can happen, for example, when *the Rubber/Cork gaskets* have started to lose their elasticity, to make them last until the next valve adjustment.

5.8.4 **Valve cover – Disassembly and Assembly**

To remove and install *the Valve Cover,* it can be helpful if there are two of you. *The Cover* is relatively heavy, and it is fairly tightly guided by both its guide pins and the studs that hold the M12-

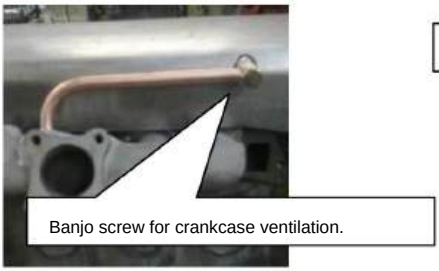
The dome nuts.

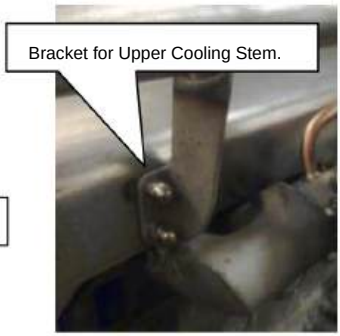
Disassembly - Procedure:

- Loosen the *Banjo screws* that are in *the crankcase ventilation pipes.* Be extremely careful as the screws may have soot stuck to them. They are pierced both lengthwise and crosswise which means they are easy to pull out.
- Loosen *the Upper Cooling Tube bracket.* There is a slot in the middle of the top of the holes, which means that the upper screw only needs to be loosened. The lower screw, however, must be removed completely.
- Loosen the ten *M12 dome nuts.* Loosen them crosswise and a little at a time.

• Get help, or *a lifting aid ,* and lift both halves *of the cover* .

- Clean the inside *of the valve cover* .
- Also clean the crankcase ventilation passage. Remove the *Calibrated Nipple* that is mounted in the pipe to be able to clean it properly.





Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

Assembly - Procedure:

- After *the Valve Cover* has been properly cleaned and is to be re-assembled, great care must be taken *with the Gaskets* to ensure that *the Cover* will hold tightly. If necessary, replace *the Gaskets.*
  If in doubt, or if you deliberately want to give *the Gaskets* a break, remove the 1mm *Washers* that are on *the 12-Pin Screws* that hold *the Cover.* Attach *the Washers* in the designated place.

- Carefully lift *the Valve Cover* into place. Be careful not to damage *the Gaskets* .
  loosens and or comes out of position. Be careful not to damage or bend the *Crankcase Ventilation* pipes. If necessary, bend *the Upper Cooling Pipe* pipe a little to prevent *the Cover* from being scratched by its bracket.

  If *the cover* is bent and does not fit *the M12 studs at all,* they can be bent into a better position using a pipe. Be careful though.

NOTE! Be extremely vigilant and careful not to damage or bend the Crankcase Ventilation pipes.

- Install *the M12 dome nuts.* Use LocTite – WEAK. Then tighten *the nuts* crosswise and a little at a time until full torque is reached.

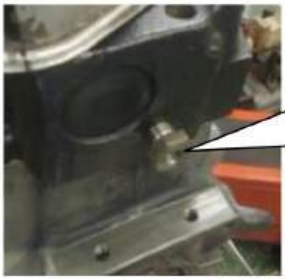
NOTE! The dome nuts must be of A4 quality to withstand the load.

Torque for tightening M12 Nuts for Valve Cover should be: 8kpm (80Nm)

- Tighten the screws for *the Upper Radiator Stem Bracket,* as well as the *Banjo Screws* that are in *the Crankcase Ventilation Pipes.* Do not forget the *Calibrated Nipple* that should be mounted in *the Crankcase Ventilation Pipe.* For correct installation of *the Nipple,* see section: *Crankcase Ventilation XXX*

In cases where the engine must be dismantled:

The threaded *bushing* and M10 screw mounted at the rear of *Block 13-16* are permanently glued and should not be loosened under any circumstances. The screw holds the rear bracket for *the Valve Cover*. The nut holding the bracket can be loosened. When reassembling, it is locked with LocTite – Medium.



Never loosen either this bushing or the screw that is glued to it.

The bushing is threaded with a cross thread and permanently glued in place.

Space for your own notes:

5.9 Cooling system

5.9.1 Cooling system - General information

The cooling system design for the 1934 Herkules is a combination of the system designed for Volvo with channels in *the engine block/ cylinder head,* and a system with external connecting pipes, *cooling water pump, radiator.*
and *Expansion tank.* For regulating the cooling water temperature, *thermostats* are used , which are located as original in the front end of each *cylinder head.* This arrangement therefore requires four temperature gauges. Cooling is via a truck radiator, common to all four *engine blocks.*

5.9.2 Water pump

Water pump – General information

The water pump for the 1934 Herkules is from a Scania LA82 known as Myrslok. The purchase was made via Tradera from a company called LG-älvan (LG11). The pump, which had been in mobilization storage, was unused during the engine's construction, but had fallen victim to the age limit regarding the rubber in the seals. The pump has been galvanized in an acidic galvanizing bath by Säffle Förnickling AB.

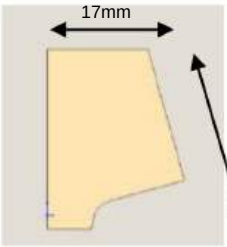
History: Scania LA82, called Myrslok. The Swedish Armed Forces bought 440 units between 1960 and 1962, which were equipped in various ways, such as a bridge construction vehicle. It had all-wheel drive, so-called 6x6.

Water pump – Integral details:

•	Head seal	Seal Ring 0363143	LECAB AB
•	Lagerätning	NO 19 40 10	Momentum AB
•	Lagerätning	BASL 25 47 10	Momentum AB
•	Deep groove ball bearings	6204 Ø20/47x14	Momentum AB
•	Deep groove ball bearings	6205 Ø25/52x15	Momentum AB
•	Pulley	According to Volvo original on crankshaft /Ext. 1:1	
•	V-belt	XXXXXXX	

Water pump – **Specification:**

•	Connection dimension: Inlet, for hose		Ø44
		Outlet, for hose	Ø44
		Inlet from heating coil Ø30	
•	Fastening screw	Dimension	2x M10
		C/C	115 mm
•	Impeller	Diameter utv.	Ø94 mm
		Number of blades	6 st
		Area per shovel, ca	5,4 cm²



Paddle wheel

Water pump

5.9.3 **Cooler**

Radiators – **General information**

The radiator is also the one (like the water pump) for the Herkules 1934 from Scania LA82, known as the Myrslok. The purchase was made via Tradera from a company called LG-älvan (LG11). The radiator, which had been in mobilization storage, was unused when the engine was built.

See also information "Water pump"

Radiator – **Specification:**

• Dimension:	Height excl. connections,	ca 815 mm
	Width	630
	Depth	125
• Cooling area, dimension Height,		ca 615 mm
	Width	590
	Depth	75
	Area	3628 cm²
• Convection surface		66 rader
		200 slats
• Weight, approx.: excluding connections and filling pipe		approximately 39 kg

5.9.4 **Cooling coil**

Cooling coil – **General information**

The cooling coil is the equipment that connects the four *engine blocks, the radiator, the coolant pump* and the convector located in the passenger *compartment.* In this case, *the cooling coil* consists of both welded pipes and rubber hose.

At the end of the Ø45mm *Cooling Tube* is a *Cast Iron Plug.* The purpose of this is to make it easier to clean *the Cooling Tube* if necessary. The bushing it sits in is glued with LocTite 248.

Cooling coil – **Specification:**

• Cooling water pipe	Exhaust pipe Ø45mm (outer) Steel tube Ø32mm (outer)		Biltema AB
• Clamp connection	T-22x1/2“x22 mfl.	866118	Biltema AB
• Radiator hose	Ø44 x 315	61379	Biltema AB
• Radiator hose	Ø45	IS-35288 Swedol AB	
• Radiator hose	Ø28	IS-35283 Swedol AB	
• Heating hose	Ø19	52509	Biltema AB
• Hose clamp	Ø52-55 857510200055		ESSKA AB
• Hose clamp	Ø36-39 857510200039		ESSKA AB
• Hose clamp	Ø26-28 857510180028		ESSKA AB

5.9.5 Thermostater

Thermostats - General information

Original *thermostats* are used for the temperature control of the Herkules 1934. placed in each *Cylinder Head.* An obvious advantage of this design is that each *Block* receives the cooling that is relevant at any given moment. It is conceivable that one of the rear *Blocks* could become warmer, due to the warm speed wind. This problem disappears because each *Block's Thermostat* ensures that the right amount of coolant passes through to maintain an even temperature.

Thermostats – Specification

• Thermostat	273342-6	Volvo
• Type		Vax
· Marking		82°C
· Starts opening at		81° - 83°C
· Fully open at		90°C

5.9.6 temperature sensor

Temperature sensor - General information

Due to the Herkules 1934's design with one *Thermostat* per *Cylinder Head,* a *Temperature Sensor* per Cylinder Head is needed. The instrumentation is from a Volvo 940, 1995. The sensor below fits several Volvo models between 1991 – 1998, including 740, 940, 960, S90, V90.

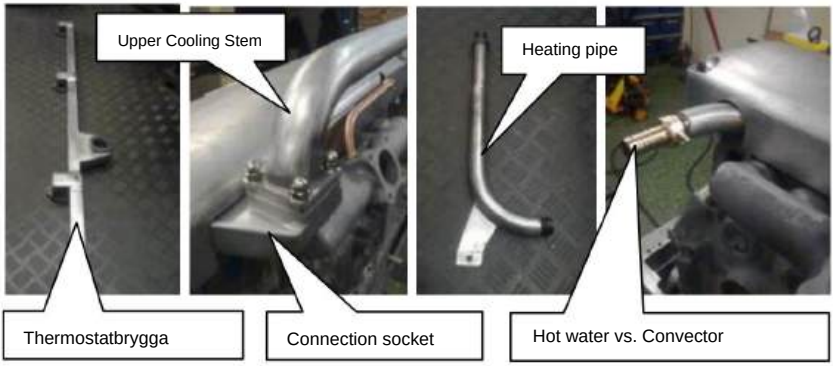
Temperature sensor – Specification

• Temperature sensor	4st	1362645	Volvo
		Thread 5/8” – 18 UNF	
• Connection connector	4st	3523813	Volvo

5.9.7 **Thermostatbrygga**

Thermostat bridge – **General information**

The thermostat bridge is the pipe that connects the respective *thermostat housings* and that leads the hot water from each *block* to *the radiator.*
It consists mainly of a 35 x 35mm square tube, with welded parts that connect to the respective *Thermostat.* Between the two middle *Blocks*
There is a connection socket for the so-called *Upper Cooling Tube.* At the rear end of *the Thermostat Bridge* there is a *Heating Pipe* for connection to the passenger compartment *Convector.*



Thermostatbrygga – **Montage:**

• Check *the thermostat* rubber seals for dry cracks or other injuries.

• In the case when *the heating pipe* has been dismantled. Thread the pipe 11 turns after the first thread has engaged. Use LocTite thread sealant during the threading process. Place *the Thermostat Bridge* with *the heating pipe* against its mounting surfaces, this is to get the screw-in angle correct. When the LocTite is locked, lift *the Thermostat Bridge* to be able to lock the Sealing Nut. First wrap generously with thread tape and then tighten the Locking/Sealing Nut.

• Put *the Thermostat Bridge* back and place all the screws in the holes in their respective places. Secure them with a few threads.

- Tighten the long screw at *Thermostat Housing A.* Make sure to wiggle/slide the tube in all directions to center the screw in the middle of the hole. Then tighten the short screw right next to it.

- Continue with the long and short screws in the remaining holes. Screw them in scheme *B, C, D.*

Tightening torque for screws at Thermostat housing **2.2kpm** (22Nm)

5.9.8 Expansion vessel

Since the Herkules 1934 has a considerable length, it has been necessary to equip it with an extraordinary *expansion vessel.* The radiator used cannot handle any overpressure, which is why a *vessel* with a volume of...
xxxxxxxxxxxxxxxxxxx

5.10 Coolant – Change, Check

5.10.1 Coolant - General information

For Herkules 1934, a good brand of monoethylene glycol should be used. The replacement interval must be a maximum of 2 years, as the cast iron in *the Block* and *Cylinder Head ,* but also the external pipe system, can be damaged by rust. Blah blah...

The replacement interval for coolant is a maximum of 2 years.

5.10.2 Coolant change, Check - Procedure

Not finished with it yet...

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.11 Lubrication system

5.11.1 Lubrication system - General information

The lubrication system for the Herkules 1934 is of *the semi-dry sump type ,* which means that the oil is not stored in an oil pan under *the engine block,* but is pumped to a separate *tank.* It is not the same design as what is commonly called a dry sump, because *the pan* is not emptied completely. There is always a certain amount of oil left, because the pumps are not able to suck out all the oil because the pumps suck from above.

5.11.2 Lubrication system - Description:

1. **Return oil pump:** In the large *trough,* i.e. the engine *body,* there are four smaller compartments where oil from each *engine block* can collect. At the bottom of each compartment, the engine block's original pumps are located on their respective vertical extensions, all in order to be able to reach the bottom of their compartment. The intention is that the pumps should empty the respective compartment of oil as much as possible. However, a certain level will always remain.
   The function and name of the pumps described are *Return Oil Pumps,* or simply *Return Pumps.* In the bottom of the trough, just below the pumps' suction screens, there are *magnetic plugs* for coarse accumulation of metal shavings.

2. **Control valve:** Just after *the return oil pumps,* to regulate the volume with which the compartment is emptied of oil, there is a *Control Valve in each compartment.*
   They should be adjusted so that minimal air is sucked into the pipe towards the return oil system, so as not to impair the lubricating ability of the engine's pressure oil.

3. **Collector:** The oil is transported down into the sump via pipes and rubber hoses.
   The hoses are collected and attached in a structure called *a collector* via hose nipples and associated clamps.

Note: See also picture page XXXX

4. Return oil filter: From *the collector,* the oil passes through the trough wall into the holder for *the Return oil filter.* There are two of these filters, and they are located on the left side of the engine. On the way to the filters, there is - in a plug - a magnet for coarse accumulation of chips before the filters.
The filters are of the lasbil type, with a fine degree of purification. These have been supplemented on the outer surface with powerful magnets, so-called FilterMag, for the collection of both coarse and fine metal shavings. When changing filters, the magnets are moved to the new filters, whereby the metal shavings remain in the filters that are thrown away.

5. Oil cooler: A copper *oil cooler* cools the oil, but only marginally.

6. Venting centrifuge: In a cylindrical chamber made from an older model LPG cylinder, the oil from *the Return Pumps is vented.*
The return oil is thrown by centrifugal force around the wall of a cylindrically shaped part of the tank after it has been flushed in the tangential direction. Due to the large density difference between oil and air, the oil is pushed out against the cylindrical jacket surface, whereby the air can thus enter the center of the tank. The air collected at the top is sucked from there into *the Air Cleaner* to later participate in the combustion.

7. Venting tank: The purpose of this *Venting tank* is to allow the oil to settle and further give it the opportunity to release air. In the tank, the oil flows along a channel to something that can be compared to the same function as a miniature waterfall. The oil then flows along the bottom of the tank towards the outlet, all to get as much air out of the oil as possible.

The air collects at the top of the tank and is sucked from there into *the Air Cleaner* to later participate in combustion.

8. Connecting pipe: This is a pipe whose main task is to conduct the oil from the engine's *breather tank* to its *suction tank. The connecting pipe*
is made of ÿ45mm exhaust pipe parts, all to satisfy as large, but also quiet flow of oil as possible. At the lowest point *of the connecting pipe* there is an *oil drain cock,* as well as a *magnetic plug.*

Note: See also picture page XXXX

9. Suction tank: In the second of the two tanks, the so-called *Suction tank,* the oil is given the opportunity to "calm down" further before its further journey towards the pressure side of the lubrication system. *The suction tank* has a partition wall which means that the oil has to take a longer path through the tank than is otherwise usual. Furthermore, there is a line at the top to remove any accumulated air here too. The air is sucked from there into *the Air Cleaner* to later participate in the combustion.

10. Pressure oil pumps/Pressure oil filters: Opposite a transmission drive at the front end of *the Trough* are two *pressure oil pumps* with mounted *pressure oil filters.* The pump housings contain regulators for automatic regulation of the lubricating oil pressure.

11. Cyclone purifier: This is a centrifugal type oil purifier. The origin is from a Scania truck engine with unknown history.

12. Pressure oil line: This line is made of bent ÿ22x 1.25mm pipe. The pipe is connected via various clamp connections to the engine block's oil inlet, where the original oil filter was previously located.

13. Pre-pressure pump: For initial lubrication of the engine bearings before starting, i.e. to build up oil pressure, an electric *pre-pressure pump is used.* The pump sucks oil from *the suction tank* and pushes it through an *oil filter* in a pipeline towards *the engine block.*

14. Pressure regulator: A pressure regulator is used to adjust the pressure from the electric *pre-pressure pump .* Under its hood there is an adjustment screw for setting.

15. Filter: for cleaning oil through the pre-pressure pump.

16. Valves: A number of manual valves to stop or open, as well as control valves to adjust a flow in one way or another.

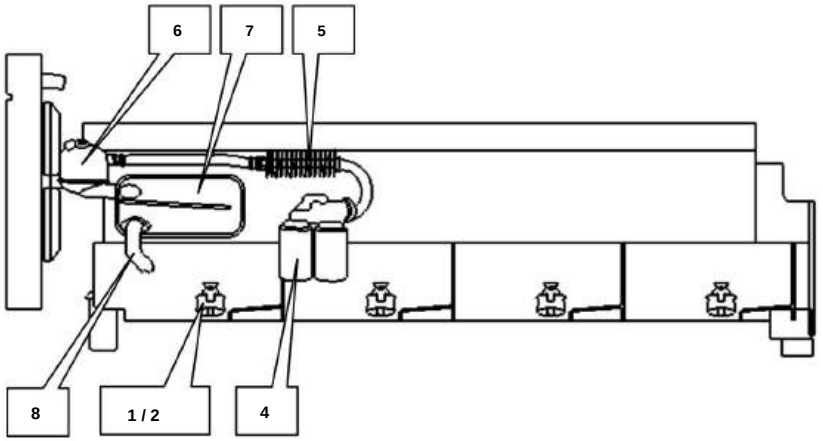
Note: See also picture page XXXX

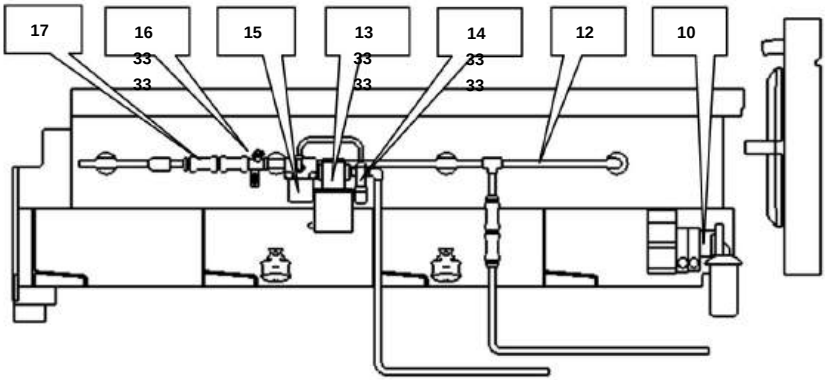
17. Check valves: Check *valves* ensure that the oil does not pass back through *the pressure oil pumps* or *the pre-pressure pump.* In the event of problems with the oil pressure, the reason may be a leak at *the check valves,* in which case an inspection must be carried out. New O-rings are available as spare parts.

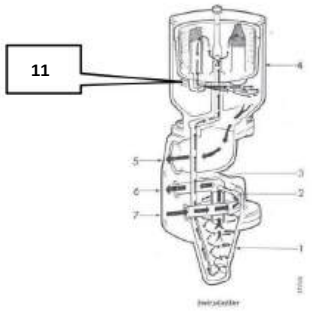
18. Line system for pressure lubrication of chains: *The chains* are lubricated and cooled via a separate line connected directly after *the pressure oil pumps.*
directly with oil through *the Chain Tensioners.* This is done by utilizing the excess capacity *of the Pressure Oil Pumps* . In the event of problems with the oil pressure, this line can be throttled or closed completely. This line also lubricates the *Chain Drive* that drives one of *the Pressure Oil Pumps* via a pipeline.

19. **Pipe system for emptying or equalizing the oil level in the pan:**
Via a separate piping system, if *the trough* is horizontal, the oil level can be equalized between the compartments in which *the return oil pumps* are mounted.
By opening the *valves* under the engine that are located under each *block,* the level is equalized in the four compartments. To do this correctly, it is important to place *the engine* completely horizontally. To help with this, a small *spirit level* is mounted on the engine . *(See also the chapter: Oil –*
Replacement, Control)

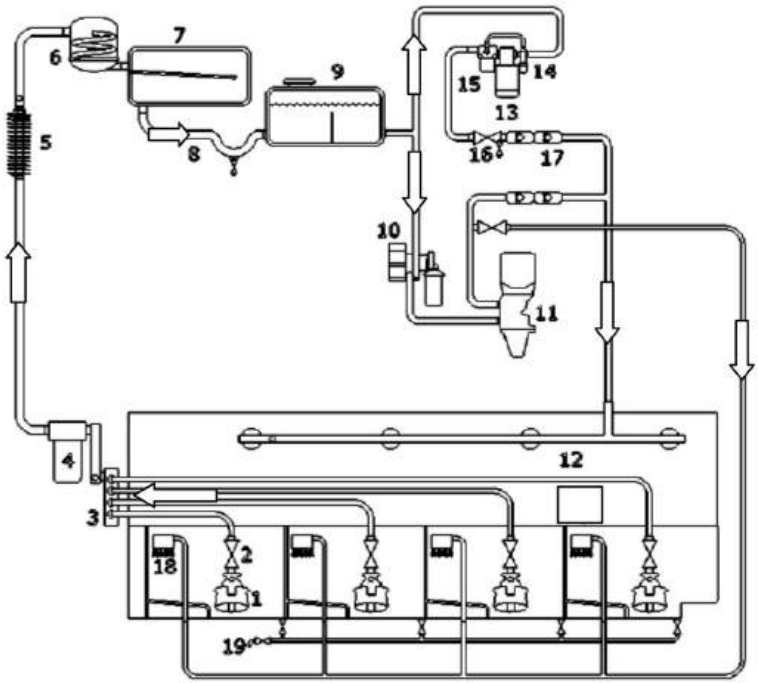
Lubrication System – Description, Overview







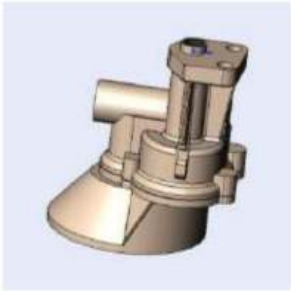
Lubrication System – Description, Overview



1. **Return oil pump**
2. **Control valve**
3. **Collector**
4. **Filter – Return oil**
5. **Oil cooler**
6. **Deaeration centrifuge**
7. **Deaeration tank**
8. **Connecting pipe**
9. **Sugtank**
10. **Pressure oil pump with filter**
11. **Cyclone cleaner**
12. **Pressure oil line**
13. **Pre-pressure pump**
14. **Pressure regulator**
15. **Filter – Pre-pressure pump**
16. **Valve**
17. **Check valve**
18. **Chain lubrication**
19. **Trough emptying**

5.11.3 **Original pump/Return oil pumps under engine block**

The original lubricating oil pumps are used to pump oil from the sump to the separate oil tanks.



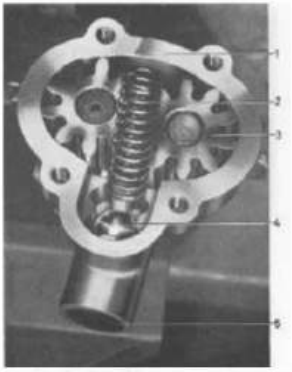
Oil pump - Specification

• Lubricating oil pump, Type		Gear
•	Number of teeth on each wheel	9
•	Axialspel	0,02 – 0,10 mm
•	Radial clearance	0,08 – 0,14
•	Tooth flank backlash	0,15 – 0,35
• Reducing valve spring, Length unloaded		39 mm
•	Loaded 5 +/-0.4 kg 26.25	
•	Loaded 7 +/-0.8 kg 21.0	
• Oil pressure according to Volvo's specification at 2000 rpm		2,5 – 6 ATÖ

5.11.4 **Return oil pumps – Procedure according to Volvo**

Oil pump with pressure reducing valve

After *the pump* has been disassembled and cleaned, check that all parts are in good condition. Test *the Spring* for *the Reducing Valve.* For test data, see the specification.



1. Pumphus
2. Fjäder för reducerventil
3. Kugghjul
4. Ventilkula
5. Hål för oljerör

Check that the gear flank clearance is 0.15-0.35mm.

Measure the axial play, 0.02-0.10mm, using a feeler gauge and a new *cover* or the old one if it is not significantly worn. Is it *the bushing* or *the shaft?* worn, they are replaced with new ones. Please note that *the Drive Shaft* with *Gears* is replaced as a unit.

The new *bushings* are reamed after pressing in with a guided reamer. Please note that loose *bushings* have been discontinued in later versions.

Oil Pump Shaft Extension – Column

Blah blah blah

Not built yet!

Picture!

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

Oil Pump Shaft Extension – Column

Not built yet!

5.11.5 Hoses, Hose nipples and clamps

• Slang Ø13/20 L-671AA	NBR	Alfagomma/Swedol
• Hose nipple,	Ø3/8”x1/2” Brass 254353	Biltema AB
• Hose clamp, Ø21mm/DIN3017 Fzb 857310150021 ESSKA AB		

5.11.6 Pipe fittings

• Cooling water pipe	Exhaust pipe Ø45mm (outer)	Biltema AB
	Steel tube Ø22mm (outer)	Anderssons Mechanics AB
• Clamp connection	T-22x15x22 866119	Biltema AB
	T-22x22x22 866422	Biltema AB
	L-22x22	

5.11.7 Valves

Slide valves - For return oil pumps

Also called *a control valve.* Valve after *return oil pumps* for regulating the suction amount (air mixing) as the oil is pumped to *the tank.*

• Shut-off valve 3/8” 8701MUAS3800 Brass		ESSKA

Slide valves - At Electric pressure pump

• Carbon valve	86 0083	Car theme
• Coal valve	86 682	Car theme

5.11.8 Check valve

After *the pressure pumps* and at the electric *pressure pump, check valves* are installed to prevent the pressure oil from taking the back way out of the system and thereby endangering the oil pressure. *The check valves* that were used were originally intended as bottom valves in irrigation systems and the like. The picture shows the complete valve. For Herkules 1934, the suction strainer is dismantled and is therefore not used.
The valve has an O-ring as a seal, which can be replaced as a spare part.

• Check valve/Bottom valve 1”	Brass	17270	Biltema AB
• O-ring for toilet	Ø18,72 x 2,62 NBR	Tools	Momentum AB

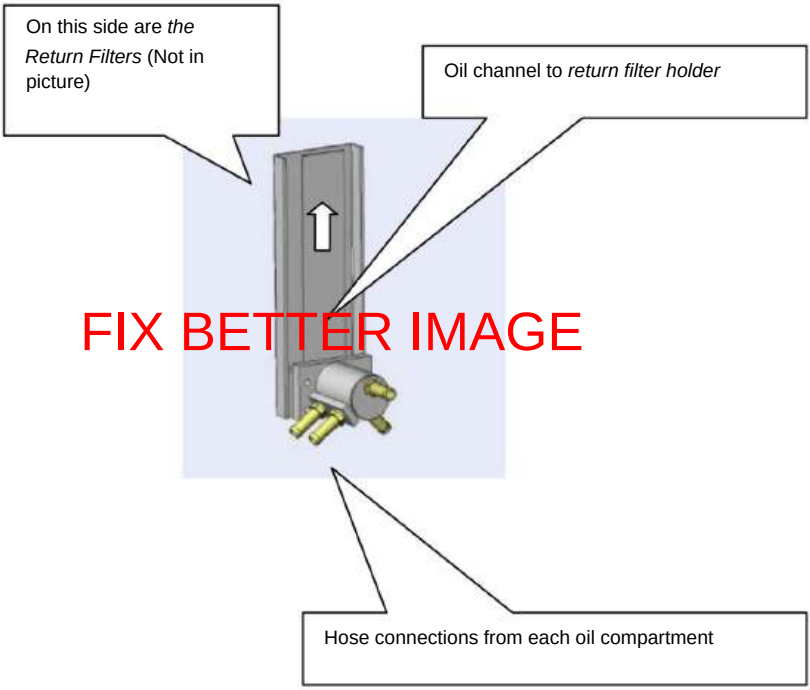
The picture shows a *check valve* with a suction strainer. The latter is not used for Herkules 1934.

Special tools

To be able to change the O-ring easily, these special tools have been manufactured.

5.11.9 **Collector and holder for return oil filter**

The collector, a welded structure mounted inside *the Trough* for collecting the hoses that are connected to the respective *Block's Return Oil Pumps.* From *the collector,* the oil is led into and up the vertical structure shown in the picture, to later enter the Return Oil Filters.



5.11.10 **Oil cooler**

The oil cooler is made up of a number of circular 2mm copper plates, and - between each copper plate - 2 spacer rings, also made of copper.

MORE TEXT

5.11.11 **Deaeration centrifuge**

MORE TEXT

5.11.12 Venting tank

MORE TEXT

5.11.13 **Connecting pipe**

MORE TEXT

5.11.14 **Tank**

TBD

Not there yet!

5.11.15 **Pressure pumps – General information**

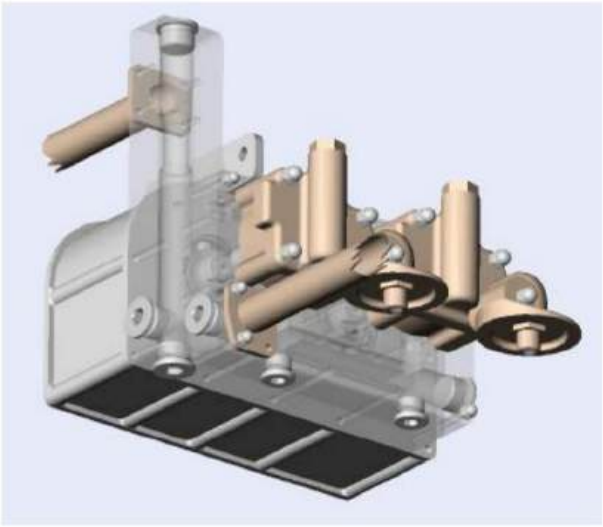
The type of oil pump that originated in the Chrysler Big Block is used as *Pressure Pumps .* These are high volume pumps, so-called High Volume. The engine's *Fine Filter is directly connected to each pump.* The pumps are driven for the Herkules 1934 directly from *the Main Shaft,* that is, at the same speed as the crankshaft. This is one (of several) reasons why the engine speed is limited to a maximum of 3400 revolutions per minute.

The pumps have built-in overflow valves which limit the oil pressure.
One of the two pumps is direct-driven, while the other is driven via a simplex chain drive.

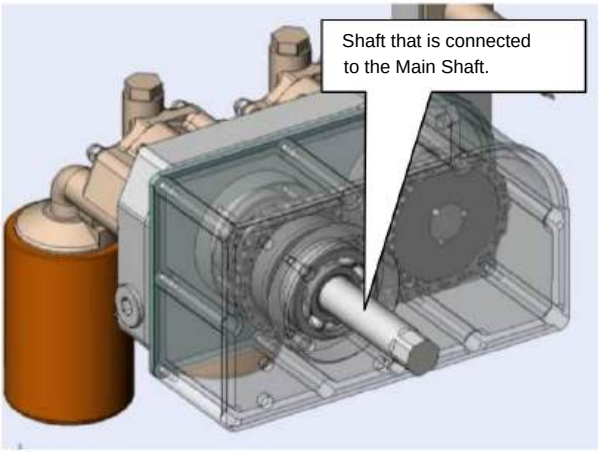
Oil pumps - Specification

- Pump M63HV (for Chrysler Big Block) Melling
- Pressure when overflow valve opens 4,14 Bar /60PSI
- Flow XX Liter/min
- Max pump speed according to Melling: 3000 – 4000 rpm (camshaft speed)

Pressure oil pumps - Distribution box



Pressure oil pumps – Drilled channels in mounting plate.



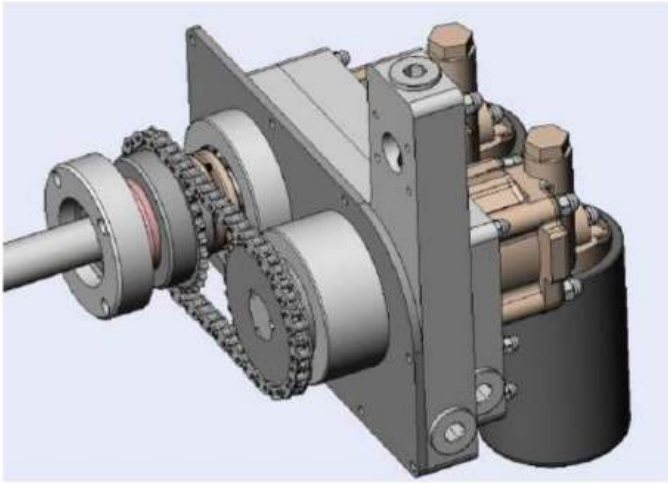
Pressure oil pumps – Simplex chain drive.

Pressure oil pumps - Distribution box

To achieve the drive of two *pumps* from one *shaft* , a *Distribution box* consisting of *simplex chain drive* and bearings to support the same.

Distribution box – **Integral details:**

• Gearbox	Welded steel	Söderström's construction	
• Distribution block	Machined aluminum	Söderströms construction	
• Sprocket	With hub	CH10-3/8”-32	Translev
• Sprocket	Plan	P-3/8”-32	Translev
• Chain	Straight link	3/8”	Translev
• Chain lock	Rivetable	3/8”	Translev
• Warehouse	SKF	ÿ30/72 x 19	Tools Momentum
• Tensioning element ETP		ÿ35/47	ETP-Transmission



Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.12 Oil purifier cyclone

5.12.1 Oil Refinery Cyclone – History

The oil purifier cyclone used for the 1934 Hercules originally comes from a Scania truck engine. The design dates back to 1958 when it was introduced in conjunction with the D10 engine. It is unique in its design, as it is able to purify incredibly small particles using separator technology. Scania conducted a practical test in the mid-1980s. An engine was run under load for ten days, and every day a teaspoon of sand was poured into the oil.
After the ten days, the engine was dismantled and the details were carefully examined. No wear whatsoever could be measured. The naming of this thing can be considered inconsistent as “Cyclone” has been used as a collective name, when this is only one of its constituent parts.

5.12.2 Oil Purifier Cyclone – Description

The 1958 model oil purifier cyclone consists of three main parts:

Centrifuge. At the top is *the Rotor* with its protective casing, the so-called *Centrifuge.*
The dirty oil channel enters *the rotor's* center shaft, fills *the rotor chamber* and is then forced out through two *nozzles.* These cause *the rotor* to rotate at approximately 6500 rpm, causing dirt particles to stick to *the chamber* walls.

The middle part is a cast iron holder where the oil connections are located. It also contains the dirty oil channel.

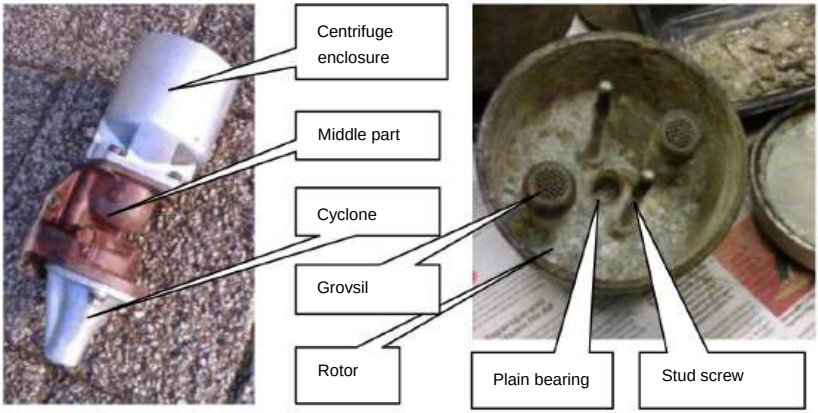
The cyclone, located at the bottom. In it, the oil begins its cleaning process as the oil is caused to rotate in a conical chamber. Due to the centrifugal force of the rotation, dirt particles are thrown against the walls of the chamber and are also forced downwards there. At the bottom, a channel begins that carries the dirt particles upwards into the cleaner. In the center is an oil line that carries the cleaned oil out to the engine's lubrication points.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

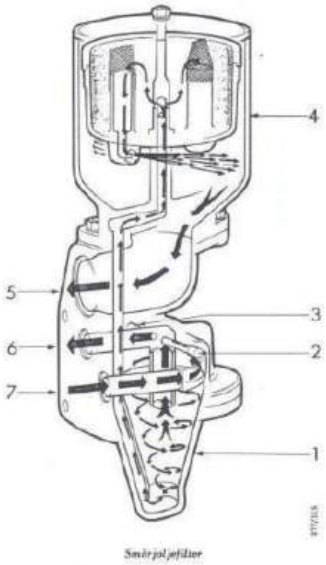
Oil Purifier Cyclone – Description



NOTE! The two nuts holding the Rotor Cover must be tightened half a turn after they are finger tight against the cover.

More pictures

Oil Purifier Cyclone – Description



1. *Cyclone.*
2. Plugged socket.
3. Plugged socket.
4. *Centrifugal filter housing* with *Rotor.*
5. Return channel to *oil tank.*
6. Channel to *pressure oil line*
7. Channel from *Oil Pumps.*

Cleaning of Centrifugal Filters

1. Unscrew the nut that holds *the enclosure* cover and remove it.
2. Lift out *the Rotor* and unscrew the two nuts. Remove the cover.
3. Scrape off the deposits on the walls *of the Rotor* and wash it.
4. Place *the Sealing Ring* in its groove and put the different parts together. Make sure that the markings on *the Cover* and *Rotor Housing* match. Press the Cover down firmly so that it bottoms against *the Rotor Housing.*
5. Screw the cover *nuts* as far as they will go with your fingers, then turn them **half a turn** with a wrench. Check that *the rotor* runs easily on the shaft by spinning it with your fingers.

6. Also, after installing *the Centrifugal Filter Cover,* check that the rotor part runs smoothly: Start the engine and run it until the oil is reasonably warm. Stop the engine. Check by listening next to *the Filter* that *the Rotor Part* is rotating. A clear buzzing sound will be heard. It should normally rotate for at least one minute after the engine is stopped.

5.12.3 **Oil Purifier Cyclone** – **Version for Herkules 1934**

Centrifuge – **Description**

No change has been made to the function and working method *of the Oil Purifier Cyclone* . It is connected directly after *the Pressure Oil Pumps* and just before the feed line for lubricating oil to the various *Blocks.*

Renovation has been carried out as follows:

- Cleaning, blasting and painting of *the Middle Section.*
- Procurement of new *Rotor Shaft*
- Hardening of *the Rotor Shaft* through Nitrocarburization.
- Manufacturing of new bearing bushings for *the Rotor Shaft.*
- New O-rings, gaskets, etc.

Renovation – **Observations**

The rotor shaft of the used *Oil Purifier Cyclone* was found to have broken. It
A new *axle* was purchased from LECAB. Since the first *axle* had scratches, a hardness measurement was made of both the old and the new *axle.* It turned out that they were both relatively soft, which is why the decision was made to harden them, all in order to improve Scania's design.

When *the Cyclone* is working, there is a slight overpressure inside *the Rotor.* This means that there is full-film lubrication of the bearings, which are therefore essentially not exposed to friction or wear. The problem arises when the engine is switched off and *the Rotor* is spinning at thousands of revolutions per minute. As the oil disappears, the fine full-film lubrication changes to boundary layer lubrication, probably ending with pure metallic contact.

• Axel:	Hardness before hardening	ca 10 HRC	ca 188 HB
	Hardness after hardening -		ca 430 HB
• Bearing bronze Red metal RG7		75-85 HB	Lagermetall AB

430HB – 85HB = **345HB.** The difference in hardness should be at least 250HB, which is why this bearing after rebuilding is definitely up to the mark.

5.13 Electric Pre-Pressure Pump

5.13.1 Forepressure pump – General information

The electric *pre-pressure pump's* task is to bring full oil pressure into the engine before starting. This is desirable because the chain transmission's radial load on the crankshaft bearings can be of such a nature that starting without oil pressure can cause damage to the bearings.

The pump's origin is as a tail lift for trucks, and its history is now unknown.

Electric *Pre-Pressure Pump*

Pressure regulator

5.13.2 Electric Pre-Pressure Pump – Specification

Hydraulic pump	BW246S	Hydraulic function AB
• Travel		2,46 cc³
• Voltage		24 Volts
• Power consumption		18,5 Ampere
• Speed		4500 RPM
• Flow		about 11 Lit/min
• Setting pressure for COLD oil		MAX 5,5 ATÖ

5.13.3 **Pre-pressure pump – Pressure regulator and filter holder**

To prevent the pressure from the electric *pre-pressure pump* from leaking, a *pressure regulator in the form of an overflow valve* has been designed. It has been manufactured from parts from a safety valve for a hot water heater. *The valve*
allows oil to circulate around the pump instead of building up pressure.
All plastic parts in the safety valve have instead been made of metal. For example, *the adjusting screw is* made of brass and *the cover is* made of steel. The latter has been galvanized.

The oil that is to be fed to the engine's lubrication points must also pass through a *pre-filter* which is located in a holder manufactured by Söderström. When adjusting *the pressure regulator,* a check of the differential pressure must be made at the same time.
The differential pressure is the pressure difference between the inlet and outlet sides *of the filter* . This is usually stated as the opening pressure.

When *the Pre-Pressure Pump* is running, be careful that neither *the Pump* nor *the Pressure Regulator* gets too hot. Take the opportunity to open the hood from time to time to learn how long it is practically possible to pump without the parts getting too hot to touch.

When setting pressure:

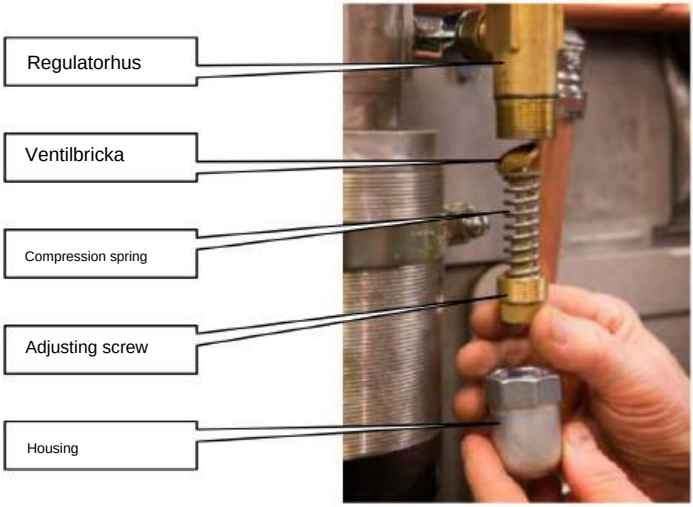
At the same time as setting the pressure, the pressure drop across the oil filter is also checked.

- Loosen *the plugs* on *the oil filter holder* and install two *pressure gauges.*
- Loosen *the cover* on *the pressure regulator.*
- Start *the pump* and check the pressure on the *pressure gauge* furthest from *the pump* (for pressure, see specification).

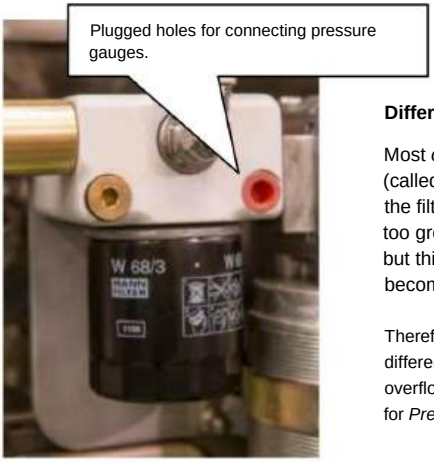
  NOTE! *The pump* must not be running when adjustment is being made!

  - Turn *the adjusting screw* clockwise to increase pressure, counterclockwise to decrease pressure.
  - At the same time, check the difference between *the Manometers* to see the differential pressure **(opening pressure)** in *the Filter.* (For pressure, see separate specification regarding *the Pre-filter).*
- When the value is set correctly, mount *the cover* on *the pressure regulator,* unscrew *the pressure gauges* and plug the connection holes.

Pre-pressure pump – Pressure regulator and filter holder



Pressure regulator



Oil filter holder

Differential pressure / Opening pressure

Most *oil filters* have a small spring-loaded valve (called a "by-pass" valve) that allows oil to bypass the filter paper if the pressure difference becomes too great. This usually happens when the oil is cold, but this phenomenon also occurs if the filter has become clogged with particles.

Therefore, it is a good reason to check the pressure difference in connection with checking and adjusting the overflow pressure. Measured value: See specification for *Pre-filter*.

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Straight 16-Cylinder

Engine components

For your own notes:

5.14 Oil filter

5.14.1 Oil filter – General information

For Herkules 1934, so-called “Spinn Off” filters from the German company MANN-filters are recommended. The engine is equipped with two ***return filters,*** two ***pressure filters*** and one ***pre-filter*** for the electric pre-pressure pump. The original B20 has filters with a filtration degree of 40µ (µ, pronounced My = one thousandth of a mm)

Good to know:

- engine wear is reduced by 50% if a 30µ filter is used instead for a 40µ
- engine wear is reduced by 70% if a 15µ filter is used instead for a 40µ

FOR HERKULES 1934 APPLIES:

5.14.2 Return filter – Specification

MANN+HUMMEL, GMBH	In 950/13
• Nominal flow	60 liters / minute
• Flow direction	as – In
• Opening pressure, bypass	1,4 Atö
• Dimension	Ø96 x 170 mm
• Thread	1” - 12 UNF
• Filtration area	3810 cm²
• Filter efficiency, 50% ISO4548	15 microns
• Filter efficiency, 99% ISO4548	36 microns
• Particle capacity	34 gram

5.14.3 **Pressure filter – Specification**

MANN+HUMMEL, GMBH	In 940/1
• Nominal flow	43 liters / minute
• Flow direction	as – In
• Opening pressure, bypass	1,2 Atö
• Dimension	Ø96 x 142 mm
• Thread	3/4” - 16 UNF
• Filtration area	3000 cm²
• Filter efficiency, 50% ISO4548	20 microns
• Filter efficiency, 99% ISO4548	>50 mikron
• Particle capacity	29 gram

5.14.4 **Pre-filter for electric pump – Specification**

MANN+HUMMEL, GMBH	In 68/3
• Nominal flow	12.58 liters / minute
• Flow direction	as – In
• Opening pressure, bypass	1,0 Atö
• Dimension	Ø66 x 75 mm
• Thread	3/4” - 16 UNF
• Filtration area	629 cm²
• Filter efficiency, 50% ISO4548	15 microns
• Filter efficiency, 99% ISO4548	38 microns
• Particle capacity	10 gram

5.15 Trough - Bottom plug

• Magnetic plug in the bottom of the Trough	35Nm **Max 40Nm**
• Thread	M18 x 1,5
• O-ring	Ø20.63 x 2.62

5.16 Engine oil

For lubrication of Herkules 1934, the following should be used:

UNDER INVESTIGATION!!

• Semi-synthetic engine oil OKQ8 Formula Advanced

• Quality		API SD SAE 10W – 40
• Densitet, 15°Celsius, Kg/m□		874
• Viscosity, cSt	at 40°	99
•	at 100°	14,5
• Viscosity index		152
Flash point, °Celsius		202
• Lowest flow temperature, °Celsius		-30

Contact person, technical questions OKQ8 Johan Andersson 020 88 88 00

5.16.1 Engine Oil – Additive

• The oil should be fortified with ZDDP. More information TBD

UNDER INVESTIGATION!!

5.16.2 **Filtermagnet – Filter Mag**

MORE TEXT

5.17 Oil – Check, Change

5.17.1 Oil change - General information

The lubrication system for the Herkules 1934 is a semi-dry sump system. This means that the oil is pumped from the four separate *sump bottoms of the engine block* to, in this case, a separate *oil tank,* the so-called *suction tank.* The *sump bottoms* which are located under each *Engine Block* have been minimized and have only the task of collecting the oil so that it can be pumped further. The B20 blocks' regular lubrication *pumps are used as return oil pumps. Between* the four *pan parts* and *the tank* there are, among other things, *return oil filters, venting accessories* mm.

From *the Suction Tank,* the oil is pumped using two Chrysler Big Block High Performance pumps via two *Fine Filters* and an *Oil Purifier Cyclone* into the trunk which supplies the four *Blocks.* The trunk also has *check valves, an electric feed pump* for pre-pressurizing the oil before starting, etc. (For detailed information on the structure of the lubrication system, see section 5.9 - Lubrication System)

5.17.2 Oil level, Check - Procedure

Checking the oil level in a 1934 Hercules requires a **much more complicated procedure** than for more common automobiles. Do not underestimate the importance of this procedure, as the oil temperature will skyrocket if the level is too high and the chains are immersed in the oil bath. High oil temperature damages not only the oil itself, but also the *metal filler* that is on the engine's *intermediate pieces* and creates a combustion surface between *the blocks.* Since there must therefore be the correct level of lubricating oil in both the separate *suction tank* and the engine *sump* , the work should be carried out as follows:

Picture of the oil filler cap

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

Procedure:

1. Position the vehicle so that the engine is completely level. On the left side of the engine, by the oil filler cap, there is a small *spirit level,* i.e. a tube with an air bubble. Only by appropriately ensuring that the engine is positioned so that the air bubble **is safely in the middle of the two lines** on *the spirit level* can the check be carried out correctly.

Picture of the dragonfly

2. Crawl under the engine, bring a graduated container that holds about XX liters. First open the front of the taps on *the oil drain stem,* the so-called *Main Tap.* No oil should then come out of the tube.

Picture of the front, Main crane

3. Then open the tap located in the first *Trough bottom,* i.e. *Trough compartment No. 1. (The main tap* should remain open) This means that the amount of oil in the first compartment in *the Trough* can be measured in this way. In the event that the function *of the Return Oil Pump* is not satisfactory, this can be determined by the amount of oil flowing out of the relevant compartment.

Picture of the crane in compartment 1

The amount of oil coming out of each sump compartment should be XX – XX liter.

Close the tap for *Trough Compartment No.1.*

4. Open the tap for *Tray No. 2* and check according to the same procedure as for *Tray No. 1.* Then continue with all *Trough Trays.*

5. Then it is time to fill the oil back into *the sump compartments.* (If the oil drained from the compartments is not contaminated, it can be poured back into the engine) This is done by closing *the Main tap* and opening all taps in *the sump compartments* . By filling in the oil filling hole on the left side of the engine (at *Block2)* , the oil can now flow into all *sump compartments* through the so-called *Oil Drain Stem.* If the oil is cold and flows slowly, let it pass for a long time so that the level between *the sump compartments* has time to equalize. Then close all taps.

The amount of lubricating oil to be filled into the Trough should be XX liters.

Do not forget to close all taps after leveling.

6. Then check the level in the separate *Suction Tank.* It should ...xxxxxx Not there yet!! XX

7. XX

Note: To my readers. It may seem like a completely unnecessary thing to check the levels in the compartments in this way. A transparent oil level sight glass could be easier... Unfortunately, I don't know now what level the pumps can hold, before they "lose suction", so to *speak. (They sit from above and suck downwards.) This depends on several factors, for example what back pressure I will have in the return oil line...*
If I drill the level glass after the engine is started, I'll get shavings in the trough.... Dilemma!

This can be changed if the engine is torn down and still needs to be cleaned... but, the filling must still be done as above.

5.17.3 **Oil change - Procedure**

Not finished with it yet...

Remember!! - DRAIN THE OIL OUT THE CHAIN LUBRICATION PRESSURE PIPE...!

Magnetic plug in the bottom of the Trough	35Nm **Max 40Nm**

5.18 Laddsystem - Dynamo

5.18.1 Charging system - General information

The charging system for the 1934 Hercules is constructed with an alternating current dynamo, which has been disguised to look like a direct current dynamo, all to highlight the 1930s era. This has been achieved with the help of a pipe and a few additional pieces of sheet metal.

When visually inspecting *Dynamon's* internal details, such as the winding, it can be easy to suspect poor quality. Time will tell whether this assumption is correct or not.

The dynamo is made from an alternating current generator that has been masked.

5.18.2 Charging system – Detailed information:

• Alternating current dynamo 63-628			BilTema AB
•	Fan belt	10 x 975La	
•	Laddregulator:	VR-B196M L5054885 M0511	
•	Crankshaft pulley	Enl B20 original	ÿ140mm
•	Pulley Dynamo	Enl Dynamo original ÿ63 mm	

Gear ratio - Pulleys

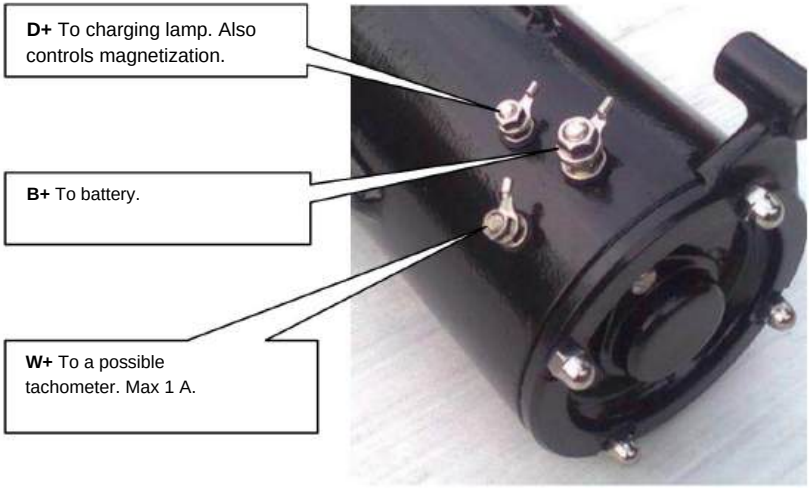
With the included pulleys, the gear ratio becomes: 140 / 63 = 1:2.2. This means

that at an engine speed of 1800 rpm, *the dynamo's* speed will be approximately 3960 rpm. At this speed, the dynamo will reportedly deliver approximately 90 Amperes.

5.18.3 Dynamo – Charging lamp – Important information!

The function of the charging lamp is not only to warn of a lack of charging. Its function is also to ensure the generator's own magnetization before it can start delivering power. It is therefore of the utmost importance that the right lamp is used for this purpose. A weak lamp consumes so little power that the magnetization function is absent, or becomes uncertain. The power required for the charging lamp must be tested at start-up. A starting value could be 5 Watts.

5.18.4 Dynamo – Connections



Note! Make sure *the Dynamo* is properly grounded. A screw for this purpose is located on the underside.

5.18.5 **Dynamo – Manufacturer's test protocol**

Computer Tested Alternator

63628

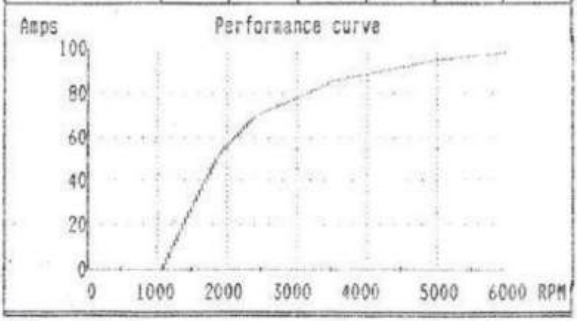
12V, 100A, N

9/3/2011 116286 0..1

Alternator test sequence:	Results:
Maximum output power	1328 Watts
Maximum output under full load	98 Amps
Voltage regulator set point	14.56 Volts
Turn on speed less than	2600 RPM
Voltage regulator load responce control	2.0 Sec
Leakage current tested @ 12 volts	3.81 mAmps
Ripple current @ 2500 RPM	28 Amps
Pulley ratio	2.08 -
Lamp terminal output voltage	14.66 Volt
Voltage regulator functions test:	Within specs
D+ = indicator lamp circuit	yes

Output currant tested at 13.50 volts

Alternator RPM	1600	2000	2400	3500	5000	6000
Amperage	36	57	70	85	95	98



*We certify these results are within specifications.

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Straight 16-Cylinder

Engine components

For your own notes:

5.19 startup system

5.19.1 Starting system - General information

The starting system for the 1934 Hercules consists of two Bosch original Volvo B20 starter motors, which engage a starter ring mounted on the engine's flywheel. It turned out that the starter ring that was already on the flywheel that was used had almost identical tooth geometry as the starter motors. This flywheel comes from an American car of unknown origin. However, a slight difference in the tooth profile between the Bosch starter motors and the American starter ring results in a slightly louder sound when they rotate together than would otherwise be considered normal.

The reasoning behind using 2 starter motors is based on the following:

- A starter motor is capable of turning an engine over, as well as moving a car that is, for example, standing on a railway crossing.
- Herkules 1934 is intended not to be started in winter.

This suggests that 2 starter motors should be able to handle the task.

5.19.2 Starting system – Detailed information:

- Starter motor, Manufacturer: Bosch
  Article number: 0 001 311 146

Starter motors – In-depth details.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.20 Ignition system - Distributor

5.20.1 Ignition system - General information

The ignition system for an engine that could have been built in the 1930s should of course not have electronic components. However, the freedom has been taken to deviate from the specification. Since the switch tips are to be contemporary, there is the advantage of being maintenance-free and having a high ignition voltage. The 1934 Herkules has thus been equipped with 2 HEI-

(High Energy Ignition) distributor. Originally intended for the Ford 302 V8 engine, but has been modified to fit this 16-cylinder engine. The modifications have included, in addition to turning the lower part, manufacturing a new bracket, etc., the installation of ball bearings instead of substandard plain bearings.

5.20.2 Ignition Distributor – Specification

• HEI distributor	Item no. 6502-RCS	AH-Performance
• Ignition coil		Built
• Ignition voltage		50kV
• Operation		Left turn
• Distributor cap color		Blue, red, black

Ignition distributor – Spare parts

• Ball bearing 12/28x8	Item no. 6001-2RSH	SKF
• Ball bearing 12/28x12	Article no. 63001-2RS1	SKF

5.20.3 **Ignition distributor - Description**

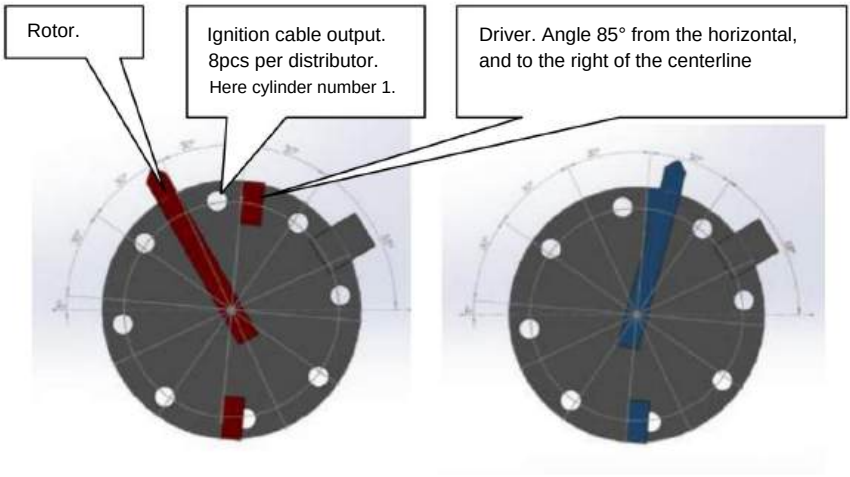
The engine's 16 cylinders are thus ignited by the two *HEI distributors.* One thing that may seem amiss in the considerations of the engine's firing sequence is that it *Block*
where the respective *Distributor* is located, is not ignited by that particular *Distributor.* So, the third *Block* is not ignited by *the Distributor* located on the third *Block,* but by *the Distributor* located on the fourth. This means that you have to take into account the angle change that occurs during engine operation to get the spark in the right place.

A good help in these considerations is **not to think about the movements of the crankshaft, but only to keep focus on the two ignition distributors.** One revolution of *the Distributors* is 16 ignitions in the cylinders, before everything is repeated again. (We do not need to think about the fact that the crankshaft has rotated two revolutions in this position). If we imagine the two *Distributors* sliding into each other so that they become one, and with a 22.5° rotational offset, we get an imaginary picture of a *Distributor*
for 16 cylinders, which have all outputs with even division. This is how the two working diagrams on the next page should be viewed. So, if the rotor points to a gap in the distributor cover, we can assume that on the other *distributor* cover there is a spark plug output at that exact location.

The picture shows the front of the two HEI manifolds.

5.20.4 Working model for Ignition Distributor Connections

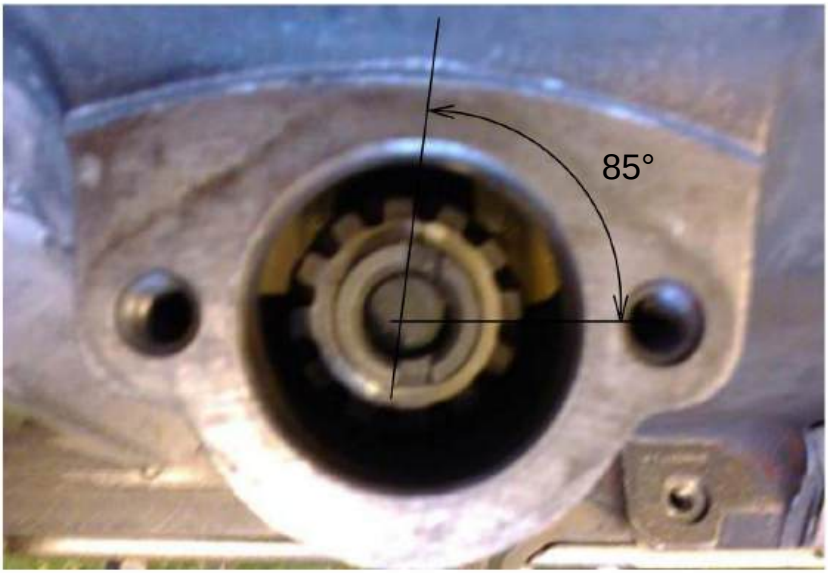
Below are the two models I used to determine where the ignition cables should be located on each distributor. The fact that the rotor points between the connections is because (as described above) another *Block's* cylinder has already fired where the cable is located.



Distributor F1 **Distributor F2**

The angles 5° + 30° + 30° etc. show the possible positions the driver can have when the first cylinder on each *block* is in position to fire. In the case of the HERKULES 1934, the driver (oil pump gear) **should** be mounted as shown below.

5.20.5 **Installing the oil pump gear**



Mounting the oil pump gear - also *the distributor drive.* The starting position is that the first cylinder in the current *block* is in position to fire.

By lifting the gear and rotating it, the positions can be changed.
However, make sure that *the Oil Pump's* driver is also engaged. Otherwise, the gear position is too high. To ensure this, it is recommended that *the Pump* is removed during the adjustment process, and reassembled when *the Distributor* is in place.

The angle of the driver should be approximately 85° from the horizontal, and the driver groove should be to the right of the center line.

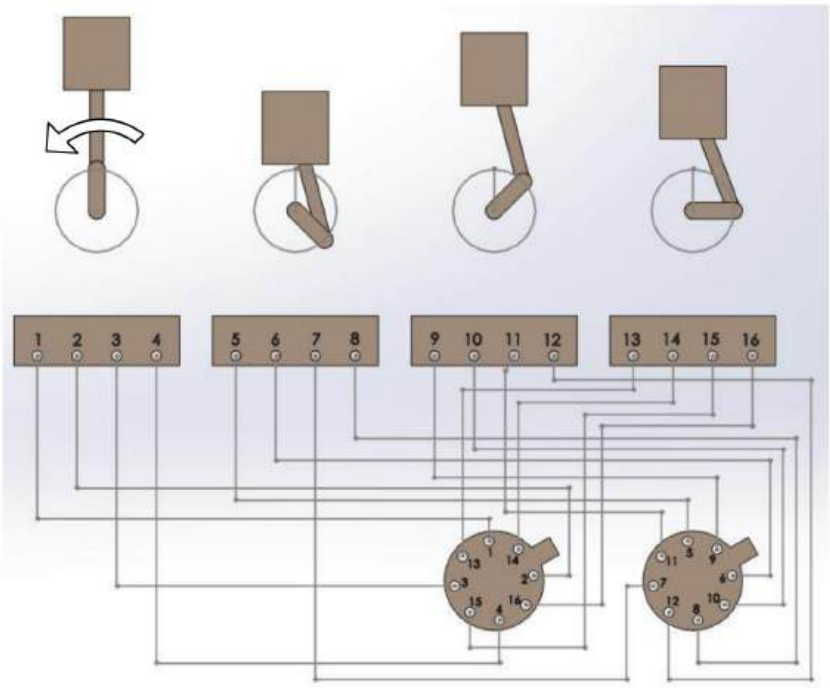
5.20.6 **Crankshaft assembly and ignition cable placement**

Crankshafts are mounted according to the picture below. *The crankshafts* are shown from the rear, meaning the engine rotates counterclockwise. The crank pin shown in the picture is the first one per *block,* meaning crank pins 1-5-9-13. This is the position when the cylinders of the said crank pins are in the compression stroke.

For further information see: XX Assembly of Crankshafts

Crankshaft degrees:

0° **135°** **45°** **90°**



The picture shows how the ignition cables of both *ignition distributors* are mounted to each cylinder.

5.20.7 **Orientation of camshaft sprocket during assembly**

The two *cam wheels* must be oriented so that the respective markings coincide.

The nut on *the camshaft* must not be tightened too tightly, as it may break.

MAX moment	14 kmph

Bild 49. Märkning på transmissionsdrev
1. Oljemunstycke 2. Märkning

NOTE! When installing oil nipples for lubricating the camshaft sprockets, note that there are two types. The nipples that are turned should be installed in Blocks 5-8, 9-12 and 13-16. The nipple that has a square shape, according to the original, should be installed in Blocks 1-4.

5.20.8 **Ignition sequence**

1 – 9 – 13 – 5 – 3 – 11 – 15 – 7 – 4 – 12 – 16 – 8 – 2 – 10 – 14 – 6

The ignition sequence, which at a quick glance may seem extremely complicated, becomes a little easier to understand with the following key:

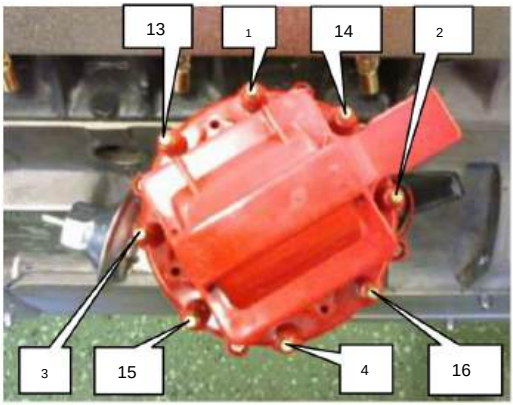
- Each *Cylinder* fires in its *Block* according to the original: 1-3-4-2.
- All *Blocks* also light in the same order: 1-3-4-2.
- The engine fires like two V8s with one *distributor* per 8a. So 90° between the two 4s that form an 8.
- All *cylinders* fire completely symmetrically, i.e. with a 45° crankshaft revolution offset.

Ignition sequence

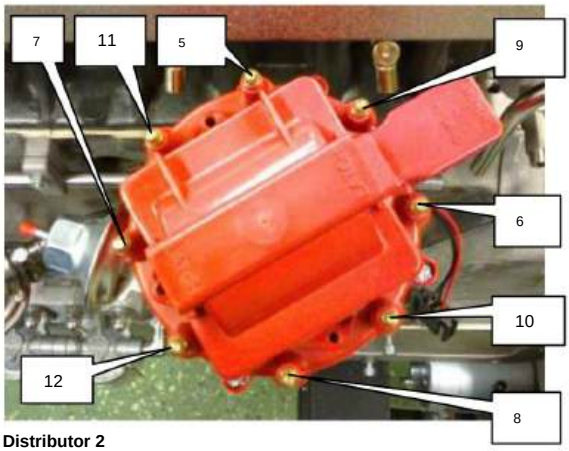
Distributor F1 (the front one) **Teeth block 1 and 4**

Distributor F2 (the rear one) **Teeth block 2 and 3**

NOTE! *The ignition distributor* drivers are positioned differently, which is why they are not interchangeable.



Distributor 1



Distributor 2

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.21 Ignition adjustment

5.21.1 Ignition Timing - Introduction

A common name historically for an internal combustion engine was *an Explosion engine.* Increased knowledge has shown that the speed of the flame front when the spark has ignited the fuel mixture is lower than in an explosion, which is why a more adequate name is *Internal Combustion Engine.* Because the combustion speed is relatively slow, it is important to ignite the fuel in good time to achieve maximum cylinder pressure just after the piston has passed top dead center. Ö.D.

When it comes to determining the ignition timing for an engine, we have to divide the problem into three parts:

- Static basic setting
- Mechanical adjustment
- Vacuum adjustment

Static basic setting

The *static basic setting* is therefore needed as a basis when it comes to getting four of the fuel mixture in time. A common value for the basic setting on engines in general can be about 8° - 12° before TDC.

Mechanical adjustment

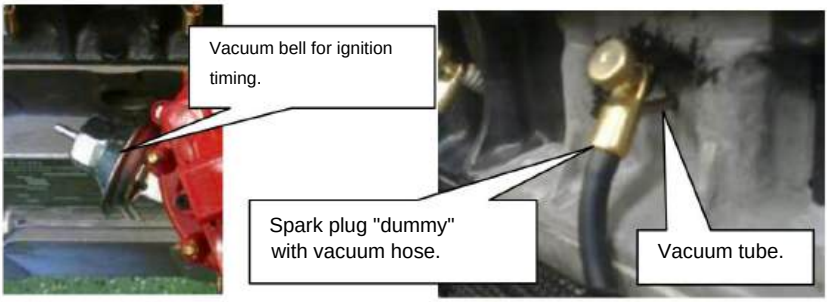
Mechanical adjustment is done by a device placed in the distributor that uses centrifugal weights to ensure that the ignition advance increases. The only thing it can do is create greater ignition advance with increased engine speed. Since the piston moves at a higher speed at higher engine speeds, it is easy to understand that the fuel mixture must be ignited earlier in these cases.

Vacuum adjustment

When it comes to *vacuum adjustment,* the subject becomes a little more interesting. In connection with this, we must first note that:

Vacuum increases ignition It is

also important to remember that a lean fuel mixture, such as at idle and during quiet highway driving, burns more slowly than a rich fuel mixture. This is especially true at idle, when the mixture is also affected by exhaust gas residues in the combustion chamber. Lean fuel mixtures must therefore be ignited earlier in the compression cycle. This can be achieved by vacuum adjustment, since the engine has a high vacuum in the intake manifold at low load.



Summation

The mechanical adjustment with *centrifugal weights* advances the ignition point only depending on the engine speed. Thus, the faster *the piston*
turns in the E.D. its earlier the spark must ignite the mixture.
The number of degrees and when they are applied depends on the weights and springs under the rotor.

These degrees at maximum deflection, together with the degrees set at the *static basic setting* at idle, give the combined pre-ignition.

Vacuum adjustment has nothing to do with the overall ignition timing or acceleration, because when the engine is loaded, the vacuum in the intake manifold drops to near zero, disabling the vacuum adjustment.
The vacuum adjustment is therefore not to be included in the total ignition calculation, but only to be considered as a load sensor.

In cases where the engine is idling, the load is low and the vacuum is high. (if not ported vacuum) This adds additional ignition advance to that previously presented.

Example: If the *Static Ignition Advance* is 10°, and at the same time the engine is spinning at a speed that causes the *Mechanical Ignition* (with centrifugal weights) to add 20°, then we have a total of 30° *Advance.* If the engine load is low (despite the high speed) *the Vacuum* is at the same time high, which can mean that *the Vacuum Adjustment*

adds another 20° so that the total *Ignition* is 50°. In the example we can therefore imagine that *the fuel mixture* is lean and the power output is low.

During acceleration, *the fuel mixture* suddenly increases so that it becomes rich, the speed of *the flame front* increases, and the need for *pre-ignition* decreases.
NOTE! For Hercules, these values are not as high as in the example.

5.21.2 Ignition adjustment

Adjustment values:		
• Static basic setting	10°	F.Ö.D
• Ignition timing at 1500 engine rpm, Without vacuum 21° - 23° F.Ö.D		

5.21.3 Distributor - Factory values

Mechanical Adjustment / Centrifugal Regulator:

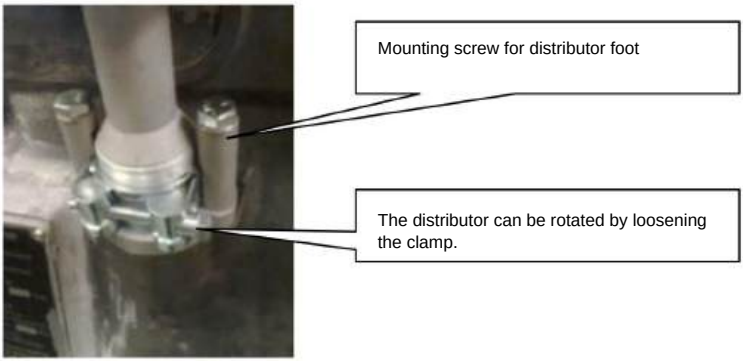
Total pretense	13° +/-1	Advantage levels
The performance begins at	300 – 500 Distributor RPM	
Values: 5°	750 – 900 Distributor rpm	
10°	1210 – 1750 Distributor rpm	
The pre-arrangement (13°) ends at	2400	Distributor rpm

Vacuum regulator

Total pretense	5° +/-1	Advantage levels
The performance begins at	60 – 100 mm Hg	
Values: 3°	105 – 145 mm Hg	
The pre-setting (5°) ends at	150 – 160 mm Hg	

Ignition adjustment

The adjustment is made by loosening the clamp screw and turning *the distributor*.
The screw must be tightened relatively tightly to keep the distributor firmly in place. **However, not too tightly, as the threads of the screw/nut may be damaged.**



NOTE! Take extreme care to ensure that the Distributor does not come out of its Mounting/Foot, as it functions as an axial bearing for the drive gear.

NOTE! The advantages and their foot mounting are individual and therefore **not interchangeable.** So pay attention to their markings!

Adjustment clamp:

- Hose clamp 857510200039 Ø36-39mm ESSKA

Reading of degrees for each Distributor

Will have to decide later whether reading should be done at the pulley, as usual, or at the flywheel... The distributors are so far back that you can't turn them and check the strobe light at the same time...

5.22 Renovation of distributors

Observations in connection with the renovation of distributors:

- *The ball bearings* were glued to the housing with LocTite 640.
- *The shaft* is also glued with LocTite 640, which is why pressing force is required when disassembling.
- The holes for *the drive pins* are positioned differently on the two *shafts,* which is why *the rotor shafts* and *drives* are mixed up . must be avoided.
- *The encoder receiver* is shimmed for better precision.
- *The pins* that hold *the driver* are of different diameters for both models (Ø4.1 and Ø4.2mm).

• The shims between *the Drive Shaft* and the lower *Bearing* should only fill up part of the axial distance between the *Drive Shaft* and *the Bearing.* After shimming, there should be a clearance of about 0.2mm. This is so that *the Drive Shaft* can move freely. Distances should not be greater, because if the LocTite adhesive on *the Shaft* loosens, *the Shaft* will move too far axially, which can interfere with both the drive to *the Camshaft* and *the Oil Pump's* engagement with its drive shaft.

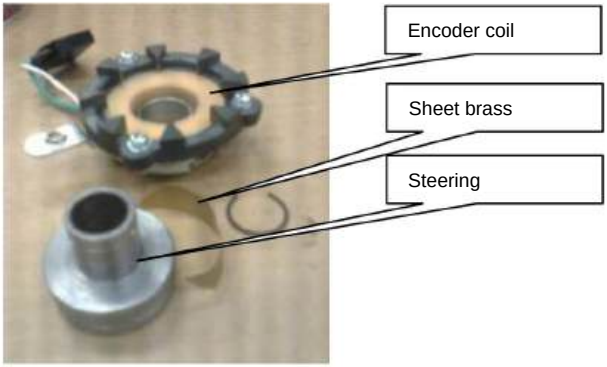
CHECK 0.2mm!

PICTURE

Renovation of distributors

Observations in connection with the renovation of the distributor:

The HEI distributor's *pulse generator coil* has been shimmed with sheet brass to get less play between *the coil* and *the magnet ring.* (the latter is *on the shaft* and not in the picture)



Ball bearings glued with LocTite 640. The lower bearing (pictured left) also functions as a thrust bearing for the oil pump drive.

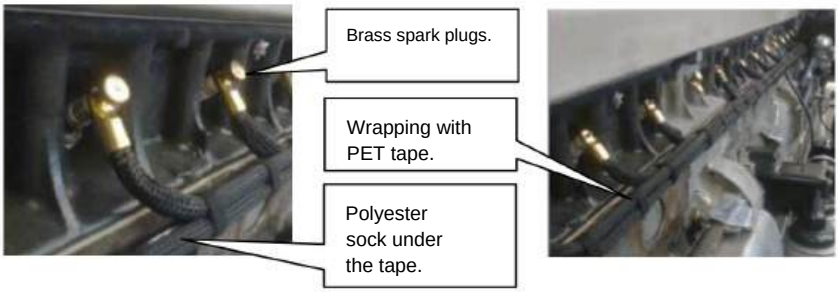
5.23 Ignition Cables and Ignition Caps

5.23.1 General information

For Herkules 1934, brass firing caps are fitted. They consist of two parts, *a cable lug* and *a nut.* The cable lug is fitted with two threaded holes for attaching *the firing cable,* M2 to lock the inner conductor and M3 to lock the casing.

The ignition cable is made of the highest quality. Kevlar, multi-layered silicone and with a fiberglass sock, all to withstand the high ignition voltage, 50kVolt.

To give *the ignition cable* extra protection, it has been fitted with a black polyester *sock . The ignition cables* have then been wrapped with PET fabric tape to give them a neat appearance.

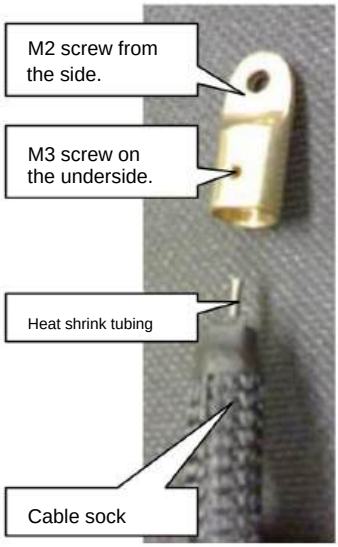


5.23.2 Fitting of caps in the distributor end

Procedure:

1. Strip the cable and fold the conductor back.
2. Press the metal cable lug into place.
3. Slide *the Cable Sleeve* over *the Cable.*
4. Put on a piece of *heat shrink tubing* and heat.
5. Coat the cable end with soap and press it into the Cable Hat.

5.23.3 **Installation of Cable Lugs**



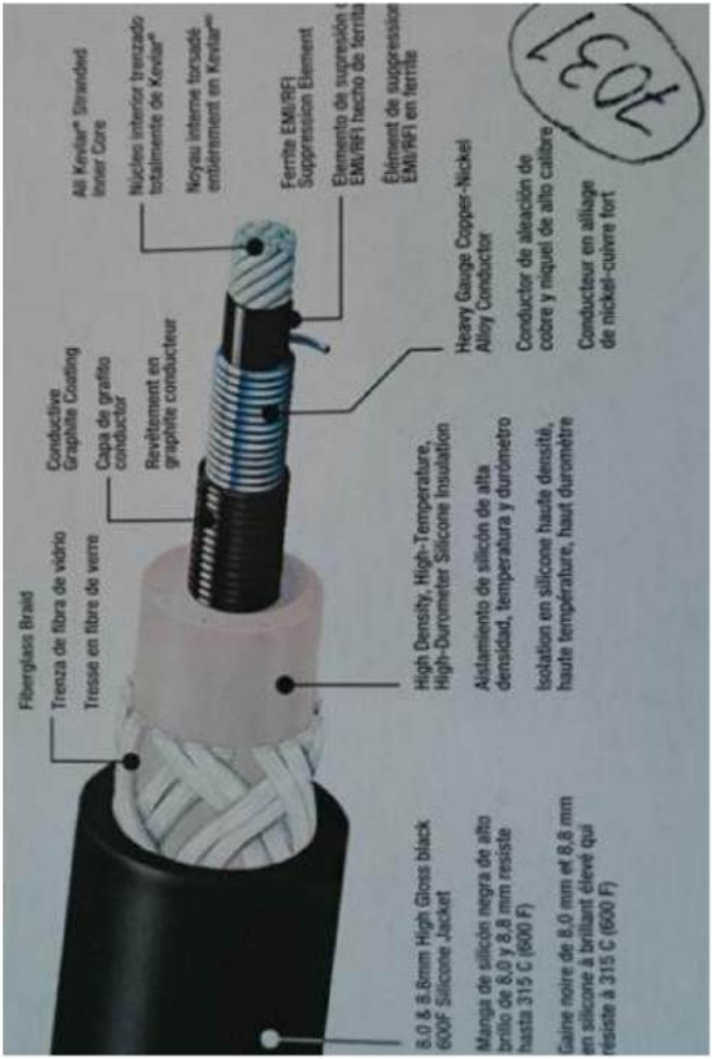
Procedure:

1. Measure the correct length *of the ignition cable.* Cut and heat the end so that it fuses together.
2. Slide *the Cable Sleeve* over *the Cable.*
3. Strip *the cable* in two steps, the outer sheath longer than the inner one.
4. Put on a piece of *heat shrink tubing* and heat. (Alternatively, the heat shrink tubing can be omitted and replaced with instant glue.)
5. Thread *the Cable* into *the Cable Lug.* Be careful to get the inner conductor into the small hole. Before *the Cable* is in the hole, coat *the Cable Sleeving* with instant glue to hold *the Sleeving* together.
   strands.
6. Tighten the screws.
7. Linda on PET tape.

Included parts:

• Cable lug with nut Brass • Braided		Make	Soderstrom
cable sleeve ÿ12		61-995	CarTheme
• PET tape	XXXX	XXXX	XXXX
• Ignition cable	ÿ8,8mm Accel 300+ 150 Ohm per fot.		

Ignition cable for Herkules 1934.



A special type of silicone cable has been used due to the 50kV ignition voltage.

5.24 Spark plug

Tightening torque	**3.5 – 4 kmph**
Electrode spacing Original	**0,7 – 0,8mm**

5.24.1 Spark plugs – General information

At the time of writing, the engine has not been started, so *the spark plugs* have not been able to be tested properly.

For the day there are two options:

- Hard plugs – IRIDIUM – Which could be excellent thanks to the high ignition voltage.
- Soft pins. Which could give a better result because the engine is operating at such a low load.

Further tests may be evaluated. Pictured are *spark plugs* from NGK. Many believe that it is perhaps the world's finest plug right now, thanks to their extensive research.

Spark plugs from NGK. Tests should be carried out with other brands, e.g. BOSCH.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.25 Fuel supply

5.25.1 Fuel pump – General information

For the Herkules 1934 only one *fuel pump* was used to feed the 4 *carburetors* with fuel. The type of *diaphragm pump* used uses the return spring movement to perform the pumping process itself. This means that it is the force of the spring in relation to the area of the diaphragm that creates the correct fuel pressure.

Because the pumping is done with the spring movement, no fuel is pumped in cases when *the carburetor float needle* is in the closed position. This means that the pump arm is then standing and riding on the top of the camshaft's intended cam. Wear is thus minimal. In our case with the Herkules 1934, whose fuel consumption is higher than for just one engine block, the wear on the pump arm and cam could be significant. This has been solved by a *sliding block* made of bearing bronze, which increases the loaded surface on both the camshaft cam and the pump arm.

Fuel pressure, measured at the same height as the pump:	**Min 0,15kp/cm²**
	Max 0,28kp/cm²

Incoming details:

• Fuel pump	Pierburg	1336184	CVI Automotive
• Packing	Paper	1378905	CVI Automotive
• Insulation	Weaving hooks 460678		CVI Automotive
• Fuel pipe	Ø10x1	EN 1.4307 Machine part	

Glued nipple for fuel pipe.

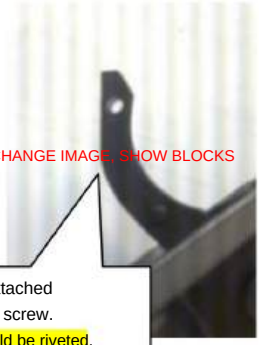
A cylindrical connection nipple has been glued with LocTite 648 into *the fuel pump* cover for connecting the fuel pipe.

5.25.2 **Fuel pump – Test drive report**

To determine whether it was possible to manage with only one *fuel pump,* a test run of the same was carried out. The result below shows that the flow is within the approved value. However, it was noted that the wear on *the fuel pump* arm increased with increased fuel consumption, which is why it was decided to provide the arm with a *sliding block* made of bearing bronze.

According to the statement, empirical tests in practice have shown that an engine developing 250 hp should have a fuel pump with a capacity of 126 Lit/hour, plus 20%. So: 126 x 1.2 = **151 Lit/hour**

Test:



Speed Camshaft	Pumped quantity	Time	Equivalent L/hr
410 rpm	5 Liter	2 min 15 sec	133.3 L/tim
745	5	2 min 12 sec	136,3
1000	5	2 min	**150 L/tim**

The test thus shows that *the camshaft,* i.e. the engine speed, does not significantly affect *the fuel pump's* capacity. Also note that *the camshaft* rotates at half the speed of *the crankshaft.* This means that *the fuel pump's* ability to supply the Herkules 1934 with an adequate amount of fuel at a speed of 2000 rpm is completely reasonable.

Further tests after the engine has been put into service may show whether the wear on *the camshaft cam* and *sliding block* is within reasonable limits.

5.25.3 Fuel Filter – General Information

The fuel filter for the Herkules 1934 is of a type originally fitted to BM tractors. This *fuel filter* has been mounted in pairs by gluing a pipe fitting with LocTite 648 between them.

- Fuel filter with glass 81711842 Vikabacken

  Fits BM Rear Loader LM621 and LM641 Tractor BM 650 and 700

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

5.26 Carburetors – Carburettors

History

For the Volvo B18/B20 engine, a type of *carburetor* called a “constant negative pressure carburetor” was used at the time . It is a type that, in addition to a throttle valve, also has a *piston. The piston's* task is to change *the carburetor throat's* flow area depending on load. The conical *fuel quantity needle* is located in *the piston* . Since the needle's diameter changes with the height at which it is located, the fuel quantity can thus vary through *the carburetor nozzle.*

The constant-negative-pressure carburetor was invented as early as 1905 by the brothers George and Thomas Skinner. The company that manufactured them was called Skinners Union, and that is where the name SU carburetor comes from. Two other gentlemen, Denis Barbet and Harry Cartwrite, tried to circumvent the two patent holders by constructing a variant of the SU carburetor. The Stromberg carburetor thus saw its first light. The official version is that it happened in the late 1930s.

BETTER IMAGE + IMAGE FROM THE OTHER SIDE

Carburetor for Hercules 1934.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

PICTURES

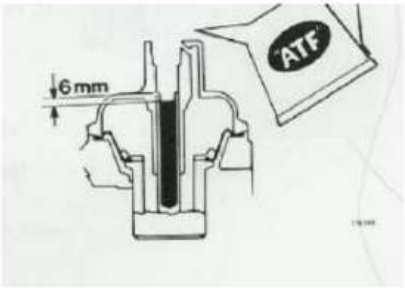
5.26.1 Carburetors – General information

Data:

• Carburetor Type •	Zenith Stromberg 175 CD-2	
Fuel Needle	B2AF / B19164	Carburetor technology
• Fuel nozzle	100 / Adjustable	Carburetor technology
• Membrane	M101R Hydringummi	KG Trimming

Setting values:

• Idle speed	500 - 700 revolutions per minute
• CO: Setting value	2,5%
· Control value	1,5 – 4%
• Max difference between Carburetors XX%	
· Oil in the shock absorber cylinder	ATF



5.26.2 **Carburetors – Functional description**

ZENITH-STROMBERG 175 CD-2

The carburetor for the Herkues 1934 is equipped with adjustable nozzles, whose flow area for the fuel is varied with a movable, conical *needle.*
The position *of the needle* is determined by the vacuum in *the carburetor housing* as this acts on a *vacuum piston* in which *the needle* is mounted in a spring-loaded suspension. This spring loading always pushes the needle against the same side of *the nozzle,* which gives a carefully controlled amount of fuel through *the nozzle.*

The carburetor consists of three main parts made of light metal, where the middle part forms *the carburetor housing.* The lower part consists of *the float housing* which encloses *the nozzle* and *the float.* The upper part consists of a *vacuum chamber cover,* which together with a *diaphragm* attached to *the piston* forms a vacuum chamber which regulates *the piston* lift and thus *the needle* position in *the nozzle.*

The vacuum chamber is connected to the space between *the carburetor damper* and the piston via channels in *the piston .*

In the original version for the Volvo B20, *the Carburetor* is equipped with a *Temperature compensator.* For the Herkules 1934, this has instead been replaced by a pipe and hose system that ends with a *Carburetor air control knob mounted on the dashboard.* The *temperature compensator,* or in this case *the air control knob,* is responsible for compensating for the fuel's viscosity difference depending on the temperature of the fuel at different times. Extra air dilutes extra fuel.

The following text explains the function *of the Temperature Compensator ,* but this therefore applies to the Herkules 1934 onwards, the manually operated
The knob instead of the bimetallic spring valve.

Carburetors – Functional description

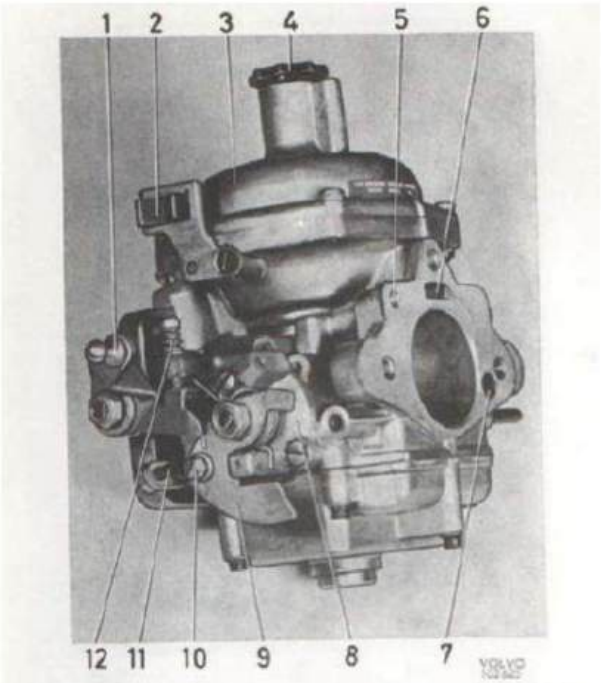


Bild 64. Stromberg-förgasare, vänster sida, B 20 A

1. Hävarm för gasreglage
2. Klammer för kallstartswire
3. Vakuumkammare
4. Dämpningsanordning
5. Avluftningskanal från flottörhus
6. Kanal för lufttillförsel under membran
7. Kanal för lufttillförsel till temp.komp.
8. Kallstartanordning
9. Kamskiva för snabbtomgång
10. Anslutning för kallstartreglage
11. Snabbtomgångsskruv
12. Tomgångsvarvskruv

Excerpt from Volvo B20 manual

Carburetors – Functional description

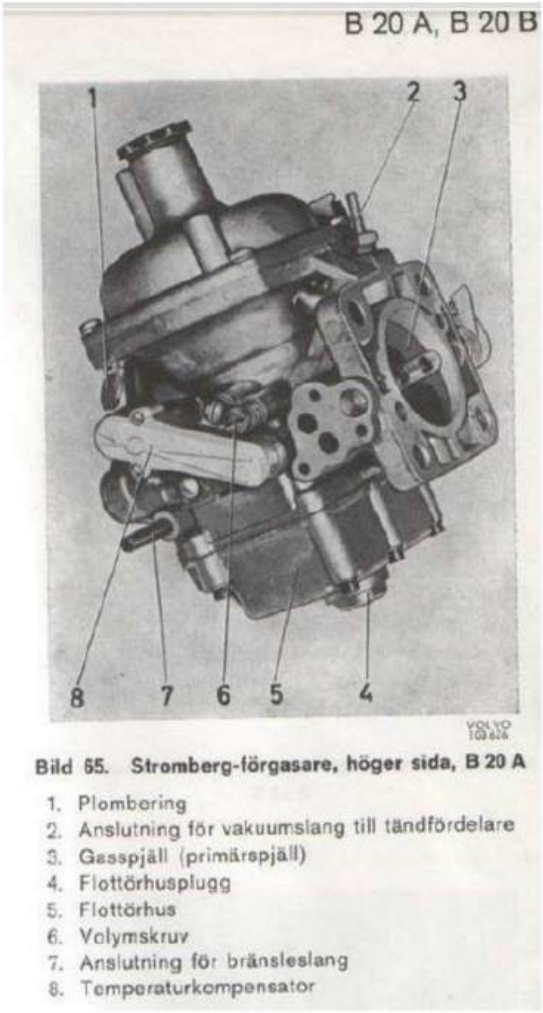


Bild 65. Stromberg-förgasare, höger sida, B 20 A

1. Plombering
2. Anslutning för vakuumslang till tändfördelare
3. Gasspjäll (primärspjäll)
4. Flottörhusplugg
5. Flottörhus
6. Volymskruv
7. Anslutning för bränsleslang
8. Temperaturkompensator

Excerpt from Volvo B20 manual

Carburetors – Functional description

Float system - General information

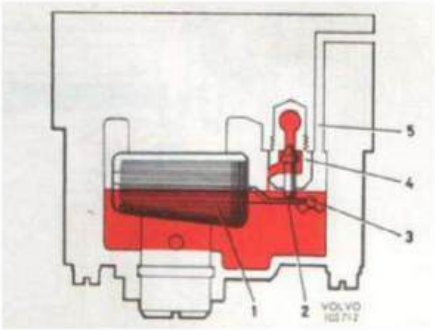


Bild 70. Flottörsystem

1. Flottör
2. Flottörarm
3. Flottöraxel
4. Flottörventil
5. Avluftningskanal från flottörhus

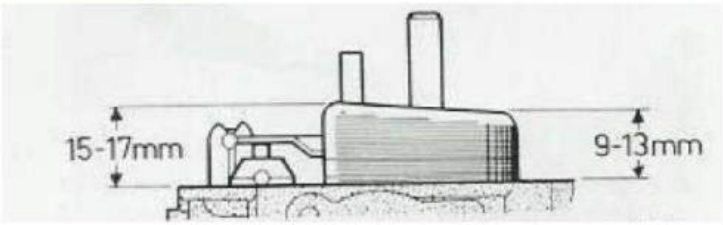
Excerpt from Volvo B20 manual

The fuel enters *the Float Housing* via *the Needle Valve,* also called *the Float Valve.* (4 picture 70) *The float,* which is double, is mounted in a bridge on the underside of *the carburetor housing* . As the fuel level rises, *the float* is lifted and at the correct fuel level *the needle valve* is closed by a tongue on *the float arm.* The fuel goes through holes in *the nozzle holder* to the inside *of the nozzle ,* where the level is the same as in *the float housing.* The seal between *the nozzle holder* and *the float housing* is made up of an O-ring.

Float - Adjustment procedure

When checking the float level, *the Carburetor* must be dismantled, turned upside down and *the Float Housing* removed. *The float* must be mounted with the inclined plane **from** *the Carburetor Housing.*

At the correct float level, the highest point on *the Float* should be 15-17mm, and the lowest 9-13mm above *the Carburetor housing* sealing surface. If the level is incorrect, adjust by bending the tongue at *the Needle Valve.* NOTE! Do not bend the arm between *the Float* and *Shaft.*



Carburetors – **Functional description**

Cold start device - Fast idle

To facilitate starting in cold weather, *the carburetor* is equipped with a *Cold start device.* Unlike many other engines that use a damper that restricts the air supply, this design is instead designed so that an extra fuel supplement is supplied.

The cold start device consists of a *Valve Disc* provided with four calibrated holes and an oblong slot and a channeled disc mounted on a *Shaft* that is affected by what is commonly called *the Choke.* On the same *Shaft,* outside the cover, a *Cam Disc* with connection for *the Choke* control cable is placed.

When *the Cold Start Device is engaged, the Valve Disc* rotates and creates a connection between the channel (1) from *the Float Housing,* via one or more of the calibrated holes to the channel behind *the Valve Disc,* and further through the slot to the channel (2) which opens into *the Carburetor Neck* between *the Vacuum Piston* and *the Throttle.* This gives the engine an extra fuel boost (richer mixture) to facilitate cold starts. At the same time, a small air boost is also provided through *the Cold Start Device.* When the “Choke Control” is pushed in, *the Valve Disc* turns and closes the inlet to the channel.

The opening of the Throttle is also affected by *the Cam Disc* - at the same time as the opening of the *Valve Disc* , in such a way that turning *the Cam Disc* opens *the Throttle* through *the Adjusting Screw (11, Figure 64 above)* and *the Lever,* before any of the calibrated holes opens the inlet from the fuel channel.
This allows the idle speed to be increased from the driver's seat if necessary during the engine warm-up period.

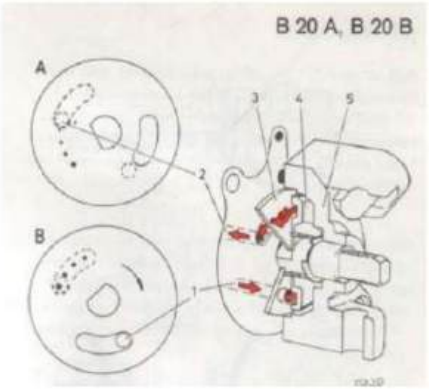


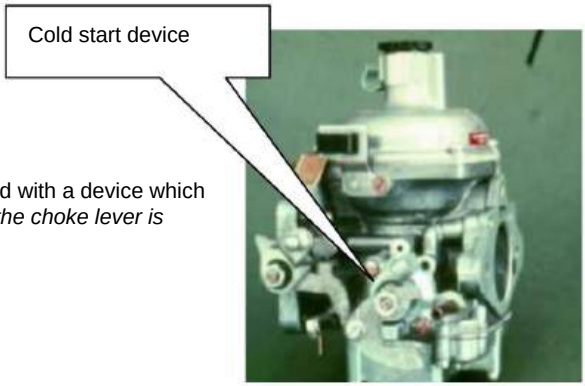
Bild 71. Kallstartanordning

A. Kallstartanordning, urkopplad	1. Från flottörkammare
B. Kallstartanordning, inkopplad	2. Till förgasarhals
	3. Ventilskiva
	4. "Kanalskiva"
	5. Hus

Excerpt from Volvo B20 manual

Carburetors – Functional description

Cold start device



The carburetor is equipped with a device which allows extra fuel in when *the choke lever is actuated.*

The cold start device consists of a disc with holes for extra fuel.

When *the Cold Start device* is activated, an extra fuel injection passes between two channels (1 and 2 in the picture).

Through a third channel, an additional amount of air comes in which is mixed with the additional fuel.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

Carburetors – Functional description

Principle image

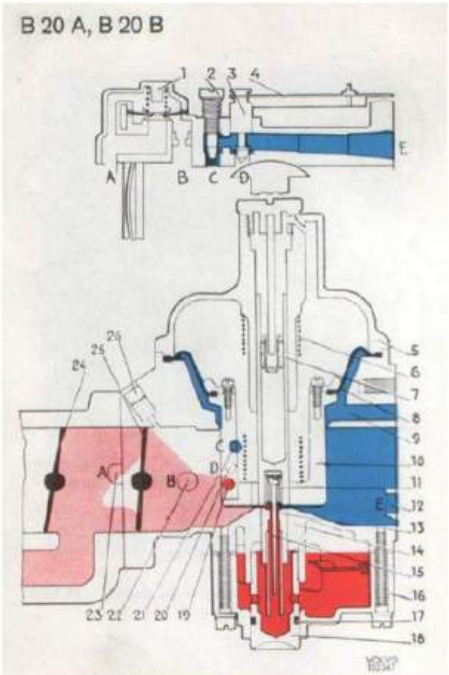


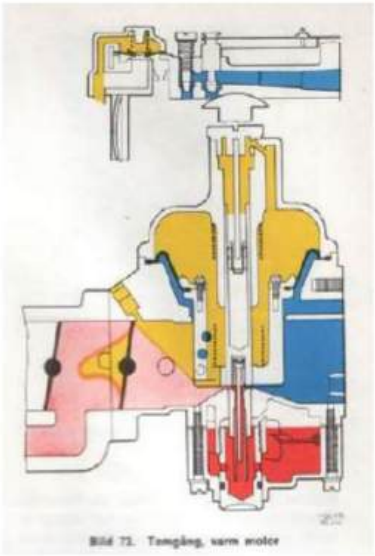
Bild 72. Principbild, kallstart
(bilden visar utförande för B 20 B. Vakuumuttaget är placerat som för B 20 A)

1. Överströmningsventil (B 20 B)
2. Volymskruv
3. Ventil för temperaturkompensator
4. Bimetallfjäder för temperaturkompensator
5. Vakuumhus
6. Fjäder
7. Dämpkolv
8. Membran
9. Kanal för lufttillförsel under membran
10. Vakuumkolv
11. Nålupphängning
12. Kanal för lufttillförsel till temp.komp. och volymskruv
13. Bränslemunstycke
14. Förgasarhus (mellandel)
15. Bränslenål
16. Flottörhus
17. Gummiring
18. Flottörhuspluggar
19. Kanal för kallstartbränsle (plac. i förg. motsatta vägg)
20. Kanal för lufttillskott genom temperaturkomp.
21. Kanal för lufttillskott genom volymskruv
22. Inloppskanal för bränsleluftblandning genom överströmningsventil (B 20 B)
23. Utloppskanal för bränsleluftblandning genom överströmningsventil (B 20 B)
24. Sekundärspjäll (B 20 B)
25. Primärspjäll
26. Vakuumuttag för täncfördelare (B 20 A. Annan placering för B 20 B).

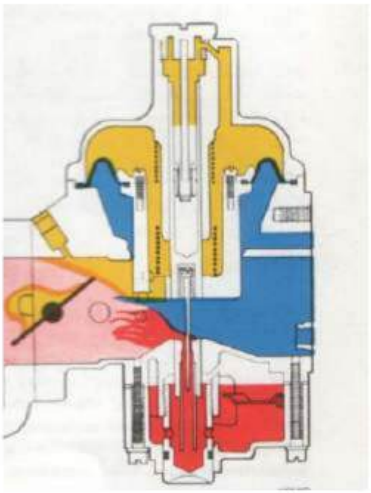
Excerpt from Volvo B20 manual

Carburetors – **Functional description**

Principle image



The picture shows dampers for B20B which does not apply to Herkules 1934 which has single dampers.



Picture 74 - *Excerpt from Volvo B20 manual*

Carburetors – Functional description

Idling

When the engine is idling, the vacuum in *the Vacuum Chamber* is low and the gap between *the Vacuum Piston* and *the Bridge* becomes small (Fig. 73). This means that the larger part *of the Fuel Needle* is in *the Nozzle* and only a small amount of fuel corresponding to the idling requirement is sucked into the engine.

The temperature compensator – which for the Herkules 1934 was replaced by a *knob* on the dashboard – compensates for the increased amount of fuel that passes through the engine as a viscosity change occurs due to different fuel temperatures.

The *volume screw* (2, Fig. 72) can be used to fine-tune the engine's idle speed.

Normal drift

When *the throttle* is opened, approximately the same vacuum is obtained in *the Vacuum Chamber* as in the engine's *Intake Manifold* - also called *Plenum.* Due to the pressure difference between the underside *of the Vacuum Piston ,* where the pressure in *the Carburetor* inlet port prevails, and the top *of the piston ,* where vacuum prevails, is lifted. *The piston* from *the Bridge.* At this point, the conical *Needle* (15, Fig. 72) which is attached to *the Piston,* is also lifted out of *the Nozzle.* The flow area and thus also the fuel quantity increases. (Fig. 74) Since the vacuum in the engine is dependent on the engine speed and load, the correct fuel quantity is always obtained under all load conditions.

Due to the variable air flow area, between *the Bridge* and *the piston,* the air velocity and vacuum above *the nozzle* always remain almost constant, ensuring good atomization of the fuel under all conditions.

Carburetors – Functional description

Acceleration

To achieve a temporarily richer fuel-air mixture during rapid throttle opening (acceleration), a damping device is fitted in *the piston* spindle. The damping device consists of a *damping piston,* attached to a rod.
The damping piston runs in oil. When *the throttle valve* opens quickly, the vacuum in the *The vacuum chamber* quickly.

When *the Vacuum Piston* (10, Figure 72) is lifted up, *the Damping Piston* (7) is pressed against its seat and prevents the oil from flowing past from the underside to the top of *the Damping Piston* and the movement *of the Piston* (10) is slowed down. This temporarily creates a stronger vacuum above *the Nozzle* and the fuel-air mixture becomes temporarily richer.

The downward movement *of the vacuum piston* is facilitated by *the spring* (6).
The spindle in *the piston* should be filled to approximately 6mm from the upper edge with oil that is approved as "automatic transmission oil" type A.

5.26.3 **Carburetors – Components**

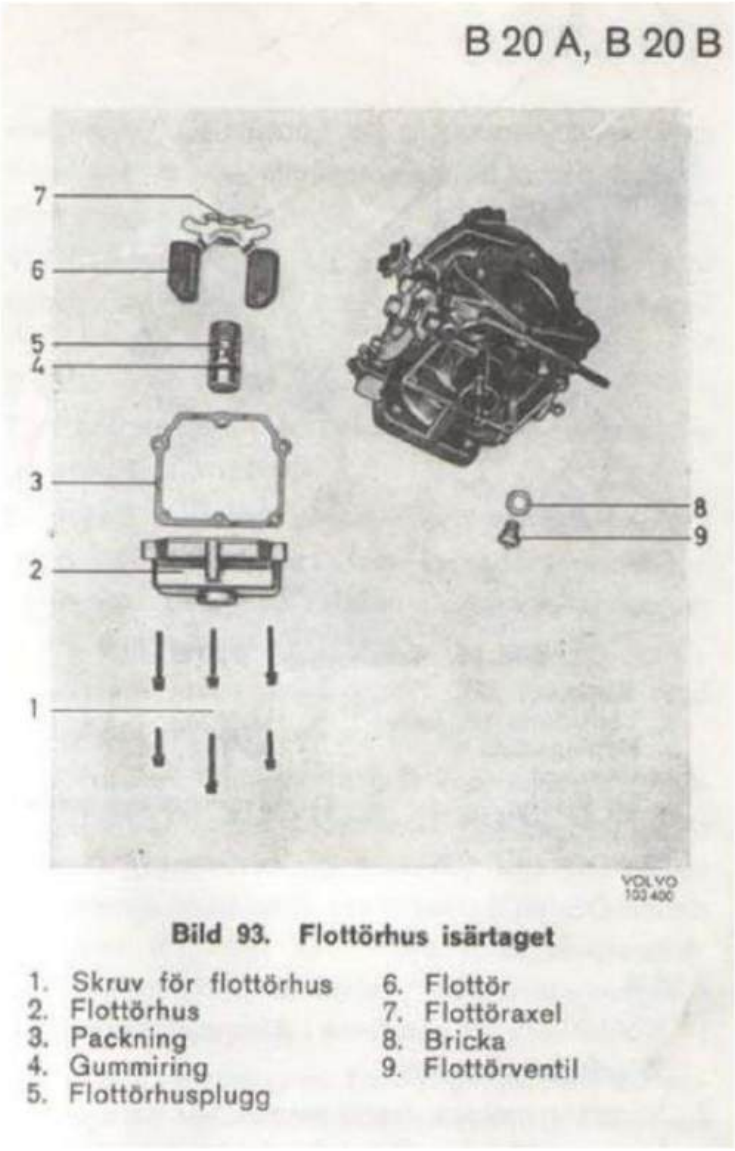


Bild 93. Flottörhus isärtaget

1. Skruv för flottörhus
2. Flottörhus
3. Packning
4. Gummiring
5. Flottörhusplugg
6. Flottör
7. Flottöraxel
8. Bricka
9. Flottörventil

Carburetors – **Components**

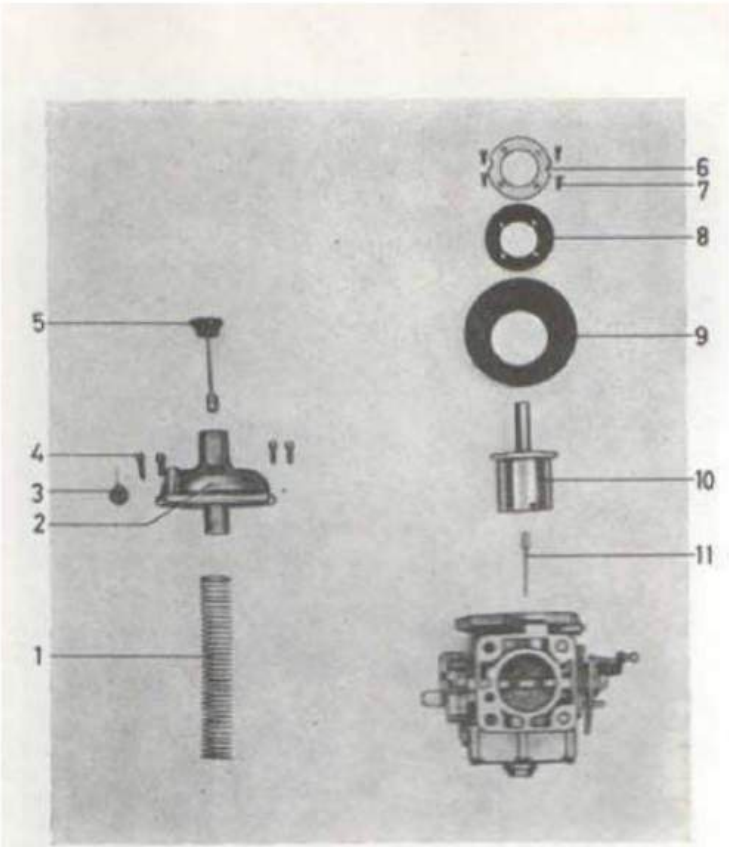
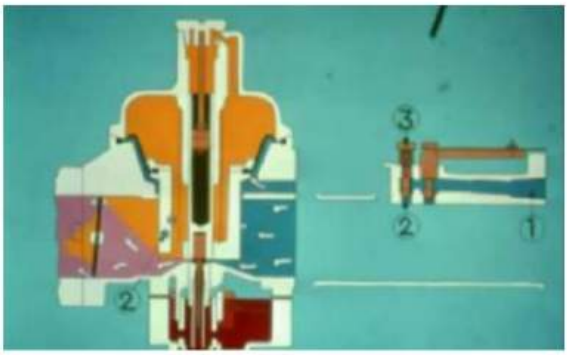


Bild 92. Överdel isärtagen

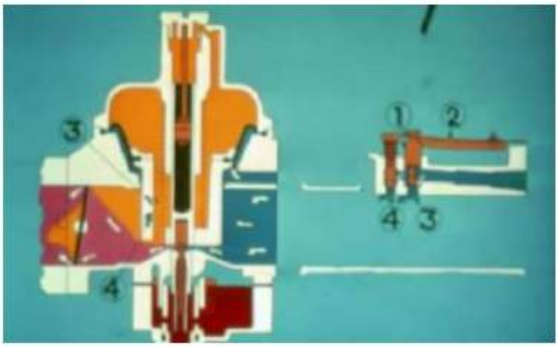
1. Fjäder
2. Vakuumkammarlock
3. Plomb
4. Skruv
5. Dämpningsanordning
6. Bricka
7. Skruv för membran
8. Bricka
9. Membran
10. Vakuumkolv
11. Bränslenål

5.26.4 **Carburetors – Temperature compensator**

Please note! *The carburetors* for the Herkules 1934 do not have this function fitted. Instead, a manually operated *knob* is fitted in its place. .



The picture shows the path of the air through the
"Temperature compensator" and the air screw when the engine is cold.



The picture shows the path of the air through the
"Temperature compensator" and the air screw when the engine is hot.

5.26.5 **Carburetors – Adjustable Jets**

For the Herkules 1934 *the Carburettors* have been fitted with a conversion kit with adjustable *Nozzles,* which was not standard for the Volvo B20. The earlier B18 had this system. The advantage is that it is easier to adjust each of the four *Carburettors* for the correct CO value, since access is from the outside of *the Float Housing.*

Description:

Steering, *Spring, Nozzle,* *Holder,* *Adjusting screw*

To note:

If the parts have been dismantled, ensure that *the Steering* is pressed in so that it reaches the surface of *the Carburetor Bridge.*

On a par with *the Bryggan*

The parts are assembled in order: *Spring, Nozzle, Holder,* and *Adjusting Screw.*

The adjustable *Nozzle* shown from the underside of *the Float Housing.*

5.26.6 **Carburetors – Specific to Herkules 1934**

For *the Carburetors* for the 1934 Hercules, some modifications have been introduced which differ from the original Volvo B20.

- Grey natural anodizing for a sober, classic look.
- Stainless steel bearings for *cold start valves.*
- Exclusion of *Temperature Compensator.*
- Pipe connection for fuel supply
- Adjustable *Nozzles.*

Of course, a complete renovation has been done before the engine is started. The renovation included replacing the dampers and *damper shafts.* When installing these new *damper shafts,* small O-rings were also installed at the bearings.
Its task is, in addition to sealing *the damper shaft,* to also ensure that the bearing is as clean as possible.

Carburetors – **Specific to Herkules 1934**

Complete disassembly has been carried out prior to anodizing as the chemical process does not allow any deviating metal in the process bath.

Complete renovation including replacement of bearing for *Temperature compensator.* The bearing is made of material from stainless A4 screw, which is reamed to Ø7.85mm. The shaft is ground to the same dimensions. The valve disc is ground with fine wet sandpaper and polished for best tightness.

The temperature compensator has been removed and replaced by a …

...glued "fitting", connected to a pipe system, which ends with a knob on the dashboard for *Carburetor air.*

The picture shows pipe connections for both carburetor air as fuel supply.

5.26.7 **Carburetors – General information about adjustment**

Pre-setting steps:

To adjust *the Carburetor* for Herkules 1934, a CO meter is required. Before any intervention in *the Carburetors* , the following should be checked and corrected if necessary:

- Valve clearance
- Spark plug
- Compression
- Ignition timing
- Air regenerative filter
- Throttle function
- Leakage on both the inlet and outlet sides (for checking the inlet side can be used as starting gas)

Always use new gaskets between the Carburetor and Plenum.

Gunson Gas test equipment, of the same type used for Herkules 1934

5.26.8 **Carburetors – Important information regarding temperature**

Adjustment of the Carburetors should be carried out at room temperature of +15ÿCelsius to +25ÿCelsius and within 3 minutes after

The coolant thermostats have opened. Warm-up should be done from a completely cold engine.

When measuring CO, it is important that *the carburetor* temperature is correct.
When the engine is idling, *the carburetors* are heated by the engine. In addition, *the float housings* are heated by radiant heat from *the exhaust pipes ,* while the flow of cold fuel through *the float housings* is small. As *the float housings* are heated, the fuel is also heated, which causes its viscosity to decrease. With reduced viscosity, the fuel's flow increases, which increases the CO content.

Check the temperature of *the float housing* by regularly feeling it with your hand. *The float housing* should feel “cold”, that is, it should not exceed room temperature.

To be safe, setting and measuring the CO content should be carried out within 3 minutes after the coolant thermostats open.

If *the carburetor* adjustment cannot be done within the stipulated time, a simple trick can be applied. Rev up the engine as much as possible within the approved value of the tachometer for about one minute. This will allow coolant to circulate in *the radiator* and give the engine the opportunity to cool, while at the same time increasing fuel consumption and can cool *the float housing.* This method can also be used if you are unsure of the engine temperature.

For connection of CO meter, see separate instructions.

5.26.9 **Carburetors – CO content setting**

Below is a guide for adjusting the CO content *of carburetors* . Allow the adjustment work to take time, and carry it out with the utmost care. This will improve fuel economy, operational reliability and reduce wear, not least regarding *the chain transmission.*

Procedure:

1. Remove *the air cleaner.* (See Chapter XXX, *Air Cleaner)*

2. Release *the ball link arms* on each *carburetor.*

3. Make sure that *the Throttle Body* with *Shaft* and Mechanism runs smoothly without bundle.

4. Check that the *Cold Start Control* lever is in the lower stop position, and that *the Fast Idle Screw* is not touching the lever. Adjust if necessary. (See picture below)

5. Check the level in the shock absorber cylinder. If necessary, top up with ATF oil. (see above)

6. Make sure the instrument panel's *Carburetor Air* knob is set to "0"

7. Press *the Vacuum Piston* down against *the Bridge* and screw the fuel nozzle with *the Adjustment Screw* until *the Nozzle* touches *the Vacuum Piston.* Then adjust *the Adjustment Screw* outwards 1 ½ turns.

8. Warm up the engine at 1500 rpm until *the Coolant Thermostats* open. That is, when the upper *Radiator Hose* starts to get hot, *the Thermostats* have opened.

9. Adjust the idle speed to approximately 700 rpm with *the idle speed screw.* Since there are four *carburetors,* this is a laborious procedure. Be as careful as possible, carefully screw in one screw at a time, and at the same time listen carefully to how the engine behaves.

10. Adjust *the Volume knob* from the default setting of 2 turns.
Unscrewed *screw,* so that the best idle speed is obtained.

11. Check the air flow through all *the Carburettors* using a *Synchrotest.* Adjust *the Throttles* with the idle screws
until *the Synchrotest* gel shows the same results for all four *carburetors.*

Carburetors – CO content setting

12. Turn *the Fuel Nozzle Adjustment Screw* outward until the engine starts to run unevenly. Then turn *the Adjustment Screw* inward until the engine starts to run unevenly, counting the number of revolutions at the same time. Set *the Adjustment Screw* between the two extreme positions. Repeat the procedure for the other *Carburetors* until the engine runs as smoothly as possible.

13. Then adjust the CO content using the engine's CO meter. First adjust the value for *Carburetor* 2 and 4, then for *Carburetor* 1 and 3. The connections should therefore first be in the exhaust pipe for *Cylinder* 6 and 14, then in the exhaust pipe for *Cylinder* 2 and 10. To get the best value, move the CO measurement between these pairs several times during the adjustment process. Tap *the vacuum chamber* lightly with, for example, the handle of a screwdriver before each reading. NOTE! Pay attention to

the time factor is 3 minutes!

14. With *the Volume Screw/ Air Screw,* adjustments to the CO content can be made within small deviations. If the screw is turned outwards, the CO content is reduced.

15. Reassemble and adjust *the ball link arms* on each *carburetor.*
Adjust the arms so that when the control is against the stop, there should be a play of approximately 0.5mm between the lever arm and the damper shaft driver.

16. Make sure *the throttle* mechanism runs smoothly without binding. Lubricate if necessary. Also tighten the *throttle* mechanism return spring if necessary.

17. Adjust *the Fast Idle Screw* until it just touches *the Cam Disc* at a point 11 – 13 mm from the top, as *the Cam Disc* rotates upwards. Adjust so that the engine speed is approximately 1100 - 1300 rpm.

18. Install *the Air Purifier* with its hoses and pipes, but leave it standing.
open.

19. Readjust the idle speed to 500 – 700 rpm. Check the air flow through all *the carburetors* again using *the Synchrotest.*

20. Close *the Air Purifier.*

See additional information on the following pages.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

Some of the previous points clarified:

Point 4

Check that *the Fast Idle Screw* is not touching *the Lever.*

Check that the *Cold Start* Control *Lever* is in its lower stop position.

Point 13

An analysis instrument was used to adjust the CO content. The instrument is rebuilt but has a built-in cooler to cool the exhaust gases. This is because for the Herkules 1934, measurements are made near *the top of the cylinder* where the temperature of the exhaust gases is so high that they can damage the instrument.

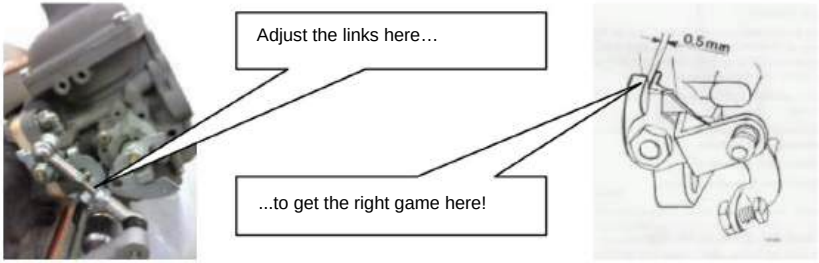
Gas test instrument	G4125	Gunson

Connection should be made in..... with..... of.....for..... as.....

TEXT & IMAGE

Points 15 and 16

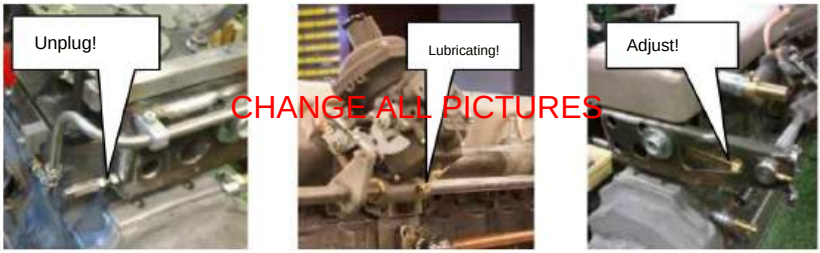
Once *the carburetors* have been exposed, inspection and any adjustments can be made so that there is a free play of 0.5mm on *the carburetor* control arm. (see picture)



This clearance must be present so that adjustment with the idle screw can be made individually for the four *carburetors*.

During the above work, if necessary, disengage *the throttle cable* and ensure that *the throttle control* moves freely and easily without a tendency to bind.

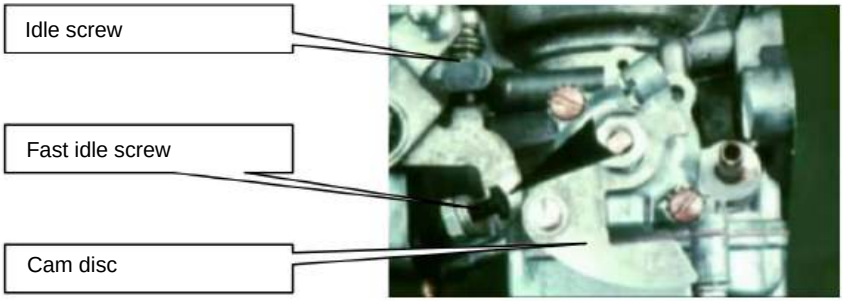
- Lubricate the linkage system with Omega grease if necessary.
- Adjust *the throttle control* return spring if necessary .



Connection of equipment for checking CO content.

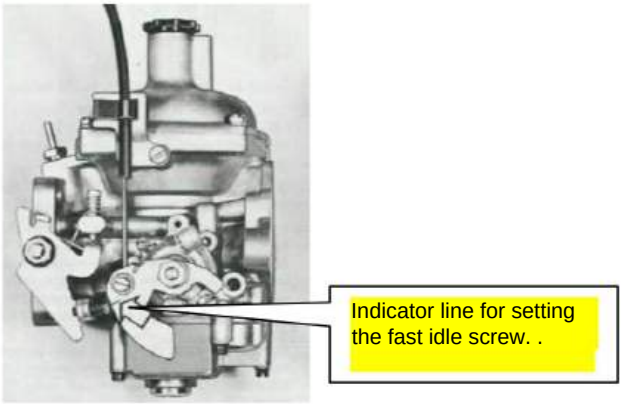
Point 17

Adjust *the Fast Idle Screw* until it just touches *the Cam Plate* at a point 11 – 13 mm from the top, as *the Cam Plate* rotates upwards.



Through this function with the Fast Idle Screw, you can, from the driver's seat, if necessary, by pulling only a small amount on *the Choke lever* to increase the idle speed during the engine's warm-up period. This is before pulling so far that it affects *the Cold Start Device.*

Tip! By depressing the throttle slightly before pulling *the choke lever*
This reduces wear on *the cam disc.*



5.26.10 **Carburettors – Diaphragm replacement**

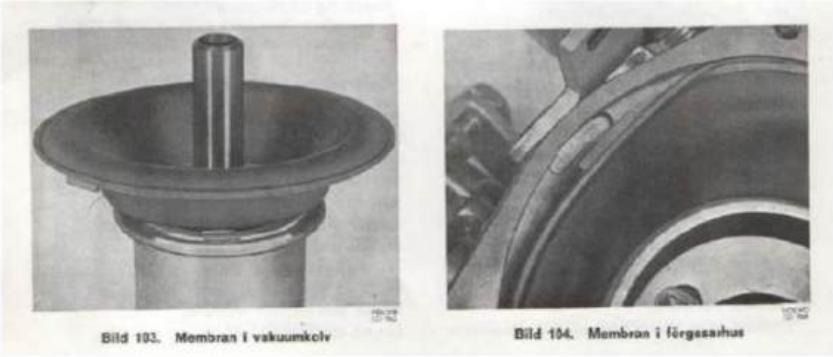


Bild 103. Membran i vakuumkolv

Bild 104. Membran i förgasarhus

The following applies to replacing the membrane:

1. Unscrew *the Damping Piston,* loosen the screws and remove *the Vacuum Chamber Cover* and the spring.
2. Pull up *the Vacuum Piston* with *Membrane.* Remove *the Membrane* by loosening the four screws. Clean *the Vacuum Flask.*
3. Install the new *Diaphragm* (103) NOTE! The rubber lug must fit into the groove *in the Piston .*
4. Lower *the Vacuum Piston* (104) NOTE! Fit the rubber lug. Install *Spring* and *Cover.*
5. Fill with shock absorber oil.

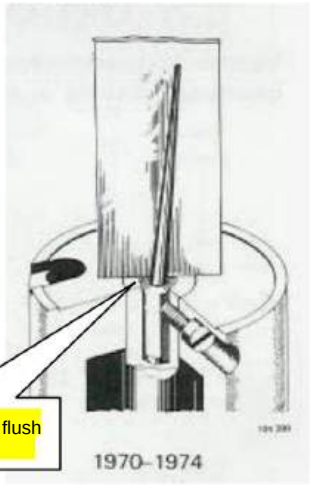
Note that there are rubber lugs on the membrane that must be fitted!

Note! Be careful not to bend or damage the needle!

5.26.11 **Carburetors – Fuel needle replacement**

1. Remove *the Vacuum Chamber Lid.* Lift out and clean *the Vacuum Piston.*
2. Loosen *the Fuel Needle* locking screw and pull the Spring-Mounted *Needle* out of *the Piston.*
3. Check the designation to ensure that the correct *needles* are being fitted.
4. Install *the Fuel Needle* with *Spring Suspension* in *the Vacuum Piston.* The flattened part of *the Spring Suspension* should face *the Locking Screw. The needle* should be inserted until the sleeve is flush.

   with *the Piston.*



5.26.12 **Carburettors – Damping device**

If the engine malfunctions during acceleration, this may be due to incorrect play in *the damper piston.*
The piston's axial play should be 0.5 – 1.1mm.

According to Volvo's recommendation, in the event of faults, *the piston* should be replaced completely.

For the damping system to function flawlessly, it is important that the damping level is correct. The prescribed periodic check is every 10,000 km.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

For your own notes:

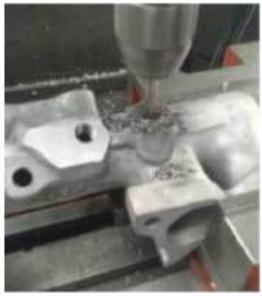
5.27 Plenum - Intake pipe

5.27.1 Plenum – General information

For the Herkules 1934, a *Plenum* has been manufactured that extends along the full length of the engine and supports the four included *Carburettors.* In addition to the original Volvo *Intake Manifold,* the starting material has also been ÿ48mm rusty scaffolding pipes. These have been joined together by flux welding, which has later been ground to a uniform appearance.

5.27.2 Plenum - Plugged holes

Some of the holes not used in the original *intake manifolds* have been plugged with *LocTite Chemical Metal 3463.* In some cases, such as the crankcase ventilation pipes, new holes have been drilled and threaded "half in half", which means that the greatest possible care must be taken with these threads. **Do not loosen them unless absolutely necessary.**



NOTE! Extra care must be taken with holes that are threaded “half in half” (cast iron versus metal putty) as they are fragile.

Söderström - HERCULES 1934

Straight 16-Cylinder

Engine components

5.27.3 **Plenum - Assembly procedure**

A certain amount of caution is required to assemble and disassemble the engine's *Plenum* . The principle of caution should apply, not least, so that the thin-walled weld joints between the pipe parts are not damaged. Since there are *guide rings* in *the cylinder head,* several parts of the engine's *Plenum* must be loosened at the same time. This means that the three M12 studs in the middle brackets must be completely loosened. For this reason, these three M12 studs must be loosened

studs **should not be glued with LocTite.** Other studs should be glued with **LocTite** – **Medium.**

NOTE! Loosen the three middle studs that hold the engine plenum completely when removing. DO NOT glue these screws with LocTite.

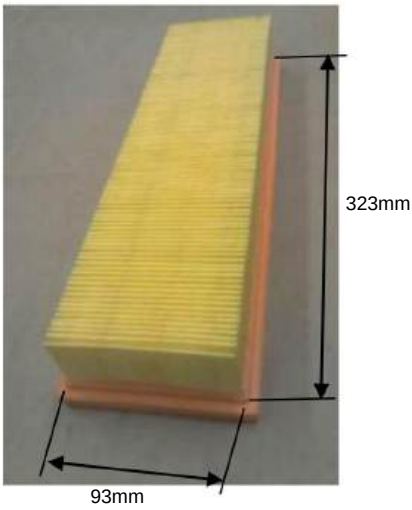
5.28 Air purifier

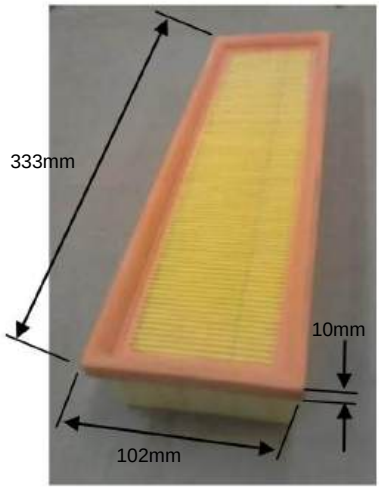
5.28.1 Air purifiers – General information

The air purifier is made of sheet metal in two halves, which are connected by stainless steel piano hinges. Blah blah XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Filter element – Specification:

Article number:	51-160	Car theme
• External dimensions:	333mm x 102mm x 50mm	
• Mounting dimensions:	323mm x 93mm	
• Height of clamping edge:	10mm	
• Suitable:	Citroen Berlingo, C2, C3 Peugeot 1007, 207, Partner	





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Straight 16-Cylinder

Engine components

Sheet metal... blah blah....bent....connection from Crankcase Ventilation...blah blah...

5.29 Crankcase ventilation

The crankcase ventilation for the Hercules 1934 consists mainly of two parts, the lower and the upper system. After a number of calculations it can be concluded that there is a great risk of underestimating *the Crankcase Ventilation*

importance. Unburned gases are constantly pushing past the engine's *pistons* and which can cause great destruction if they happen to ignite in *the Crankcase* . Therefore, the Ventilation has .....Blah blah blah

… do not underestimate the importance of …

Explain distance to Banjo nipple... copper paste!

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Straight 16-Cylinder

Engine components

For your own notes:

6 Transmission

6.1 Transmission: Crankshaft – Rear wheel

6.1.1 Transmission – General information

The power transmission from *the crankshafts* is via *chains* to a *main shaft* placed in *the trough* , further to a *flywheel, clutch, gearbox, cardan shaft* and *rear axle.* Due to problems with torsional vibrations, it is not possible to manufacture a *crankshaft* as long as required for a straight 16-cylinder engine. This fact, as well as the impracticality of a long engine hood, is the reason why such an engine has never been built to date. The problem has been solved for the Herkules 1934 with the *main shaft* placed in *the trough* .

Performing work inside any of the Engine Blocks requires the entire transmission to be dismantled, and the Engine Blocks to be detached from the Trough from the rear.

6.1.2 Transmission - Integral machine elements

- Original *Vevaxlar* i B20-block.
- *Chain sprockets* mounted on each *crankshaft.*
- *Main shaft* in *Trough* including *Flywheel hub.*
- *Main* and *Thrust Bearings* for *Main Shaft.*
- *Chain drive* on *Main shaft.*
- *Tensioning elements* for *chain drives.*
- *Chains.*
- *Chain tensioner.*
- *Flywheel* including *thrust bearing holder* and *clutch.*
- *Gearbox / Propeller shaft*
- *Rear axle*

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Straight 16-Cylinder

Transmission

OVERVIEW PICTURE SHOWING THINGS FROM PREVIOUS PAGE

6.2 Main shaft

6.2.1 Main shaft - Material

The main shaft dimensions are well-suited for its task. The choice has been made to minimize the risk of unforeseen oscillations which are difficult to predict.

Make: **THIS IS CEAX 280 Ø50 h8**

Length:	**1990mm**
Weight:	**about 31kg**
Measured diameter:	**49.97mm**
Designation according to EN 10027-1	**19MnVS6**

Mechanical values:

• ReH min	450 N/mm²
• Rm	min. 620 N/mm²
• A5	min 19%
• Hardness approx.	HB200 – 240
• Impact strength	min 27 J at -20°
• Day	0.4 – 0.8 my

Chemical analysis:

• C	0,16 – 0,20
• And	0,20 – 0,50
• Mn	1,40 – 1,75
• P	max 0,025
• S	0,015 – 0,025
• In	0,08 – 0,12

6.2.2 **Main shaft - Strength calculation**

The assumption is that each *Block* develops 170Nm. Due to larger intake valves, flattened *Block/ Cylinder Head* and thinner *Cylinder Head Gasket* this is just an assumption. If Ethanol is used as fuel, this assumption may also change.

(Newton was intentionally used in formulas for simplicity)

Torsional resistance

Wv = ÿ x d³ = **24.544N**

16

Tangential stress

ÿmax = Mv = 170Nm x 4block = 680.000Nmm = **27N/mm²**

Wv 24.544 24.544

Shape change

Shear modulus

G = Shear modulus

E = Modulus of elasticity = 210,000

v = Fish constant = 0.3

Iv = Torsional moment of inertia

G = E = 210,000 = **80.769**

2 (1+v) 2,6

Iv = ∏ d□ = 1.9634.954 = **613.592**

32 32

Torsion twist

ÿ **=** Mv x L = 680,000Nmm x 1990 = 1,353,200,000 = **0.027rad**

G x Iv 80.769 x 613.592 49.559.212.250

0,027rad x 57,3 = **1,55°**

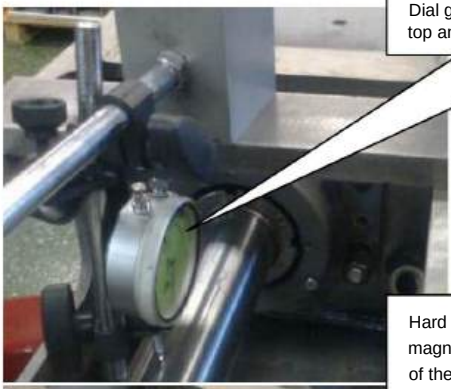
Summation:

Approximately 1.5 degrees of total shaft rotation at maximum torque if all torque is applied to the front end of the shaft and the counterweight is at the coupling end. In practice, the torque distribution is spread over the entire length of the shaft, **with the rotation clearly well below one degree.**

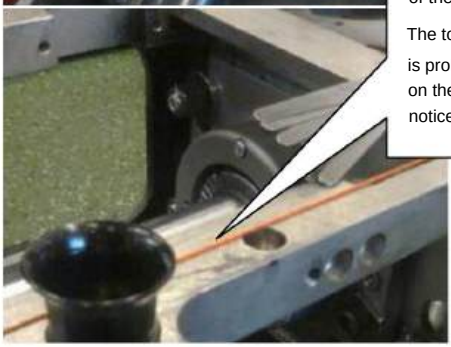
6.2.3 **Main axis – Straightness, Thoughts and reflections**

The next page shows an image from the CAD where it is graphically stated how the curvature of the trough affects the measurement result of *the Main Axis.*

By placing a dial indicator on a plate and measuring down *to the Main Shaft* , the following measurements have been measured.



Dial gauge for measuring between *the trough* top and *the Main Shaft.*

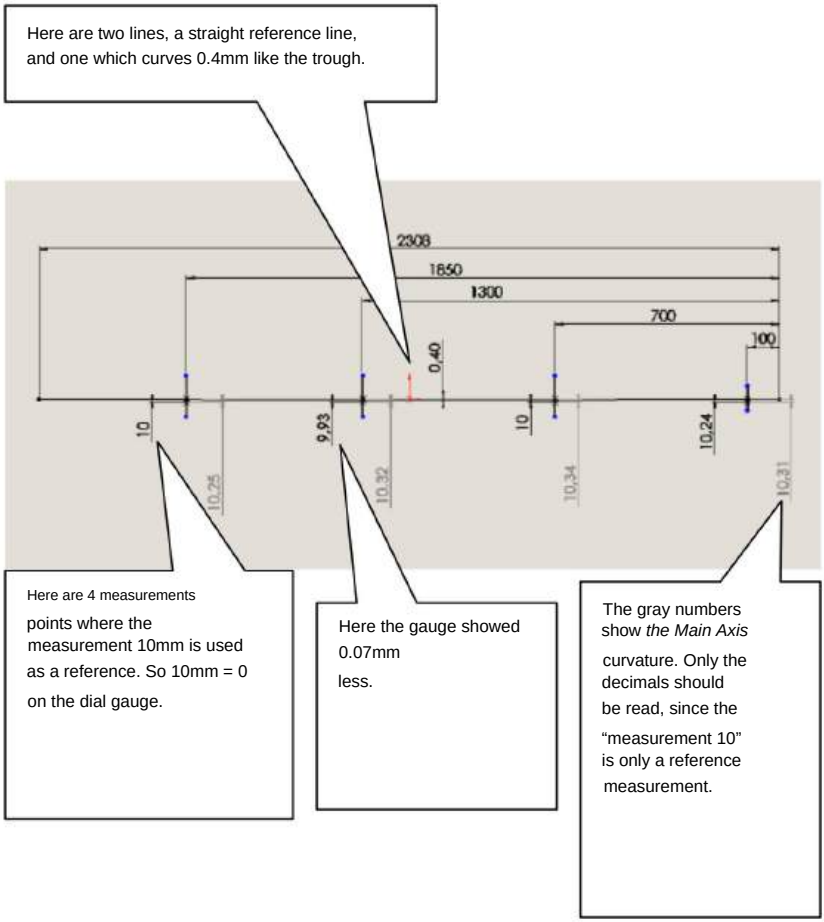


Hard tension Simple card, caliper and magnifying glass to measure the curvature of the trough.

The tolerance with this measurement method is probably +/-0.03mm. With 0.05mm on the feeler gauge, a clear deflection is noticeable on the string.

Due to welding work on the top of *the Trough* after face milling, a curvature was unfortunately created. The curvature is in the order of 0.4 +/-0.03mm, and is therefore negligible.

Conceptual model for controlling the curvature of the main axis



The measurement thus shows that the main axis curves 10.34 – 10.25 = 0.09mm

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Straight 16-Cylinder

Transmission

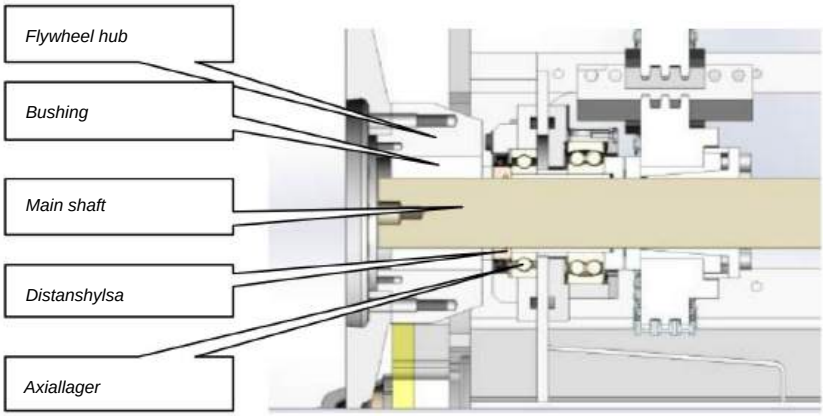
For your own notes:

6.3 Flywheel hub

6.3.1 Flywheel hub – General information

According to the original design, *the flywheel hub* was to be mounted with a friction-type clamping element. After a number of test assemblies, it was found that *the flywheel* had a play of about 0.35mm, which is why it was decided that *the flywheel hub* should be locked with LocTite instead. A spacer sleeve, so-called *bushing,* was manufactured to fill the space previously occupied by the clamping element. The following observations came to light during the work.

The picture shows *the flywheel hub* after it glued to the filler bushing and then to *the Main Shaft.*



6.3.2 **Mounting Bushing to Flywheel Hub**

• Sleeve diameter dimensions:	ÿ50/80
• Length, clamped in hub:	about 69mm
• Fit to hub before blasting:	Play 0.02mm
• Surface treatment before gluing:	Blasting
· LocTite:	648
· Pressing force:	that's 12 tons

Observations:

Since *the bushing* ran with play in *the flywheel hub,* it was assumed that the peaks that the blasting could create would be smoothed out during the pressing process. This turned out to be a big mistake.

The frictional heat generated by the pressing hardened the LocTite prematurely, which is why pressing could hardly be carried out with great difficulty. After 3-
4 powerful slamming "shots" finally landed the bushing at a compressed length of about 69mm.
Whether this negatively affected the bonding cannot be determined at this stage.

6.3.3 **Mounting the sleeve to the main shaft**

• Sleeve diameter dimensions:	ÿ50/80
• Length, tucked in over the shoulder:	about 66mm
• Fit to hub before blasting:	Game 0.05mm
• Surface treatment before gluing:	Blasting
• LocTite:	648
• Pressing force:	Easy running

Observations:

After the misjudgment regarding the impact of blasting on the diameter measurement, a greater degree of caution was taken when measuring the clearance for *the Main Shaft.* was determined. The clearance was then increased to 0.05mm. It turned out during the gluing that *the flywheel hub* could be pushed into place without any difficulty whatsoever.
After the glue had hardened, the axial runout was checked, which indicated that grinding was necessary. The grinding was carried out with a grinding spindle borrowed from Myká, a coordinate table and a holder welded together from scrap. With the help of a hand drill, *the main shaft* could be rotated at the appropriate speed.

The grinding resulted in the axial runout of the flywheel hub changing from 0.08mm to 0.02mm.

Grinding operation of flywheel hub.

6.3.4 **Gluing of Flywheel Hubs – Strength Calculation.**

Bushing to Flywheel Hub ÿ80mm, Length 69mm

Loctite 648, strength 30N/mm²

Strength:

80 x 3,14 x 69 = 17.333mm² x 30N/mm² = **519.990N**

Moment

680.000Nmm / 40 = **17.000N**

519.990 / 17.000 = 30

Conclusion: If the gluing of the Bushing to the Flywheel Hub is carried out adequately, it will hold 30 times the nominal torque.

Bushing against Main Shaft ÿ50mm, Length 66mm

Loctite 648, strength 30N/mm²

Strength:

50 x 3,14 x 66 = 10.362mm² x 30N/mm² = **310.860N**

Moment

680.000Nmm / 25 = **27.200N**

310.860 / 27.200 = 11

Conclusion: If the gluing of the Bushing to the Main Shaft is carried out adequately, it will hold 11 times the nominal torque.

6.3.5 **Pinning of Flywheel Hub, Bushing and Main Shaft**

Despite the calculated strength of the adhesive joint, it was still decided to pin the parts together. This was due to the uncertainty regarding the quality of the adhesive. A drilling template with hardened drill bushes was used to assist in drilling the holes, which was screwed into place in the existing holes.

The workflow has been as follows:

- Drill template has been mounted in place
- Using a drilling machine, Ø5mm face milling has been carried out on the relevant surfaces.
- Drilling with Ø3.8mm drill bit
- Brotschning med handbrotsch Ø4H7 (4,0 – 4,012)

- Hardened cylindrical pins with a length of 15mm have been used as pins between *the bushing* and *the flywheel hub* . The effective length used is only 12mm.
- Hardened cylindrical pins with a length of 20mm have been used as pins between *the Bushing* and *the Main Shaft* . The effective length used is only 17mm.
- Pin diameter Ø4m6 (4.004 – 4.012)

With the tolerances on the pins and holes above, the pins should fit in the holes with a good fit. In practice, this could not be achieved, resulting in a gap of about 0.02 – 0.05mm. The point of this was that the holes and pins could be coated with LocTite 648 and the pins could then be tapped into the holes with relative ease.

6.3.6 **Calculation of strength for pinned joints**

Incoming materials

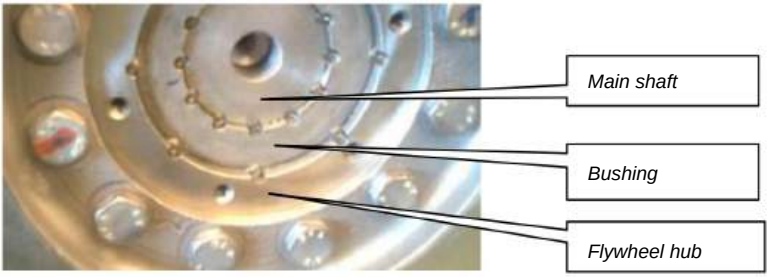
Detail	Mtr. beteckn	The beteckn	Yield strength	Permissible voltage
None	SS2172	S355JR	310N/mm²	207 N/mm²
Bushing	SS1672	C45E	320N/mm²	200 N/mm²
Axel	SS2142	19MnVS6	390N/mm²	260 N/mm²
Pin Ø4 CPK	DIN625		800N/mm²	600 N/mm²
LocTite	648		31N/mm²	31 N/mm²

As can be seen from the above list, it is not the pin that is the weak link. Therefore (according to the above) one can view the aspect of solidity from two perspectives, according to:

1. ...if the LocTite which holds the pin in place in the overly large reamed hole gives way, resulting in play.
2. ...when the hole edge pressure for the steel parts becomes so great that the joint total owner.

We therefore assume in the following calculations that the LocTite for cylindrical fastening of *the flywheel hub* (as previously) does not fulfill its function at all. This is to determine whether *the flywheel hub* will remain in place even if the LocTite bonding comes loose.

6.3.7 **Surface pressure LocTite 648 for pin joints**



For pinned connection between *Bushing* and *Flywheel Hub*

Diameter joint	Ø80mm (Radius 40mm)
Pin Diameter	Ø4mm
Pin Length	12mm
LocTite 648	30N/mm²
Number of pins	8st
Moment Motor	680Nm

4 x 12 x 30 x 8 /2 = **5.760N**

680.000Nmm / R40 = **17.000N**

5.760 / 17.000 = **34%**

LocTite against pins in Ø80 joint holds 34% of engine torque

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For pinned connection between *Bushing* and *Main Shaft*

Diameter joint	Ø50mm (Radius 25mm)
Pin Diameter	Ø4mm
Pin Length	17mm
LocTite 648	30N/mm²
Number of pins	12st
Moment Motor	680Nm

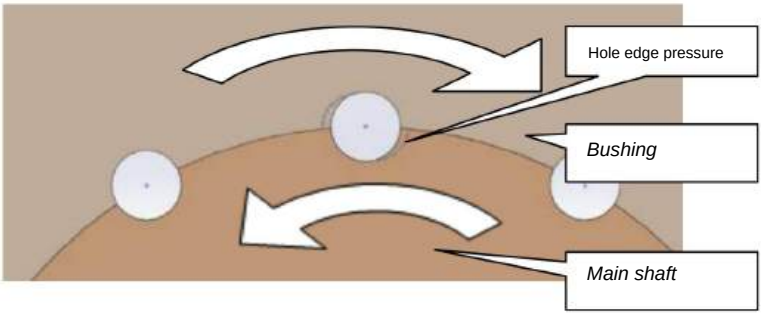
4 x 17 x 30 x 12 /2 = **12.240N**

680.000Nmm / R25 = **27.200N**

12.240 / 27.200 = **45%**

LocTite against pins in joint Ø50 holds 45% of the engine torque

6.3.8 **Hole edge pressure for pinned joint**



For pinned connection between *Bushing* and *Flywheel Hub*

D / 2 x L x number of pins

Ø4 / 2 x 12mm x 8 = **192mm²**

680.000Nmm / 40 = **17.000N**

17.000 / 192 = **89N/mm²**

For pinned connection between *Bushing* and *Main Shaft*

D / 2 x L x number of pins

Ø4 / 2 x 17mm x 12 = **408mm²**

680.000Nmm / 25 = **27.200N**

27.200 / 408 = **67N/mm²**

The hole edge pressure at the flywheel hub pin is clearly approved for the engine's maximum torque.

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Straight 16-Cylinder

Transmission

For your own notes:

6.4 Flywheel – Starter ring

6.4.1 Flywheel – General information

The flywheel originally comes from Chevrolet with unknown history. Originally the flywheel had cast balance weights, which were turned away to get a completely symmetrical design. The starter ring was removed before machining by heating with a gas burner. When reassembling it, the starter ring was heated in the oven, while the flywheel was cooled in a freezer. The parts were assembled with LocTite 128467.

The hub was ground for the best fit against the flywheel by MYKÅ AB.

Flywheel starter ring glued with LocTite

6.4.2 **Flywheel / Hub – Technical specification**

• Screws Flywheel - Hub • Tightening torque • Screw locking	M10 x 55 Quality 8.8 5.5 kpm (55 Nm) LocTite – Medium
• Steering stick Article No.: ISO7379 12x30/M10 Wiberger	Fitting screw Quality 12.9
• Screw locking • Tightening torque	LocTite – Medium 5.5 kpm (55 Nm)

Space for your own notes:

6.5 Coupling

6.5.1 Connection – General information

The clutch for the 1934 Hercules is a single-plate multi-plate clutch originally intended for GM, such as Blazer, Suburban, Pickup, etc.

• Manufacturer	LUK / Rock Auto
Article no.	04-902
• Type	Enskivig lamell
• Diameter	12”
• Max moment	813Nm / 600 lb ft

Pressure plate, clutch disc, release bearing and centering tool.

The release bearing in the picture is not used for Hercules.

6.5.2 **Balancing – Mainshaft, Flywheel and Clutch**

Due to the dimensions *of the Main Shaft,* it has been difficult to find a suitable method to perform dynamic balancing. Dynamic balancing involves placing the shaft in a balancing machine, rotating the shaft and reading the unbalance value on the machine's dashboard.

By drilling appropriate holes, balance can therefore be created within appropriate values.

For *the Main Shaft* with *Flywheel* and *Coupling,* static balancing has therefore been applied for HERKULES 1934. This means that the shaft is placed in special holders with easy-rolling wheels. In the event of an imbalance, the shaft rolls on the wheels so that the imbalance, with the help of the earth's gravity, ends up at the bottom.

During balancing, it turned out that the balance was absolutely excellent.
Using a magnet that was moved between different positions, it was determined that the imbalance is less than 5 grams.

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Transmission

Clutch – Release bearing:

Not there yet!

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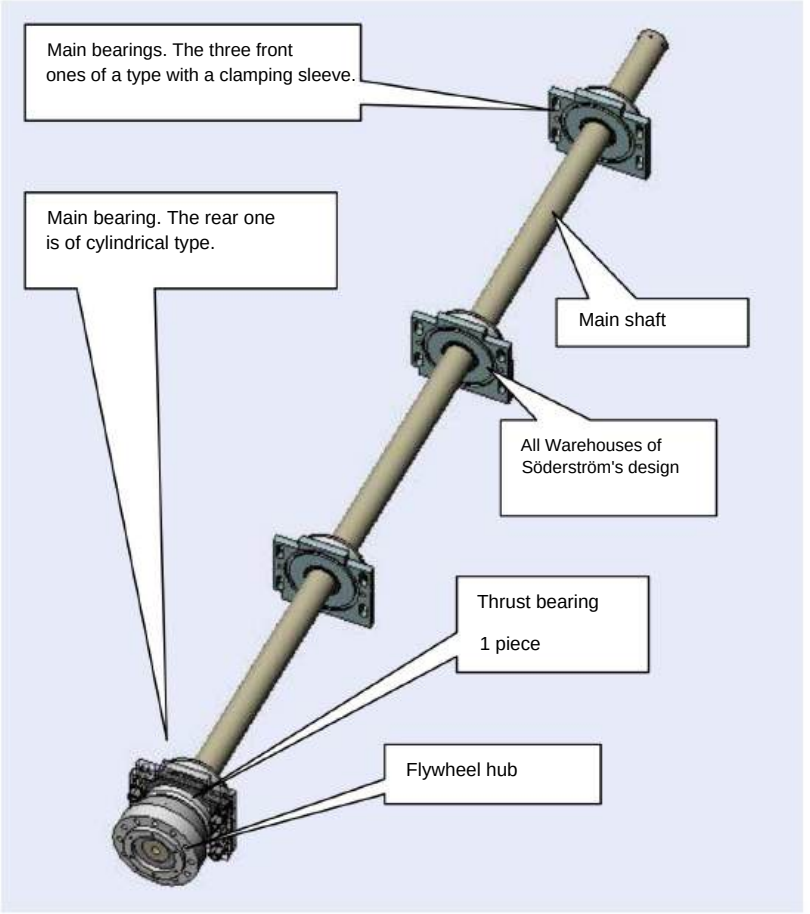
Transmission

For your own notes:

6.6 Main Shaft Bearing

For *the Main Shaft* in Herkules 1934, two types of bearings were used:

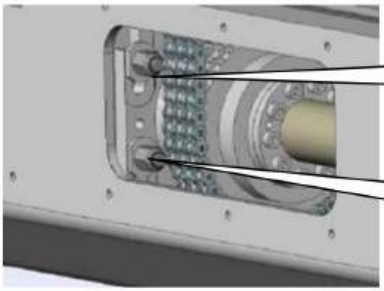
• Main bearing	Spherical double row ball bearing
• Thrust bearing	Deep groove ball bearings



6.6.1 **Bearing housing – Screw connection**

Screwed joints – General information

The bearing housings have slotted grooves which have been added to make it easier to loosen *the bearing housings* and lift up *the main shaft* when installing *chains.*
The reason is that *the chains* are riveted (without chain locks) due to the high chain speed. The length of the slots is about 20mm. This has the disadvantage that the clamping surface for the screw connection is reduced. To get good support for the screw connection, **hardened washers** should always lie over the slots as shown.



All *bearing housings* are screwed with M12 screws, which in many cases are welded together to form a yoke of 2 screws. The quality of the screws must be 8.8 in order to achieve adequate preload. This also means that the sleeves that are mounted in any case are required to get a sufficiently long clamping length on the screw connection.

When disassembling, mark and note where screws, washers and sleeves were installed.

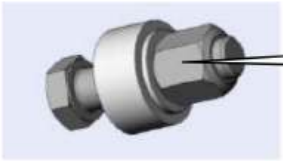
In general, it can be said that against the oval screw slots that are milled in *the Bearing Housings* there should always be a 4.6mm hardened washer. Under the screw head or nut for *the Main Bearing* there is usually a flat washer, the exception is if there is already a hardened washer there. The flat washer is of the type: BRB Ø13x2 8.8 quality which means that the washer is marked with 3 punched points. For screw joints that hold *Main Bearings* 13-16 at *the Thrust Bearing,* the head of the special screws in *the Screw Yoke* should rest against the rear trough wall without any form of washer. The head of this *Yoke is a nut* that is glued rigidly to the screw and should not be loosened. The nuts are also welded together as a yoke.

NOTE! All screws are locked with LocTite – Medium, unless otherwise stated.

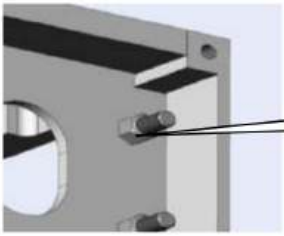
6.6.2 **Bolted joints – Surface pressure/Load capacity**

Screw, Torque	**M12 - 8.8 = 8.5 kilopondmeter /**71–97Nm
Preload force M12 - 8.8 = **3,940 kiloponds**	
All screws are locked with LocTite – Medium	

Bearing capacity, bearing housing area: 480mm² x 23.5 kp/mm² = **11,280 kiloponds**



Load capacity, Hardened nut against BRB washer: 140mm² x 64 kp/mm² = **8,960 kiloponds**



Load capacity, nut to rear trough wall: 198mm² x 35 kp/mm² = **6,930 kilopond**

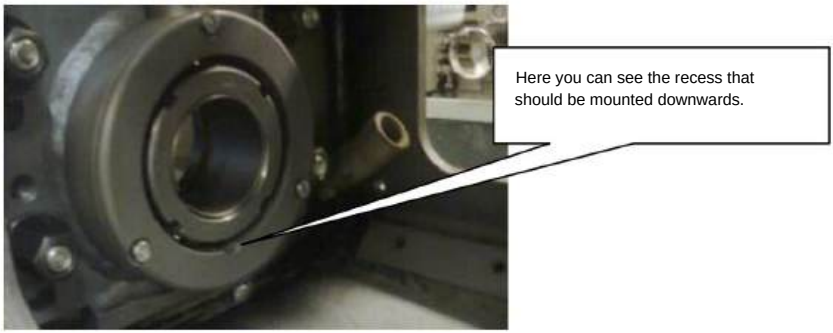
The above calculation therefore shows that the components and materials involved can withstand the prestressing forces that occur in the bearing screw connections.

6.6.3 **Main warehouse – General information**

Four spherical double-row ball bearings are used for *the main shaft* .
The bearings are sealed and thus lubricated with grease for life and therefore do not require any additional lubrication.

On each side of the outer ring *of the main shaft* spherical ball bearing there is a *weighing washer.* whose task is to keep the bearing centered in the housing and to minimize the risk of the bearing's outer ring rotating. The latter is due to the fit in *the bearing housing* being quite loose to allow the outer ring to move axially during temperature variations. An *End Cap* holds the parts together using three screws, M5 x 14mm.

Please note that the recess on the End Cap must be mounted downwards to prevent the oil level from rising too high in the bearing housing. This could otherwise cause contaminated oil to penetrate past the bearing seal and contaminate it.



Bearings 1 to 3 are held on the shaft using *a clamping sleeve* with associated *KM nut* and *folding washer.* Bearing 4 sits on a cylindrical surface and is clamped by a wave washer.

6.6.4 **Main warehouse – History**

There have been a number of changes to the design of the bearing, which has left some traces on various details. At the time of writing, both *the Main Bearing* and *the Thrust Bearing* are currently being changed for the third time in a row. For *the Main Bearing ,* the first three *Bearings* are now equipped with *a Clamping Sleeve* and the rear one has a cylindrical fit. The inner ring for the latter is held in place by means of *a Washer.*

Regarding the history of the rear *Main Bearing ,* there is a chain of events to follow. Since *the Tensioner* that was supposed to secure *the Flywheel Hub* did not fulfill its function, *the Hub* was glued in place against *the Main Shaft.* This made it impossible to mount either *the Main Bearing* or *the Thrust Bearing* as originally intended. This meant that *the Main Bearing* lost its *Clamping Sleeve, and* a number of bushings and spacers had to be manufactured, including a bushing to change *the Main Shaft* diameter from Ø50 to Ø55 at the rear bearings. Since the shaft diameter was changed, due to the lack of a suitable bearing dimension for *the Main Bearing, the Thrust Bearing* also had to be replaced.

This is the reason why there are 2 spacers on the back of *the thrust bearing.*

It may seem strange that a bearing would wear more if it is less loaded, but de facto that is exactly how it is. If the load is too low, there is a risk of the rolling elements sliding and bouncing. Sliding rolling elements can destroy the functional surfaces through smearing or micropitting. In part of the design phase, it was therefore decided to use a type of *radial thrust bearing.*

After a number of trips back and forth, it was decided instead that the probability that such a bearing would be needed is so small that it is worth not doing so. The future will tell if it was a stupid decision. The high weight, vibrations and all the dynamic rumbling of *the Main Shaft* must be considered to be able to handle the task of loading the bearings to the point that problems do not arise. Compared, for example, with an electric fan motor, which can operate for years without problems.

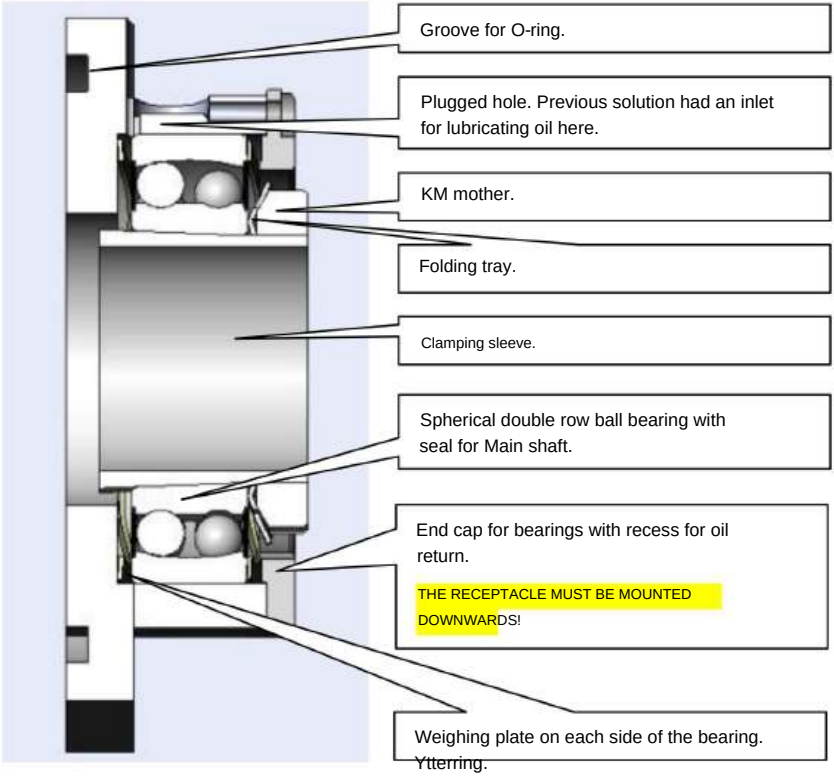
NOTE! Many hours of design are involved in the Main Shaft bearings. Consideration has been given to the assembly process, thermal expansion, lubrication, etc. It is therefore of EXTREME IMPORTANCE that the assembly process is carried out according to the following instructions to the letter. This is to avoid bearing failure.

6.6.5 **All Main Warehouses – Detailed Details**

• Welded bearing housing, Fit for bearing in housing H7 Made by Söderström			
• End caps for bearing			Manufacturer Söderström
housings • Double row Spherical Ball Bearing 2211 E2RS1TN9 SKF Tools Momentum			
• Double Row Spherical Ball Bearing 2211 E2RS1KTN9 SKF Tools Momentum			
• Clamping sleeve		H 311 C	SKF Tools Momentum
• Weighing washer		Ø98/88 x 0,5	Tools Momentum
• Hardened Washer t= 4.6mm Ø 13 DIN 6340			Wiberger AB
• High nut	Half-time 10	M12 DIN 6330	Wiberger AB
• O-ring, Main bearing housing 13-16 Ø119.2 x 5.7			Tools Momentum
• O-ring, Thrust bearing housing 13-16 ØXXXX small			Tools Momentum
• Screw		M6S M5 x 14 fzb	
• Screw		M6S M12 x diverse fzb	

For assembly of bearings in Bearing Houses, see point XXX.

6.6.6 **Warehouse No. 1 to No. 3 – Assembled parts.**

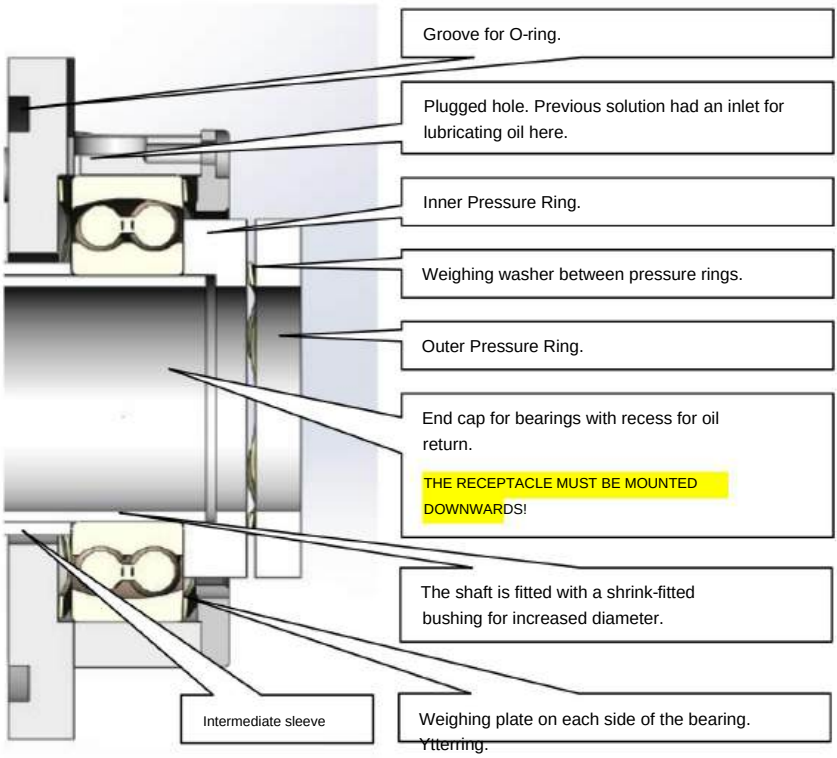


Cross-section of *Bearings No. 1 to No. 3* for *the Main Shaft.* The first three bearings for *the Main Shaft* are equipped with *a Clamping Sleeve.* Pay close attention to the assembly instructions for all of the engine's bearings, as bearing failure may otherwise occur prematurely.

For torque tightening of Bearing Housing, See point XXX Screwed joints –

Surface pressure/ Bearing capacity.

6.6.7 **Warehouse No. 4 – Assembled parts.**



Cross-section of *Bearing No. 4* for *the Main Shaft.* That is, the bearing closest to *the Thrust Bearing.* This bearing, unlike the other bearings for *the Main Shaft,* is not equipped with *a Clamping Sleeve.* Instead, the inner ring is locked with *a Wave Washer* to prevent rotation relative to *the Main Shaft. The Wave Washer* takes tension against *the Sprocket* via *the Outer Pressure Ring,* and transfers the force further out towards *the Flywheel Hub.* More on this later.

For torque tightening of Bearing Housing, See point XXX Screwed joints –

Surface pressure/ Bearing capacity.

6.6.8 **Main bearing – Lifespan**

Table data:

2211 E2RS1KTN9 – Bearing with clamping sleeve

d	DB	Load dyn./C	Load Stat./Co	Load Ext./Pu	Max Speed
50	100 25	27,6kN	10.6kN	0.54 kN	4500

2211 E2RS1TN9 – Bearing with cylindrical mounting

d	DB	Load dyn./C	Load Stat./Co	Load Ext./Pu	Max Speed
55	100 25	27,6kN	10.6kN	0.54 kN	4500

Lifespan issues

A couple of the biggest problems in making roller bearings last a long time are dirt and installation errors.

Dirt particles that become rolled in over time damage the bearings, significantly reducing their lifespan. This is why Herkules has sealed bearings.
Eventually, small particles will still contaminate the bearings and cause damage, which is one of the reasons why the engine is equipped with a *Cyclone cleaner* for the engine oil. *The Cyclone cleaner* is capable of cleaning particles smaller than one thousandth of a mm.

One of the installation problems is that the bearings are not perpendicular to the shaft.
That is precisely why the spherical bearing was created. Another is that the bearings are clamped axially against their shaft. For this reason, Herkules has *washers* on each side of the outer ring of the bearings, so that it can move freely.

If *the main bearings* for Herkules were not exposed to the above problems, among others, they would, according to SKF's calculation calculator, last between 66,800 and 1,000,000 hours.

Since it was decided in a later part of the construction phase not to

install a special clamping device for radial load and the future will tell if it was a stupid decision. The high weight, vibrations and all the dynamic rumbling of *the Main Shaft* must be considered up to the task. The formula for minimum radial load is: Co x 0.01 So: 10.6kN x 0.01 = 0.106kN.

The radial load per bearing should therefore be in the order of 11kg to prevent damage to the bearing. The main shaft weighs considerably more.

Söderström - HERCULES 1934

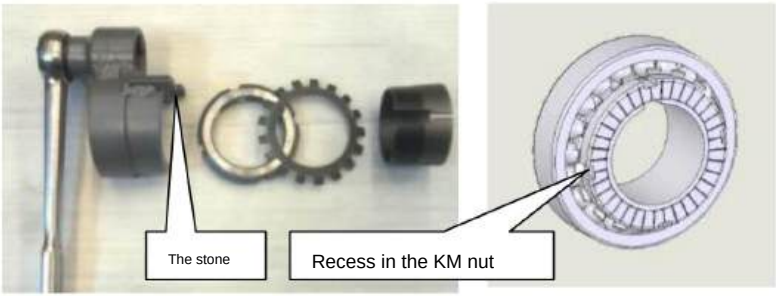
Straight 16-Cylinder

Transmission

For your own notes:

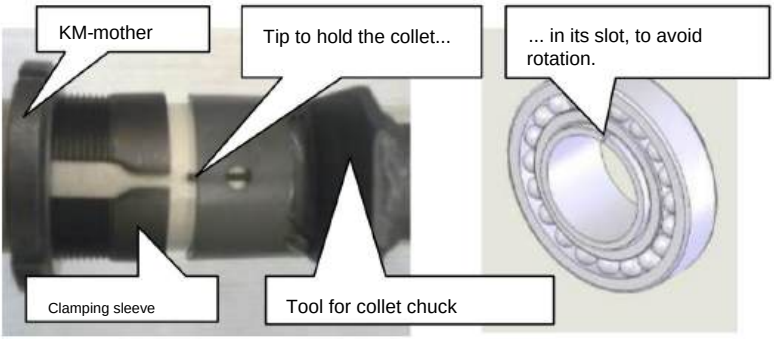
6.6.9 **Main bearing – Special tools, General**

MORE ABOUT THE SPECIAL TOOLS IN THE RELEVANT SECTIONS



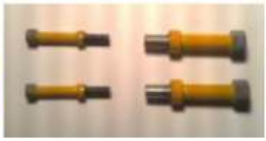
Tool of Söderström's design for pulling the KM nut onto the bearing's clamping sleeve. The tool's hooks grip the nut's recess. Access is increased with a ratchet wrench.

Main bearing – Special tools



Tool of Söderström's design for pushing the clamping sleeve into the bearing.
The tool has a tip made from (in this case) a cut 2mm drill shank. The tip fits into the slot in the collet. By holding the tool in place, the collet is prevented from rotating when the nut is tightened.

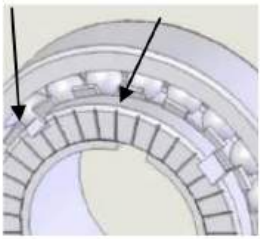
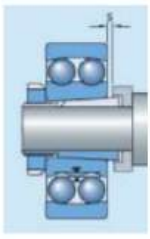
6.6.10 **Main bearing – Special tools, Centering screws**

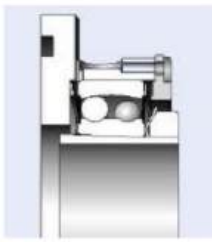


Centering screws, M5 and M8 respectively, for centering the bearings in *Bearing Housing No. 1 through No. 3.*
The screws with M8 threads should be threaded in as far as the shoulder, the M5 screws should then be threaded as far as possible.

Since the bearings of the Herkules *Main Shaft* have changed over time, a special assembly procedure is needed to avoid building harmful stresses into the bearings.

One of the problems is that the bearings mounted on *the clamping sleeves* is moved laterally during the tightening process, i.e. when *the KM nut* is tightened. According to SKF's recommendation, *the KM nut* should be tightened 75° after the nut has been installed by hand, or the bearing should be pushed up onto *the clamping sleeve* 0.40mm – measured with a dial indicator.



The bearing should be forced sideways into the housing by the centering screws. After the bearing has been placed against the shaft, the screws are removed and the bearing is driven further up the clamping sleeve with the KM nut until the bearing is in the center of the housing.

To solve the problem of the bearing being displaced laterally, the length *of the centering screws* is adjusted so that the bearing is displaced laterally, in the housing, 0.50mm* in the opposite direction. When installing, ***the KM nut*** should therefore **first be tightened only so tightly that *the clamping sleeve* is secured to *the main shaft.*** Then all *centering screws* should be dismantled. In this way, the bearing can be driven further up onto *the clamping sleeve* and finally, after 0.40mm, it will be centered in *the bearing housing.*

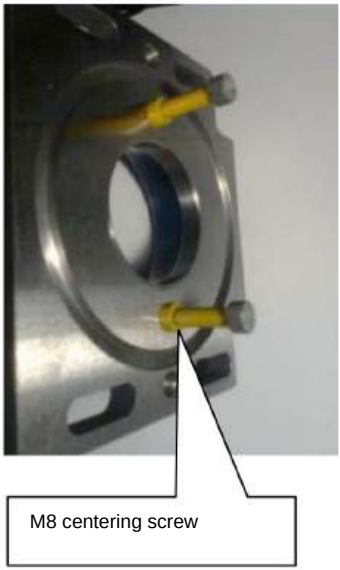
*The 0.10mm difference in the instructions above is to compensate for the approach which is probably 0.10mm towards *the Main Shaft* before further drive-up occurs.

6.6.11 **Main bearing – Assembly in bearing house**

To center the bearings in *Bearing Housing No. 1 to No. 3* during *the clamping sleeves* tightened, the temporary *centering screws* must be used. These must be removed before starting the engine.

These *centering screws* should **not** be used for Bearing Housing No. 4. Otherwise, the procedure is the same for this bearing, except for the mentioned tools.

NOTE! Using the centering screws is extremely important. This is to avoid building up tension in the bearing.



Main bearing – **Assembly in bearing house**

Procedure in bullet form:

• Start by screwing in the two *M8 centering screws,* from the back, **as far as they will go.** Tighten them firmly by hand.

• Turn *the Bearing Housing* over and place a *Scale Washer* in the bottom of the bearing location, over the two *Centering Screws.* Rotate *the Scale Washer* so that it does not touch the M8-*The centering screw.*

• Mount *the ball bearing* so that it rests against the wave washer which in turn rests against the two *centering screws.* Turn the bearing the correct way around, i.e. with the largest cone opening for *the clamping sleeve* facing down at the bottom of *the bearing housing.*

• Place a new *Scale Washer* over *the Ball Bearing.* Rotate the washer so that the scale is aligned with *the Centering Screws* (as per point below). That is, rotated like the first *Scale Washer* (point above) but with the highest scale mirrored.

• Install *the locking ring* with 3 M5 x 14 screws. Use **LocTite Medium - Tighten at 0.65kpm** which gives a pre-tensioning force of 3x 660kp = 1980kp (19.8kN)

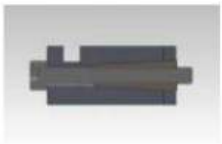
• Screw in the two M5 *Centering Screws* as far as they will go with firm hand force, so that the screws and *Scale Washer* are in contact with the bearing. Make sure that *the Scale Washer* is rotated correctly so that the screw does not press on the scale. (See point above).

• Place *the clamping sleeve* in the bearing (from the back), put on *the folding washer* and *KM-nut.* However, *the KM-nut* should only be threaded on a few turns to prevent the sleeve from getting stuck when *the main shaft* is threaded through all the bearings.

For Bearing Housing No. 4, centering screws or clamping sleeves should not be used, otherwise the same.

6.6.12 **Main bearing - Ø14 Guide pin**

To guide *the Main Bearing Housing* against *the Trough Wall* , Ø14mm slotted *Guide Pins* equipped with *Insert Cones were used.*



The Ø14mm *guide pins* with the associated *locking washers* are **marked so that they can be mounted in the correct location.**

Screw, Lock Washer M6 - 8.8 = **1.1 kilopondmeter /**11Nm M6 screw is locked with LocTite - Medium.

Screw, Cone The M4 - 12.9 = **0,15 kilopondmeter /**1,5Nm
cone is gently tapped inwards during the screwing process. M4 screw is locked with LocTite – Weak. Only a **small** drop at the large end of the cone, this is to avoid accidentally gluing it on. . the same cone.

Steering column – Disassembly / Assembly

NOTE! This is important. When disassembling, first unscrew the M4 screw completely to make sure the screw runs freely. Then screw the screw back so that there are a few turns left before the screw head contacts the slotted sleeve. Then tap the screw head to release the cone from the slotted sleeve.

When reassembling (after disassembly), **clean the thread with a tap and replace the screw with a new one.**

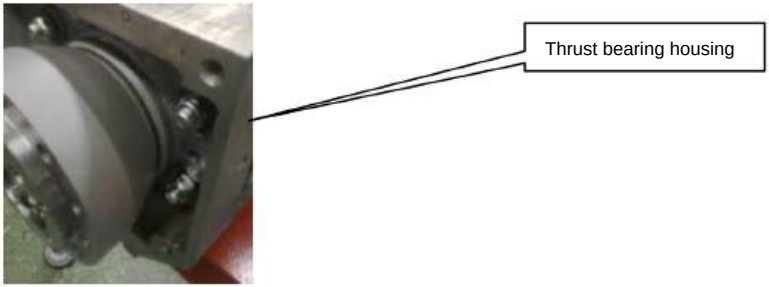
6.6.13 **Thrust bearings – General information**

To absorb the axial force that occurs when the driver depresses the clutch pedal, there is an *axial thrust bearing* in the form of a standard deep groove ball bearing. The bearing is dimensioned to withstand an axial load of
1,000kp (10,000N) for a number of hundred hours (i.e. when the clutch pedal is depressed). The bearing is protected by a standard seal and lubricated for life with high-temperature grease from the factory. The fit of the outer ring to the housing is relatively tight and the outer ring of the bearing is trapped between *the bearing housing* (against 2 filler washers) and the rear trough *wall.*

To keep the bearing loaded under normal driving conditions, a radial tensioning function has been designed which uses *disc springs* to hold the force.

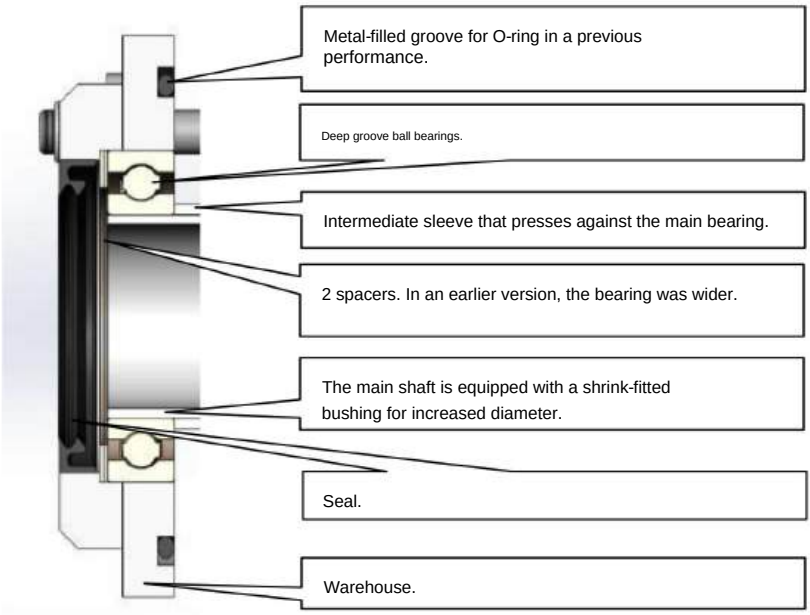
Thrust bearing – Detailed information:

• Welded bearing housing •		Manufacturer Söderström
Deep groove ball bearing	6011-2RS1/C3 GJN	Tools Momentum
• Sealing	Ø119,2 x 5,7	Tools Momentum
• O-ring, Thrust bearing housing 13-16	Øliten	Tools Momentum
• Hardened Washer t= 4.6mm DIN 6340		Wiberger AB
• Disc spring	SF-TAF 7962	Stockholm Spring
• Washer	BRB ØXXXX	
Mother	M12 NyLoc	

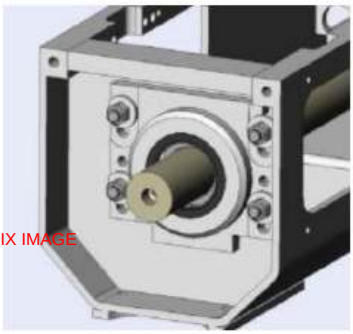


Bearing housing for thrust bearing. Here partially hidden behind the flywheel hub.

6.6.14 **Thrust bearing housing – Assembled parts.**



Cross-section of the bearing for the thrust bearing. At the back of *the bearing housing*
There are also 2 grooves for smaller O-rings. (Not shown in picture)



FIX IMAGE

PICTURE OF SMALL O-RING GROOVES

6.6.15 **Thrust bearing – Lifespan**

Table data

d	DB Load dyn./C Load Stat./Co Load Ext./Pu Max Speed			
50	90 20 37.1kN	23,2kN	0.98kN	10.000

Max. Axial load: **1,000 kp = 10 kN**

Lifespan issues

A couple of the biggest problems in making roller bearings last a long time are dirt and installation errors.

One of the installation problems is that the bearings are not perpendicular to the shaft. This may be one of Hercules' Achilles' heels, because the surface that *the thrust bearing* is not machined. Only time will tell if this will be a problem.

If *the thrust bearing* for the Herkules were not subject to this problem, it would last up to 710 hours according to SKF's calculation calculator. This is the time that the clutch pedal is depressed. Due to uncertainty factors in the calculation, it may be wiser **not to have the clutch pedal depressed more than absolutely necessary.**

To increase the service life of the thrust bearing, the following additions have been introduced:

- Increased bearing clearance — Additional designation C3
- High-temperature grease — Additional designation GJN

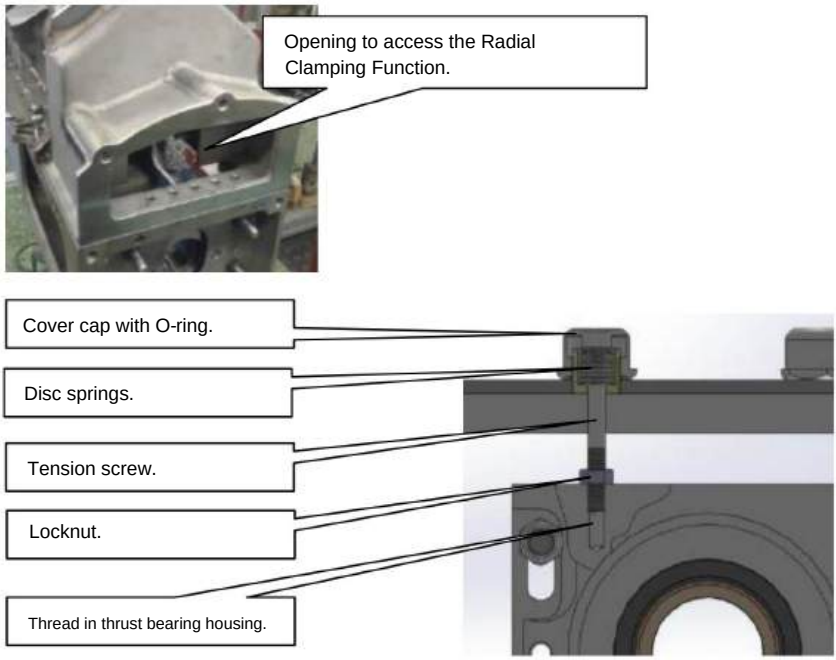
If in the future it turns out to be difficult to obtain a bearing with these additional designations, it is certainly possible to achieve sufficient function without them. However, this will result in a shorter bearing life.

6.6.16 **Thrust bearing – Radial clamping function**

In order for *the thrust bearing* to be loaded during normal operation, i.e. when the clutch pedal is not depressed, a *radial tension function* has been designed.

Radial clamping function – Detailed information:

- Sealing cap — Manufacturer Söderström
- Disc springs Ø16/8.2x0.6 SF-TAF, DIN 2093, No. 4269 Sthlms Spring
- Screw MC6S M8 x ??? 12.9
- O-ring Ø1.78 x 25.12 — Tools Momentum



Radial clamping function for thrust bearing housing. In the picture, the disc springs are not clamped together.

6.6.17 **Axial bearing, radial clamping function - Calculation procedure**

To obtain sufficient force to keep *the thrust bearing* radially seated, it is required that *The bearing housing* is so loose that it can actually move in a radial direction. For this purpose, *disc springs* are used for both retention and tensioning.

Calculations have been made as follows:

M12 screw holding bearing housing - Pitch 1.75mm

120º rotation angle (two hexagon flanks) then corresponds to L = approx. **0.582mm**

Disc spring No.: SF-TAF 7962 = 1363N when pressed down s= 0.95mm

1363 / 0.95 = **1435N per mm of depression**

1435N x 0,582mm = ca **835N**

So: By turning the nut two flanks, *the disc spring* is compressed approximately 0.582mm, which in turn presses *the bearing housing* with 835N per screw against *the trough wall.*

835N x 4 screws = 3340N

3340N x 0.10 (coefficient of friction for lubricated steel) = **334N**

It therefore takes 334N, (33kp) to move the bearing housing laterally (upwards)

M8 screw that radially tightens bearing housing - Pitch 1.25mm

120º rotation angle (two hexagon flanks) then corresponds to L = approx. **0.42mm**

Disc spring No.: SF-TAF 4269 = **502.5N** when pressed down s= **0.45mm**

So: By turning the screw two flanks, *the disc spring* is compressed approximately 0.42mm, which in turn lifts *the bearing housing* by approximately 500N per washer per screw.

By placing two disc springs inside each other, the force is doubled.

500N x 2 screws x 2 washers = **2,000N**

The bearing housing is therefore lifted with a force of approximately 2000N, (200kp)

Conclusion: With this procedure, the force that applies radial load becomes *Thrust bearing* 2,000N – 334N = 1,666N. The ball bearing is therefore loaded with 166kp, which can be considered a good value. However, empirical tests have shown that a 180º rotation angle (three hexagonal flanks) is a more suitable value to achieve a safe load for both joints.

6.6.18 **Thrust Bearings – Mounting Procedure Against Trough**

Procedure in bullet form:

1. Lubricate the surface of *the Trough Wall* where *the Thrust Bearing* is to be mounted with a thin layer of Omega grease. This particular grease has an extraordinary ability to prevent moisture from reaching the metal. Only a thin layer is preferable because otherwise the grease will - somehow - be able to spread to *the Clutch Plate,* where it definitely does not belong. The purpose of the grease is to: Keep dirt and moisture away from the bearing and contribute to lower friction between *the Bearing Housing* and *Trough Wall.*

2. Apply a **thin** bead *of Motor Silicone* in the ground groove on the back of *the Thrust Bearing Housing.* Also fill in the smaller O-rings that should be in the two grooves. Grease the O-rings with Omega grease. Allow the Motor Silicone to dry until it is so firm that it is not sticky.

3. Mount *the Thrust Bearing Housing* loosely and provisionally against *the Trough Wall.* If *Main Bearing Housing 13-16* is already mounted on the inside, **do not forget to insert *the Intermediate Sleeve.*** Thread on each of the screws with, in order: *Hardened Washer, Disc Spring, BRB Washer* and a provisional *M6M Nut.* (This will be replaced with a lock nut at a later stage) Fit the nuts with finger force.

Change image for M6M

NOTE! The nuts must be tightened in this

The sheath should not be tightened, but only put into place with finger pressure.

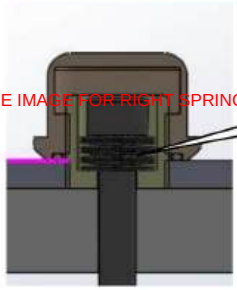
4. Assembly should then be carried out according to what is described later in the book as: Section *6.6.19 Bearing Housing, All – Assembly Procedure in Troughs*

   After all *Main Bearings* have been installed and tightened according to instructions, it is finally time to tighten *the Thrust Bearing.*

5. Start the work by installing the screws and *disc springs* that belong to *the Radial Tension function.* **Don't forget *the Lock Nut* that should be on *the Tension Screw.***

Each screw should have 16 disc springs. The bottom two are both turned with the disc upwards, the next two with the disc downwards. The following two are again turned upwards with another two downwards. And the rest are alternated in the same way, that is, two upwards and two downwards. .

CHANGE IMAGE FOR RIGHT SPRINGS



For correct tensioning, it is important that the disc springs are mounted correctly.

6. Then tighten the respective M8 *Allen screw* very carefully while paying full attention to *the disc springs* located under the screw heads. Stop turning the moment the screw head makes contact with *the disc spring.* The radial load of *the thrust bearing* should then be tightened by **further turning the screw 180º.** This corresponds to turning the screw half a turn, i.e. three of the hexagon flanks. Pay attention to the starting and ending position of the Allen key.

7. Now replace the temporary M6M nuts that hold *the Thrust Bearing* with Nyloc nuts. These nuts should also be fitted in a similar way to the radial clamping function. Carefully tighten the nuts one at a time, while paying attention to the nut making contact with *the disc spring.* When the nut makes contact, **it should also be tightened a further 180º.** This is of course also equivalent to turning the nut three of the hexagon's flanks. If the above is followed, *the Thrust Bearing* will always be kept loaded, which significantly increases its service life.

6.6.19 **Bearing Housing, All – Assembly Procedure in Trough**

The following applies to both main bearings and thrust bearings.

Carefully place *the Main Bearing Housings* and *Thrust Bearing Housings* in their respective locations. Then insert the Ø14 Guide Pins through the holes in the Bearing Housings and Trough wall. This is so that the temporary M8 centering screws can be mounted and protrude through the trough wall without being damaged. Make sure that *the washers* and *sleeves* are mounted in the correct place.

Due to the design changes over time, and *the Flywheel Hub* being glued instead of being secured to the Main Shaft with clamping elements , a different assembly procedure is required for *Bearing Housing* 13 – 16. This bearing housing lacks the temporary M8 centering screws found in other *bearing housings.*

Before the bearings are mounted in place in the Trough, Centering Screws must be installed in Bearing Housings No. 1 through No. 3 to ensure that the bearings are centered. See previous instructions.

In this position, *the bearing housings* do not need to be fully torqued with their M12 bolts. screws, however, the screws must be set so that the housings lie properly flat against the trough wall. After *the ball bearings* (KM nuts) have been tightened, *the centering screws, guide pins* and *bearing housing* must be loosened and *the main shaft* lifted approximately 20mm, so that *the chains* can be mounted.

Bearing Housing, All – Assembly Procedure in Trough

The thrust bearing is also mounted, first temporarily, later more permanently against the rear *trough wall.* Use the two *screw jacks* that are common to *Main Bearing Housings* 13–16.

For the axial support bearing, there must be a Hardened Washer, Disc Spring and Flat BRB Washer before the M6M Nut. This screw connection should later be finger-tightened only to make the bearing housing fit against the trough wall without significant force. When final tightening is to be done, the M6M nuts are replaced with Nyloc nuts.

See separate instruction: Thrust bearing – Assembly procedure against trough, page XXX

After all the bearing housings are in place, *the main shaft* is pushed with the greatest care, to avoid scratches and breakage, into the *bearing housings* placed in *the trough* . Make sure that the details at *bearing housings No. 13-16* are not forgotten: *Intermediate sleeve,* outer and inner *thrust washer* and *weight washer.* (see previous picture)

Then place *the chain sprocket, tensioner* and *chain* around the axle.

NOTE! The surfaces of the clamping sleeve should be oiled with a thin mineral oil, e.g. **Klueber Quitsch Ex or equivalent. However, NOT** low-friction, synthetic or molybdenum disulfide. If necessary, pry the bearing clamp sleeves apart with, for example, a screwdriver.

Check that the bearing housings are in the correct location according to the marking.

The main shaft must then be pushed into the correct axial position to the position where the spacer sleeve on the back of *the Flywheel Hub* securely **contacts** the inner ring ***of the Thrust Bearing .***

Bearing Housing, All – Assembly Procedure in Trough

Procedure in bullet form:

PLEASE NOTE! IT IS EXTREMELY IMPORTANT THAT THE WORK IS CARRIED OUT ACCORDING TO THE INSTRUCTIONS BELOW TO AVOID BREAKDOWNS. .

1. Check and make sure that *the Main Shaft* is **properly inserted,** so that the two 1mm spacers permanently mounted on *the Main Shaft* **are in good contact** with the inner ring *of the Thrust Bearing .*

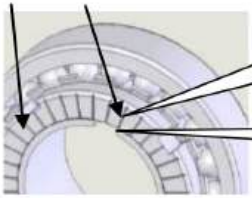
2. Lock *the Main Shaft / Flywheel Hub* with the purpose-made *The special tool* so that *the shaft* cannot rotate or move axially. **Make sure that *the Flywheel Hub* marking is facing upwards.**

2 PICTURES TOOLS

3. *The clamping sleeves* are then pushed into each *bearing housing/ bearing* only a little at a time and carefully without force. Repeat the procedure several times until all *clamping sleeves* have been pressed into the respective bearing. This step must be carried out carefully and with caution, since force affects the temporary *centering screws* whose task is to keep *the bearings* correctly positioned in the respective *bearing housing. The KM nuts* are then applied with good hand force.

The tool in the picture is used to push the clamping sleeve into the bearings in Bearing Housing No. 1 through No. 3, but also to prevent rotation of the same.

4. After *the KM nuts* have been applied with good hand strength (some assistance may be required from *the KM nut tool* and lifting *the shaft),* the starting position for the pull is marked using a marker pen.



The KM nut has 36 milled indicator lines, spaced 10° apart. The lines are used to tighten the nut to the appropriate preload.

Tool for tightening the KM nut. Use both a fixed shaft and a ratchet shaft for good access in the Trough.

NOTE! Since the Main Shaft with accessories has a considerable weight, it is necessary to lift it slightly while the Clamping Sleeves are pressed into place. Use, for example, pieces of wood, protectively taped profile pipes or similar during the lifting operation. **Ensure that *the trough* is not contaminated** by particles from the tools *the Shaft* is lifted with.

5. *The clamping sleeves* must then be locked in position against *the main shaft.* This is done by tightening *the KM nuts* a little at a time on each of them until *the clamping sleeve* is securely attached to *the shaft.*
NOTE!
This is not yet the final tightening, but only to get *the clamping sleeve* to attach to *the shaft.* It can therefore be about 1-2 lines on *the KM nut.*

NOTE! This is not yet the final tightening, but only to make *the Clamping Sleeve* attach to *the Shaft!*

6. After *the KM nuts* have been applied enough to secure *the Clamping Sleeve* , it is time to remove *the Centering Screws.*

7. At this point it is time for the final tightening. Tighten each *KM nut* **only a little at a time** and carefully. Tap the *nut* **a little and carefully** with a plastic mallet or similar between each tightening so that any tension has the opportunity to move. **NOTE!**

   Make sure the club is clean so that the bearing is not contaminated.

   Repeat the procedure several times until all *KM nuts* have been tightened to their correct position according to the marker marking.

8. Remove *the Special Tool* that holds *the Main Shaft.* Rotate *the Shaft* and feel for smooth running without binding or resistance, so that it can be considered to be running smoothly. If not, repeat the procedure above. (See the chapter on *Bearing Housing – Disassembly from Trough)*

9. If the installation of the wiring is approved according to the above, pry up and tap one of the ears *of the Folding Washer* into one of the recesses in the KM nut intended for this purpose.

NOTE! Do not forget to tap in one of the ears of the folding tray.

10. Loosen *the Bearing Housings* and the Ø14mm slotted *Guide Pins* so that *the Main Shaft* can be lifted approximately 20mm. Use, for example, pieces of wood, protectively taped profile pipes or similar during the lifting operation. Temporarily tighten a pair of *the Bearing Housings.* **NOTE! Ensure that *the Trough* is not contaminated** by particles from the tools *the Shaft* is lifted with. Use caution, lift *the Shaft* so that it is kept as parallel as possible to *the Trough.*

11. Slide *the Sprockets* and *Tensioners* into their places in *the Chains.*

12. Lower *the Main Shaft* to its lower position, place the Ø14mm slotted *Guide Pins* in their positions. Tighten *the Bearing Housing* and *Guide Pins.* (See previous separate instruction).

For your own notes:

6.6.20 **Bearing housing – Dismantling from trough**

To dismantle *the Bearing Housing* from *the Trough,* the operation is largely the reverse of the assembly. The exception is of course the procedure with, for example, *the Guide Pins.*

However, it may be good to know the *Special Tool* that can be used to release the tension in *the Bearing Clamping Sleeve.* By loosening *the KM nut*
a few turns, and attaching the tools below, you can use *the Sprocket Wheel* as a slide hammer to knock *the Clamping Sleeve* out of *the Bearing.*

PICTURE

NOTE! For Ø14mm Steering Pin, see separate instruction: Steering Pin – Disassembly / Assembly on the side: XX

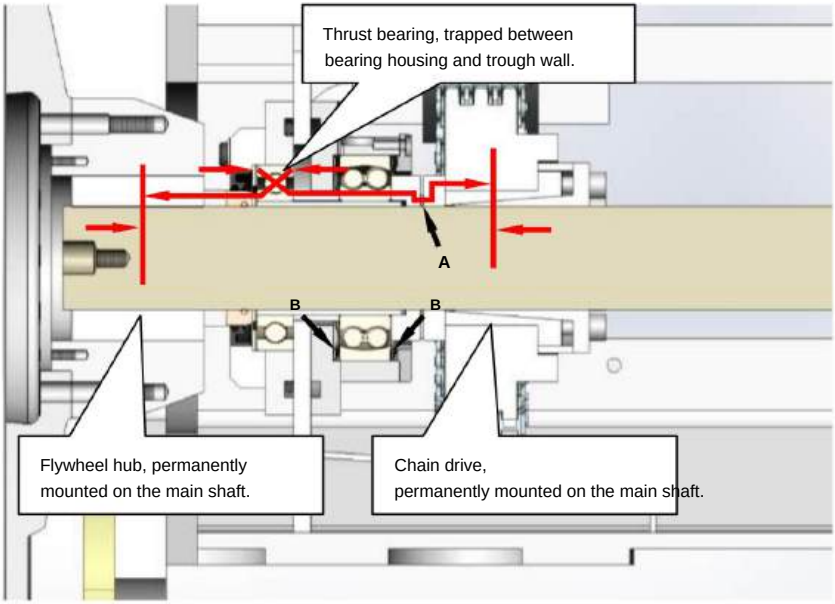
6.6.21 **SKF - Technical Support:**

Consultations have been made with SKF in Gothenburg. The contact person has been:

Engineer Ja[redacted]

6.6.22 **Thrust bearing – Force distribution**

The image below shows the path of force through various details to create axial locking of *the Main Shaft.*



The force of the axial movement is therefore trapped between *the flywheel hub* and *the chain sprocket.*
A *Scale Washer* (at arrow A) keeps the parts in tension, regardless of temperature differences, i.e. different length expansion of the components. When installing *the Chain Sprocket,* care must be taken to ensure that *the Scale Washer* is sufficiently seated. More about this in the chapter *Chain Sprocket – Mounting to the Main Shaft (See section* XXX).

The thrust bearing is mounted enclosed between *the bearing housing* and *the trough wall.*

At arrows **C,** the two wave washers are visible that allow the outer ring *of the main bearing* to move freely axially at different temperatures, i.e. longitudinal expansions of all the components.

6.7 Chain drive

6.7.1 Chain drive – General information

The chain drive was added because it is not possible to connect the crankshafts and extract the power at one end. The torsional rotations and thus the natural oscillations become too large. For the Herkules 1934 the problem is solved with Triplex chain drives.

Calculating these chain drives is complicated, if not impossible. It only takes a small change in a parameter to radically change the result. A number of assumptions have therefore been made where the input data has not been satisfactory. Among the wishes has been that the components involved should not be too expensive or take up too much space. Thus, the calculations have shown that the following chain drive is the most suitable for Herkules:

- Kedjedrev Triplex 1/2” 40 teeth

6.7.2 Chain drive - Simplified calculation

Calculation data obtained from Rexnord, Kedjeteknik and Ramströms

- 26 – 40 teeth. Operates up to about 30 m/s
- Sprocket wear can be minimized by replacing the chain when it is elongation amounts to approximately 1.5 – 2%
- Temperature range for 100% power output: • -20º to +150º Celsius

Permissible speed for small sprocket, 1/2” chain drive, normal: 1800 rpm

- Sag (2%) on the slack side at commissioning: 0.02 x 177.8 (pitch distance) = 3.56mm
- Load factor for combustion engine: • At the high 1.2

speeds that occur, the chain drive must be mist lubricated.

Chain drive - Simplified calculation

Input data:

- Motor **170 Nm**
- Chain drive Pitch diameter 161.87 /2 = Pitch radius **80.935**
- Chain Triplex 1/2" x 5/16" Breaking strength **56kN**

Main bearing load at max torque: 170Nm / R 0.081 (pitch radius) =

2.099 N

Chain load dependent on centrifugal force: $Pq = qx\ v^2$

Pq = N

q = 2kg/meter

v = chain speed m/min

3500rpm x 161,87 x 3,14 / 1000 mm = 1779,85 m/min / 60 = **29,7 m/sek**

$Pq = 2 \times 29.7^2$

Pq = **1.764 N**

The above means that 45% of the chain load at 3,500 rpm comes from the centrifugal load that affects the chain due to the high chain speed.

Chain drive - Simplified calculation

Margin for chain breakage:

2.099 + 1.764 = **3.863 N**

56,000N / 3,863 N = **14 times**

According to Chain Technology, at least 10 – 15 times the breaking load margin is needed to achieve a reasonable service life for the chain. 14 times can therefore be considered clearly acceptable.

Speed chain:

Normal speed during operation at cruising speed **1,800rpm**

1,800rpm x 0.509 (circumference of chain drive) = 916 meters per minute

916 / 60 = **15 meters per second.**

15 m/sec can be considered a high chain speed, but should still be completely reasonable over time considering the excellent lubrication that occurs in the Herkules 1934. Due to the high chain speed, limiting the engine speed to a maximum of 3000 rpm must be considered of utmost importance for the service life of the chains.

Chain drive - Simplified calculation

Max power output chains:

Max power per chain according to Ramström's table:

At 1800rpm the chain can withstand 19.5 kW x 2.5 (factor for Triplex chain) **= 49 kW**

49 kW / 1.2 (factor for combustion engine) = 41 kW

41 kW x 1.36 = **55 hp**

55hk x 4Block **= 220 hk**

At 2800rpm the chain can withstand 13.5 kW x 2.5 (factor for Triplex chain) **= 34 kW**

34 kW / 1.2 (factor for combustion engine) = 28 kW

28 kW x 1.36 = **38 hp**

38hk x 4Block **= 152 hk**

The above assumes mist lubrication.

Conclusion

The chain drives are capable of 220hp at 1800 rpm continuously, for an estimated service life of 15,000 hours. However, there is a large uncertainty factor due to the shafts being vertical and with the driving wheel at the top. **This requires great accuracy in chain tensioning,** as the slack in the chain otherwise climbs onto the sprocket tooth tip, resulting in significant wear.

At 2800 rpm, the chain drives can handle 152 hp for 15,000 hours, when the engine produces about 260 hp. But since maximum power output only occurs for a limited time, there is a good chance that the chain drive can last for a long time.

6.7.3 Chain Sprocket – Mounting to Crankshaft

- Triplex Kedjedrev 4st ISO 08B-3, Z-40, Nav T-12-40, Translev

- The sprockets should fit tightly against the crankshaft.
- Guide pin CPK Ø8mm (hardened) Cut to L= 32
- Hole for guide pin reamed m6. The pin has a “light” fit in the sprocket, but sits with a strong fit in the crankshaft. Tapped into place with a large forging hammer. The hole in the end is drilled for extra security.
- Screw for chain sprocket UNF 3/8” x 25 Quality 12.9 - 3pcs Allen and 3pcs Hexagon (The availability of screws in that strength class was limited, which guided the choice)

- Tightening torque 7 kpm / 70 – 80Nm in two steps for all. (the hexagon screw has been experienced as more flexible when tightening)
- LocTite 270 Strong on all screws, none on the pin.

6.7.4 Chain Sprocket – Mounted to Main Shaft

- Triplex Kedjedrev, 4st ISO 08B-3, Z-40, Nav T-12-40 Translev
- Tensioning elements, 4 pcs KTR 250 Clampex Tools Momentum

6.7.5 Chain

- 3.6m Triplex Chain 1/2” DIN Tsubaki Translev
- 4pcs Triplex Rivet Link 1/2” DIN Tsubaki Translev

6.8 Tensioning elements for chain drive

6.8.1 Tensioning elements – General information:

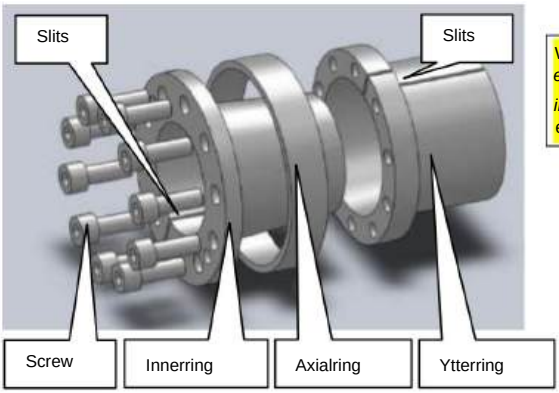
KTR Kupplungstechnik GmbH has been developing and manufacturing shaft couplings for countless applications for more than 50 years and is today a world leader in this field. Their solutions are used daily in applications such as conveyor belts, assembly lines, mobile hydraulics, multi-operation machines, stone crushers, ships, pumps, wind turbines and much more.

For axle and hub the following applies:

• Surface smoothness	<16µm
• Tolerance shaft/hub	h8/H8
• Max moment	260kpm

Tensioning element – Description:

The CLAMPEX® KTR 250 *Clamping Element* is a machine element that can connect different shafts and hubs to a completely backlash-free application. One of the biggest advantages of this is that there is no need to mill keyways in the shaft, which would adversely affect its strength. By tightening *the Clamping Element's* screws, the Herkules *Chain Drive* can be attached to its *Main Shaft* in a satisfactory manner but still have the advantage of being easily dismantled. However, the instructions below must be followed to ensure proper function.



When installing *the tensioning elements* , the slots in *the outer* and *inner rings* must be turned 180º from each other.

6.8.2 **Clamping elements – Assembly**

When installing *the tensioning element,* there are a few things that are important to consider:

- Dirty or previously mounted *clamping elements* must be disassembled and cleaned.
- When assembling, *the clamping element* should be oiled on the inside and outside ***of the outer ring and the screws.*** Leave the other surfaces dry. Use spray oil from **Klueber – Quitsch Ex.**

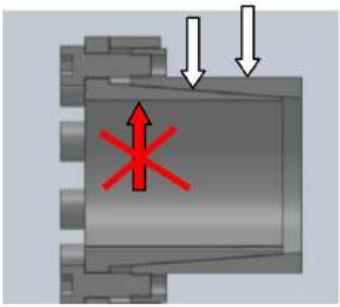
NOTE! Do not use any high-performance oil such as synthetic, molybdenum disulfide or similar. This will most likely cause the tensioning element to slip.

NOTE! Do not oil the inside of the Inner Ring or the outside of the Shaft!

- Make sure that *the tensioning elements* are mounted so that the slots in *the outer* and *The inner rings* are turned 180º from each other.
- When installing, check that *the axial ring* fits snugly against *the sprocket.*
- Tighten the screws crosswise, a little at a time until full torque is reached.

Tightening torque for M8 screw in Clamping element should be:

4,1kpm (41Nm)



Oil the clamping element in the joint between the inner and outer rings and the screws.

Leave the inside of the Inner Ring unlubricated

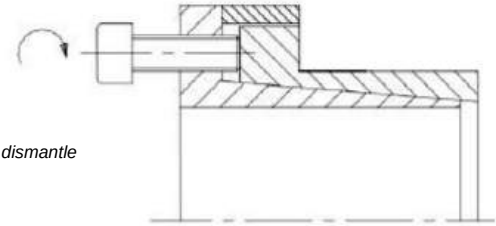
6.8.3 **Clamping elements – Catalog data**

CLAMPEX® – KTR 250

d x D [mm]	Dimensions [mm]					Clamping screws DIN EN ISO 4762 - 12.9 µtotal=0.14				Transmittable torque or axial force		Surface pressure between clamping element		Weight [~kg]	Shrink programme
	B	B_1	B_2	B_3	D_1	M	Length	n_s x z	T_A [Nm]	T [Nm]	F_{ax} [kN]	Shaft PW [N/mm2]	Hub PN [N/mm2]		
50 x 65	78	70	82	45	93	M8	33	10	41	3600	104	133	84	1.3	●

As can be seen from the table, *the tensioner* can handle 2600Nm. Current *Crankshaft* produces the equivalent of 170Nm, which gives a safety margin of 15 times. This should be able to handle the inertia forces that could affect operation.

The clamping screws can also be used to dismantle the clamping element.



6.8.4 **Clamping element – Disassembly**

Dismantling the CLAMPEX® KTR 250 *clamping element* is very easy. Proceed as follows:

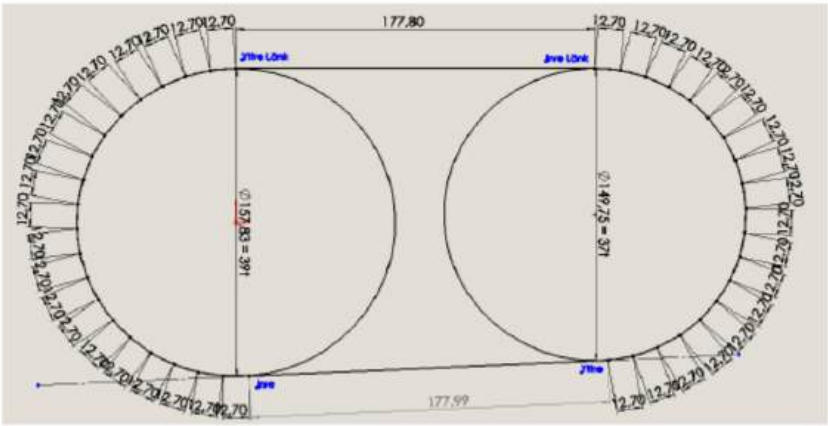
- First remove all screws. When loosening the screws, do this carefully and crosswise.
- Move the screws one step, to the threaded hole located in *the Inner Ring,* next to the original ones.
- Screw in the screws to loosen *the clamping element.* Do this in several steps and also pull crosswise.
- Clean *the tensioning element.*

6.8.5 Chain drive – Thoughts and reflections

Choice of number of teeth

According to accepted practice, sprockets should have an uneven number of teeth. This is because, according to reports, the chain drive should wear more evenly and also less. I have spent an enormous amount of time and thought about this, and I am convinced that the alleged problem is one of the many myths that occur in mechanics. In my opinion, there are no technical criteria that show that this is true. For the Herkules 1934, a chain drive with 40 teeth has been chosen, even though this is not a European standard. The advantage is that - if desired - the crankshafts can be shifted 10 teeth/45° by rearranging the chain. If in the future it turns out that my reasoning is completely incorrect, I have a solution here to change this possible problem.

An investigation shown in the picture below has shown that **39-teeth and 37-teeth give a wheelbase similar to that for which the engine was designed.** This could be a solution to try. However, there will be a gear ratio difference of 1.054, i.e. about 5%. A slight increase in load also occurs due to the reduction in the pitch radius.



The theoretical pitch measurement between *the crankshaft and the main shaft* in the engine is 177.8mm. This measurement is reduced slightly because there will be a chain slack of about 2% of the pitch measurement when newly installed. *The chain tensioners*
So you have to take care of 177.8 x 0.02 = 3.56mm.

As can be seen in the picture, the measurement is 177.8 + 177.99 /2 = 177.895. This is a difference of one tenth of a mm, which should be negligible.

Söderström - HERCULES 1934

Straight 16-Cylinder

Transmission

For your own notes:

6.8.6 **Chain drive – Chain tensioner**

Chain tensioner – General information

To tension the chain drive, and thereby also minimize wear because **the slack in the chain must not be allowed to climb onto the tooth tips,** there are manually adjustable chain tensioners. *The chain tensioner's* sliding plastic has oil holes for lubricating the chain.

Chain tensioner – Detailed information:

• Milled yoke		Manufacturer Söderström
• Milled Sliding Block	HDPE 1000	Manufacturer Söderström
• Distanshylsa		Manufacturer Söderström
• Passkruv	ISO7379 6/20/M5 Wiberger AB	
• Cylindrical Stick	Ø8x20	Wiberger AB
• O-ring	Ø6.75 x 1.78	Tools Momentum AB
• Spring	No. 2685	Lesjöfors/Sthlms Spring

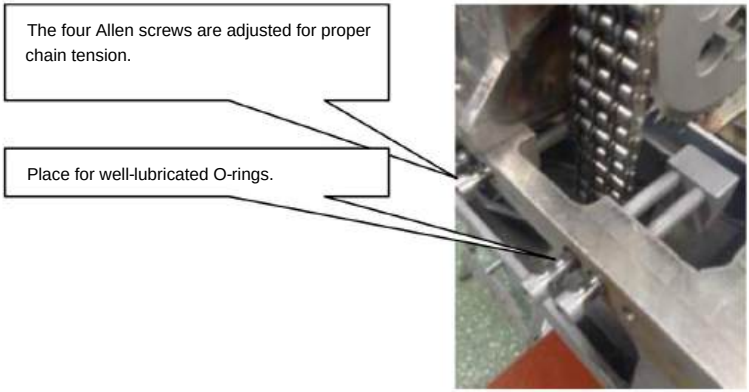
The sliding block is held in place using a cylindrical pin and a set screw.

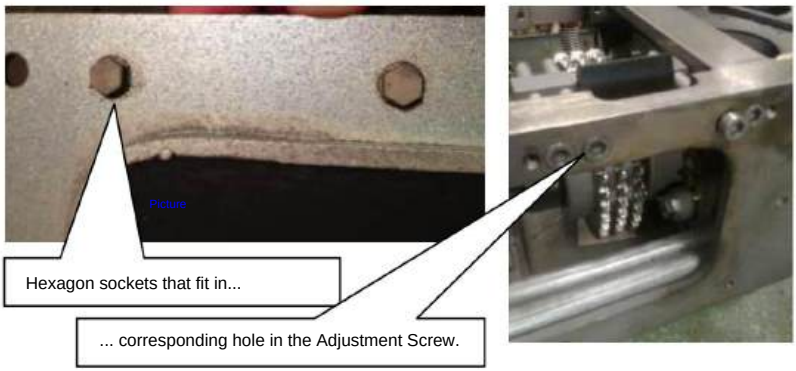
6.8.7 **Chain tensioner – Chain lubrication:**

More info coming later!

6.8.8 **Chain tensioner – Adjustment**

To tighten the chain drive, adjust the four Allen screws that become accessible after the side cover has been removed. There are two fixed Allen pins in the side cover, which act as a locking device for the adjustment when the side cover is in place. For this reason, the adjustment of the two middle adjusting screws must be done in such a way that the Allen pins can engage.





Söderström - HERCULES 1934

Straight 16-Cylinder

Transmission

Chain tensioner – **Adjustment**

For chain drives, shafts that are placed horizontally with the driving part at the top are most favorable. The drive that occurs in Herkules 1934 is the worst in this context. That is, with the shafts placed vertically above each other and with the driving part at the top. With such a drive, the chain tension must be given the greatest care.

Great care must be taken when adjusting the chain so that the stress on the main bearing does not become too great before full oil pressure and a dynamic oil film have been formed. **Serious damage to the engine's *crank bearings* can quickly occur** if *the chains* are too tight. On the other hand, if *the chains* are too loose, there will be play and in all likelihood vibrations as a result.

NOTE! The chain tension must be checked regularly and carefully!!! This is because the operating conditions of the chain for the Herkules 1934 are of a particularly demanding nature.

If the chain is tensioned too tightly: *The crankshaft bearings* will be seriously damaged.

If the chain is tightened too loosely: *The chain* can then slip out of the tooth base of the driven wheel, resulting in severe wear.

This is of extremely great importance and should **not** be underestimated.

Chain tensioner – **Adjustment, Procedure:**

1. Make sure the engine has cooled down for at least 24 hours. This is to avoid that the engine temperature has a detrimental effect on the longitudinal expansion of the parts.

2. Make sure the engine has been in operation previously, so that *the chain* links and bearings are adequately filled with oil.

3. Insert a piece of brass sheet between *the Chain* and *Chain Tensioner.* The thickness of the sheet brass **should be 0.30mm** and its width should be large enough to cover the width *of the chain* .

4. Tighten *the adjusting screws* enough to allow the brass plate to move without binding or binding. Position the hexagon so that the locking pin can engage when *the Side Door* is later screwed into place.

5. Repeat the procedure for all *Chain Tensioners.*

6. Install *Side Doors.*

6.8.9 Sliding block - Manufacturing

When turning a sliding block, ensure that the tool is aligned so that the block is parallel. Turning can be done with a fairly large cutting depth.

NOTE! Take great care when manufacturing to ensure that the block is parallel. This is to prevent the chain from wearing unevenly.

Drilling of lubricating oil holes is carried out using the original as a reference. This is so that the holes end up right in front of the chain links, where the lubrication need is greatest.

Söderström - HERCULES 1934

Straight 16-Cylinder

Transmission

For your own notes:

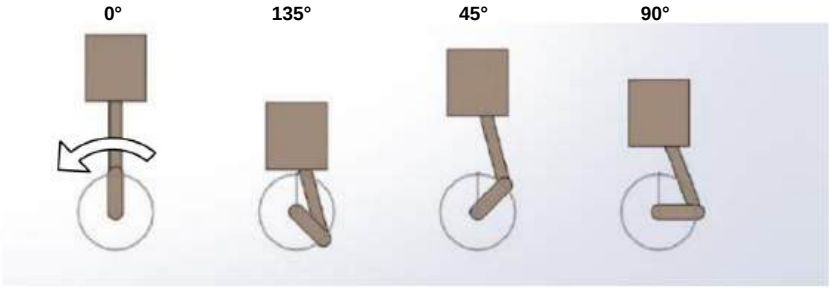
6.9 Mounting the Crankshaft to the Main Shaft

Chain drive with *clamping sleeve, sprocket* and *chain.*
The latter is shown in both new and worn/tensioned versions in the same picture.
The screws in *the clamping sleeve* should be tightened crosswise and a little at a time. See instructions regarding: *Chain drive - Clamping element*

The following applies to the assembly of the crankshaft components:

Crankshafts are mounted according to the picture below. *The crankshafts* are shown from the rear, meaning the engine rotates counterclockwise. The crank pin shown in the picture is the first one per *block,* meaning crank pins 1-5-9-13. This is the position when the cylinders of the said crank pins are in the compression stroke.

Crankshaft degrees:



6.9.1 **Mounting of Crankshaft to Mainshaft:**

This assumes that the Main Shaft, Bearing Housing and Chains are in place. See: Bearing Housing – Assembly Procedure in Trough, Item XXX

- *The main shaft* is locked with a special tool in the starter ring – the so-called *Starter Ring Lock.* See separate instructions.
- Install *the Piston Locking Tool* against *Pistons* in *Blocks 1-4.* See separate instructions.
- The relevant *crankshaft* is rotated counterclockwise (seen from the rear) until the piston is firmly against the surface of the Special Tool. See separate instructions.
- Check that the two relevant *sprockets* in each drive play with each other. NOTE! This is of utmost importance that it is done correctly! Otherwise the chains will wear out quickly.
- Tighten the screws in *the Sprocket Tensioner Sleeve* crosswise and a little at a time until full torque is achieved. See: XXX Sprocket - Tensioner

NOTE! Always pay attention to the fact that *the Chain Sprocket* is still playing.

Regarding screwing *the Clamping Sleeve* into *the Chain Sprocket* for *Block 13-16* applies a special procedure. *The chain sprocket* must then tension a *Scale washer* to obtain adequate preload in *the Thrust Bearing.* Two *Special Tools* are available for this . A tool that tightens *the Chain Sprocket* against *the Scale Washer,* and a *Insertion Gauge* to obtain the correct setting dimension. For further information, see: XXX Special Tools for Assembling Crankshafts.

- Check that the special tools that hold the Flywheel and lock *the Pistons* are still in place.
- Remove *the starter ring lock* and *the piston locking tool* from the current *Block.*
- Mount the special tools against the next *Block.* Make sure that *the Starter Crown Lock* is in the correct position according to the marking on the flywheel. (see separate instructions).
- Repeat the above until all *Collets* are tightened.

6.9.2 Special tools for mounting crankshafts

Piston locking tool

This is a special tool that is screwed into the surface of *the Cylinder Head* of the current *Engine Block* . The purpose of this tool is to support the *Piston* in the first *Cylinder* and, with a screw device, hold the second piston in the same *Block.*

NOTE! It is of utmost importance when installing *the Piston Locking Tool* that:

- *The crankshaft* is rotated counterclockwise.
- *The tool* is tightened into *the Block* when *the Piston* for the relevant *Cylinder* is on its way up the compression stroke.
- Continue to carefully rotate *the Crankshaft* until *the Piston* hits *the Tool* stody.

NOTE! *The piston* must be on its way up in the compression stroke.
This can be checked by looking at the camshaft cams for the *cylinder in question.* If *the valve lifters* are fitted, it is easy to see where *the camshaft cams* are located with a pair of *pushrods,* for example.

- Lower *the Tool's Clamping Screw* against *the Piston* in the other *Cylinder* and tighten it sufficiently to ensure that *the Crankshaft* will not be dislodged during continued work.

PICTURE

Special tools for mounting crankshafts

Starter crown lock

This is a special tool that screws into blah blah blah…

picture

More text when it is constructed…

Clamping tool for fitting thrust bearings

Including insertion dimensions

6.10 Gearbox

6.10.1 Gearbox – General information

For the 1934 Hercules, a GM transmission, **the Muncie SM465,** was used which originally comes from Chevrolet Pickup C2, 1970 model.

It is an extra heavy duty gearbox which has been used in American pickups and similar by GMC and Chevrolet brands, e.g. Blazer and Suburban, between the years 1968 to 1991. The SM in the name stands for "Synchro-Mesh"

Muncie SM465, a very strong gearbox. Note the large reinforcement ribs on the sides of the gearbox.

6.10.2 Gearbox – Technical data

Gear ratio:

• Low gear	6,55:1
• First gear	3,58:1
• Second gear	1,70:1
• Third gear	1,00:1
• Reverse gear	6,09:1

Input shaft: 1-1/8” 10 spline

Gearbox oil:	Type	OKQ8 T-55, SAE 80-90
	Volume	About 3.8 liters

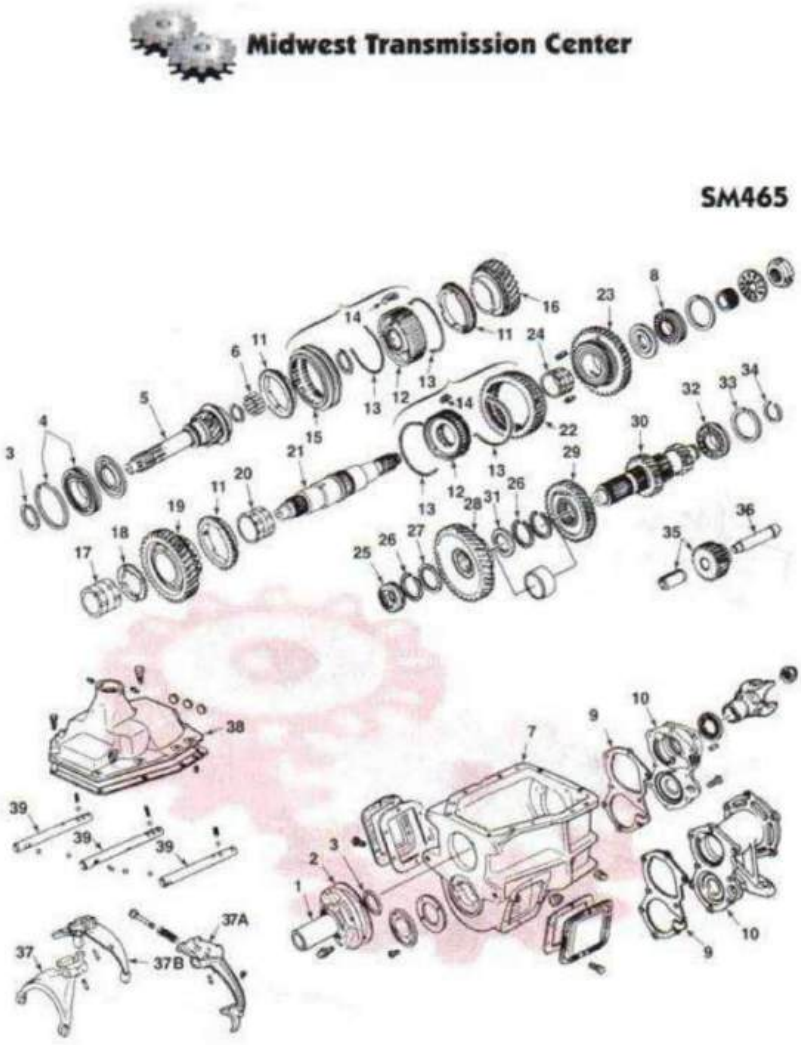
For filling oil in the Muncie 465 Gearbox, a conventional mineral oil or possibly a semi-synthetic oil is recommended instead of a fully synthetic oil. Conventional manual transmissions do not have the thermal stresses that internal combustion engines or hypoid gears do. Synthetic oil in these transmissions does not harm, but is

on the other hand, a financial waste.

Do not use hypoid gear oil in this gearbox. Hypoid gear oil contains substances that can be corrosive to the copper alloy metals that may be used in bushings, synchronizer rings, etc.

For filling oil in the Muncie 465 Gearbox it is recommended
Gearbox oil 80W-90, API-GL5

6.10.3 **Gearbox - Exploded view / spare parts list**



Note. See also spare parts list in original repair instructions later in this manual.

6.10.4 **Gearbox – Original repair description**

Chevrolet
GMC

DESCRIPTION

Muncie transmission model 465 is a four-speed heavy duty unit with all helical gears except reverse. First gear is a constant mesh type that engages with the second speed synchronizer sleeve. Second, third and fourth speed gears are synchronized.

TROUBLE DIAGNOSIS

See Manual Transmission Troubleshooting in MANUAL TRANSMISSION SERVICING Section.

SERVICE (IN VEHICLE)

REAR BEARING RETAINER OIL SEAL

1) Drain oil from transmission and disconnect drive shaft. Remove parking brake from rear of transmission. Disconnect speedometer cable and remove speedometer driven gear from mainshaft rear bearing cap. Using flange or yoke holding tool, remove the output yoke or companion flange nut from mainshaft. Remove mainshaft rear bearing cap and gasket. Discard gasket. Remove oil seal from rear bearing cap, and discard seal.

2) Coat outer diameter of new oil seal with a suitable sealing cement. Install seal in bearing cup using a suitable seal driver. Press seal in flush with outside of bearing cap. To reassemble components, reverse removal procedure and fill transmission with suitable lubricant.

REMOVAL & INSTALLATION

See Manual Transmission Removal in MANUAL TRANSMISSION SERVICING Section.

TRANSMISSION DISASSEMBLY

COVER & SHIFT FORK MECHANISM

Mount transmission in suitable holding fixture and remove cover screws. Move reverse shifter fork so reverse idler gear is partially engaged before removing cover. Forks must be set so rear edge of slot in reverse fork is in line with front edge of slot in forward forks as viewed through tower opening. If necessary, insert two bolts in cover flange threaded holes and turn evenly to raise cover dowel pins from case.

OUTPUT YOKE & REAR BEARING RETAINER

Set transmission in two gears at once to lock mainshaft and remove yoke flange nut. Remove output yoke, and brake drum if equipped. On models with a transfer case, use suitable tool (J-23070) to remove mainshaft rear bearing lock nut (see illustration). Remove parking brake and brake flange plate if equipped. Remove rear bearing retainer and slide speedometer drive gear off mainshaft.

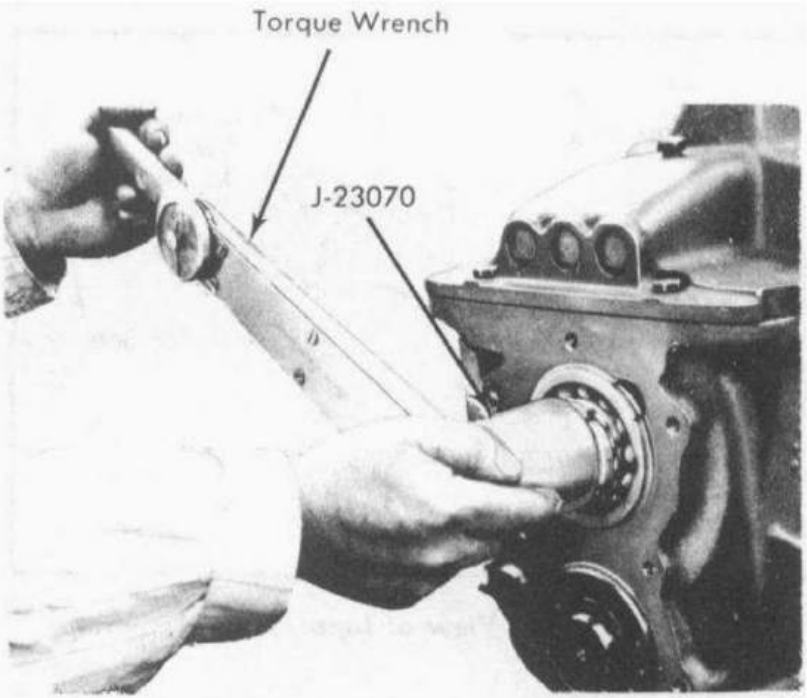


Fig. 1 Removal or Installation of Mainshaft Rear Bearing Lock Nut (4-WD)

COUNTERGEAR

Remove drive pinion bearing retainer and countergear front bearing cap. Pry countergear front bearing out by inserting a screwdriver into groove at cast slots in case. Remove countergear rear bearing snap ring from shaft. Using suitable

bearing cap. Pry countergear front bearing out by inserting a screwdriver into groove at cast slots in case. Remove countergear rear bearing snap ring from shaft. Using suitable puller tools (J-22832 and J-8433-1), remove countergear rear bearing (see illustration). This will allow countergear to rest on case bottom for mainshaft removal.

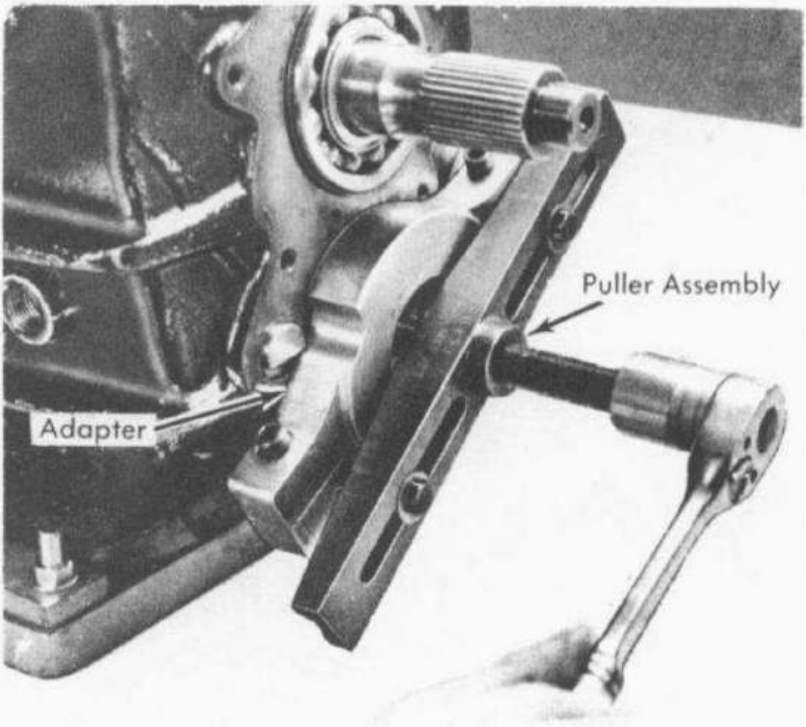


Fig. 2 Removal of Rear Countergear Bearing

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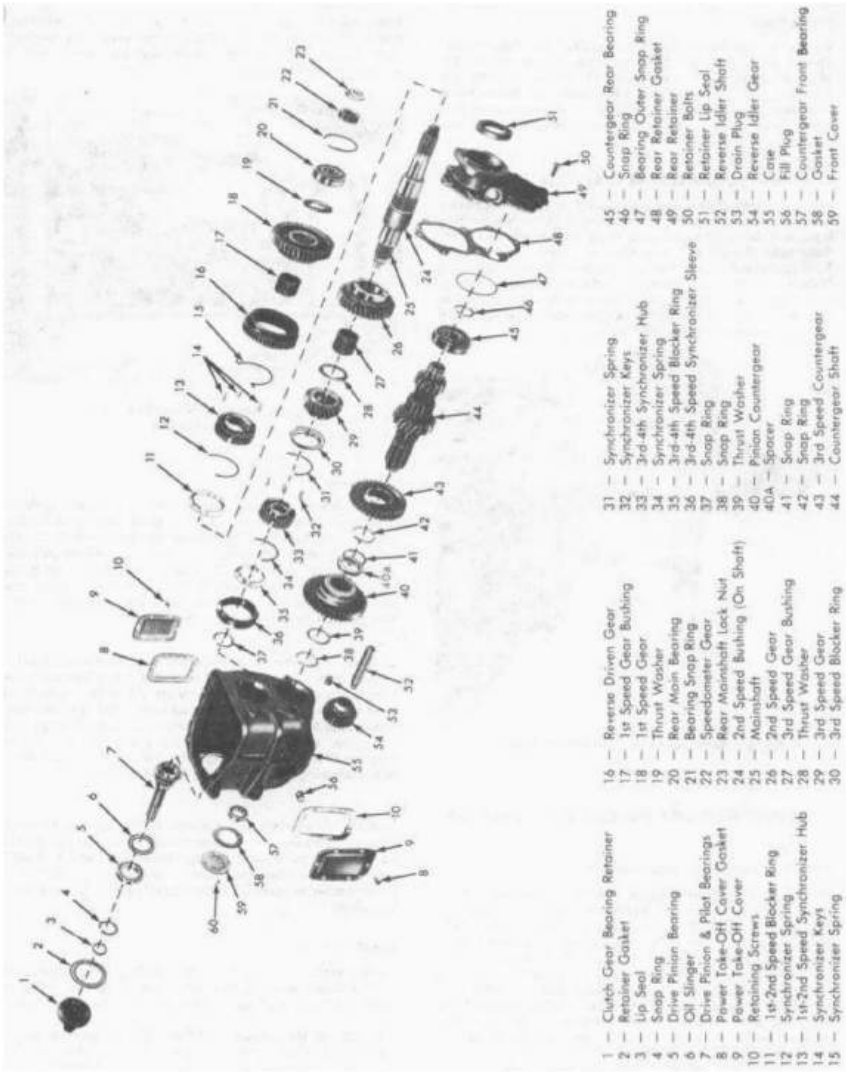
Straight 16-Cylinder

Transmission



1 — Clutch Gear Bearing Retainer
2 — Retainer Gasket
3 — Lip Seal
4 — Snap Ring
5 — Drive Pinion Bearing
6 — Oil Slinger
7 — Drive Pinion & Pilot Bearings
8 — Power Take-Off Cover Gasket
9 — Power Take-Off Cover
10 — Retaining Screws
11 — 1st-2nd Speed Blocker Ring
12 — Synchronizer Spring
13 — 1st-2nd Speed Synchronizer Hub
14 — Synchronizer Keys
15 — Synchronizer Spring
16 — Reverse Driven Gear
17 — 1st Speed Gear Bushing
18 — 1st Speed Gear
19 — Thrust Washer
20 — Rear Main Bearing
21 — Bearing Snap Ring
22 — Speedometer Gear
23 — Rear Mainshaft Lock Nut
24 — 2nd Speed Bushing (On Shaft)
25 — Mainshaft
26 — 2nd Speed Gear
27 — 3rd Speed Gear Bushing
28 — Thrust Washer
29 — 3rd Speed Gear
30 — 3rd Speed Blocker Ring
31 — Synchronizer Spring
32 — Synchronizer Keys
33 — 3rd-4th Synchronizer Hub
34 — Synchronizer Spring
35 — 3rd-4th Speed Blocker Ring
36 — 3rd-4th Speed Synchronizer Sleeve
37 — Snap Ring
38 — Snap Ring
39 — Thrust Washer
40 — Pinion Countergear
40A — Spacer
41 — Snap Ring
42 — Snap Ring
43 — 3rd Speed Countergear
44 — Countergear Shaft
45 — Countergear Rear Bearing
46 — Snap Ring
47 — Bearing Outer Snap Ring
48 — Rear Retainer Gasket
49 — Rear Retainer
50 — Retainer Bolts
51 — Retainer Lip Seal
52 — Reverse Idler Shaft
53 — Drain Plug
54 — Reverse Idler Gear
55 — Case
56 — Fill Plug
57 — Countergear Front Bearing
58 — Gasket
59 — Front Cover

DRIVE PINION

Remove drive pinion bearing outer race to case retaining ring. Remove drive pinion and bearing by tapping on bottom side of drive pinion shaft and prying out at bearing snap ring groove at same time. Remove 4th speed gear synchronizer ring when drive pinion is removed. **NOTE** — *Cutout section of drive pinion gear should be down to clear countergear for pinion removal.*

MAINSHAFT, COUNTERGEAR & REVERSE IDLER GEAR

Remove mainshaft rear bearing retainer snap ring and, using suitable puller tools (J-22832 and J-8433-1), remove bearing from case. Slide 1st speed gear thrust washer off mainshaft. Raise rear of mainshaft and move rearward, then lift shaft front up and out of case. Remove synchronizer cone from shaft. Slide reverse idler gear rearward and move countergear back until front end is free of case and remove assembly. Drive reverse idler gear shaft out of case from front to rear, using a drift, and remove reverse idler gear.

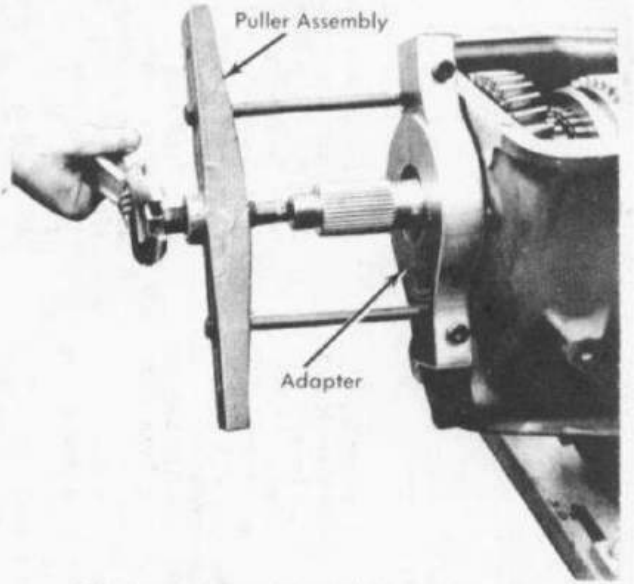


Fig. 4 Removal of Rear Mainshaft Bearing

COMPONENT DISASSEMBLY & REASSEMBLY

COVER & SHIFT FORK MECHANISM

Disassembly – Drive out pins retaining 1st-2nd and 3rd-4th speed shifter forks to shifter shafts, and also remove shaft expansion plugs. **NOTE** – *Pin retaining 3rd-4th speed shifter fork-to-shaft and shifter fork must be removed before removing reverse shifter head pin.* With shifter shafts in neutral position, drive shafts out of cover to remove shifter forks. Ensure that detent balls, springs and interlock pins are not lost as shifter shafts are removed. Drive out pin holding reverse shifter head and drive out shaft. Ensure that detent balls are not lost as they are under spring tension in rear rail boss holes.

Cleaning & Inspection – Wash all parts in clean solvent and inspect forks and gates for wear at pads and lever slots. Check forks for alignment. Check roll pin fit in forks and gates. Check neutral notches of shift shafts for wear from interlock balls. Shafts which are indented at points adjacent to neutral notches should be replaced.

Check forks for alignment. Check roll pin fit in forks and gates. Check neutral notches of shift shafts for wear from interlock balls. Shafts which are indented at points adjacent to neutral notches should be replaced.

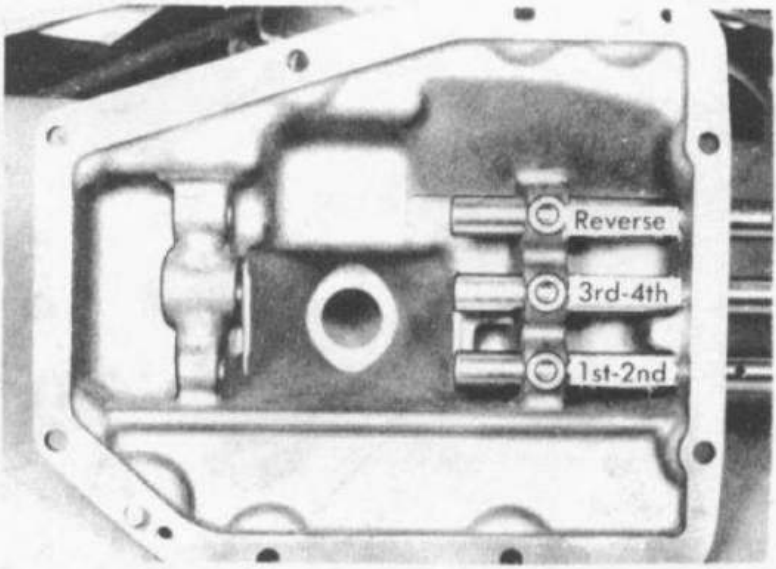


Fig. 5 Location of Shift Shafts in Shift Housing

Reassembly – 1) Reassemble cover installing shifter shafts in order of reverse shaft, 3rd-4th speed shaft and 1st-2nd speed shaft. Place fork detent ball springs and balls in hole positions in cover. Start shafts into cover depressing yoke detent balls with a small punch, and push shafts on over balls. Starting with reverse shifter shaft, hold fork in position and push shaft through yoke. Install cotter pin in fork and shaft, then position fork in neutral position.

2) Hold 3rd-4th fork in position and push shaft through yoke, but not through front support bore. Place two interlock balls between reverse and 3rd-4th shifter shafts in crossbore of front support boss. Install interlock pin in 3rd-4th shaft hole and grease to hold in place. Push 3rd-4th shaft through fork and cover bore, keeping both balls and pin in position between shafts until retaining holes line up in fork and shaft. Install retaining pin and move to neutral position.

3) Place two interlock balls between 1st-2nd shaft and 3rd-4th shaft in crossbore of front support boss. Hold 1st-2nd fork in position and push shaft through cover bore and fork until retainer hole and fork line up with hole in shaft. Install retainer pin and move to neutral position. Install new shaft hole expansion plugs.

DRIVE PINION

Disassembly – Remove 17 mainshaft pilot bearings and roller retainer. Remove snap ring holding bearing on pinion shaft and press shaft out of bearing using an arbor press.

Cleaning & Inspection – Wash parts in cleaning solvent and inspect roller bearings for pits or galling. Check bearing surface in shaft recess for galling. Inspect gear teeth for wear and pinion pilot for wear. Check pinion bearing for roughness.

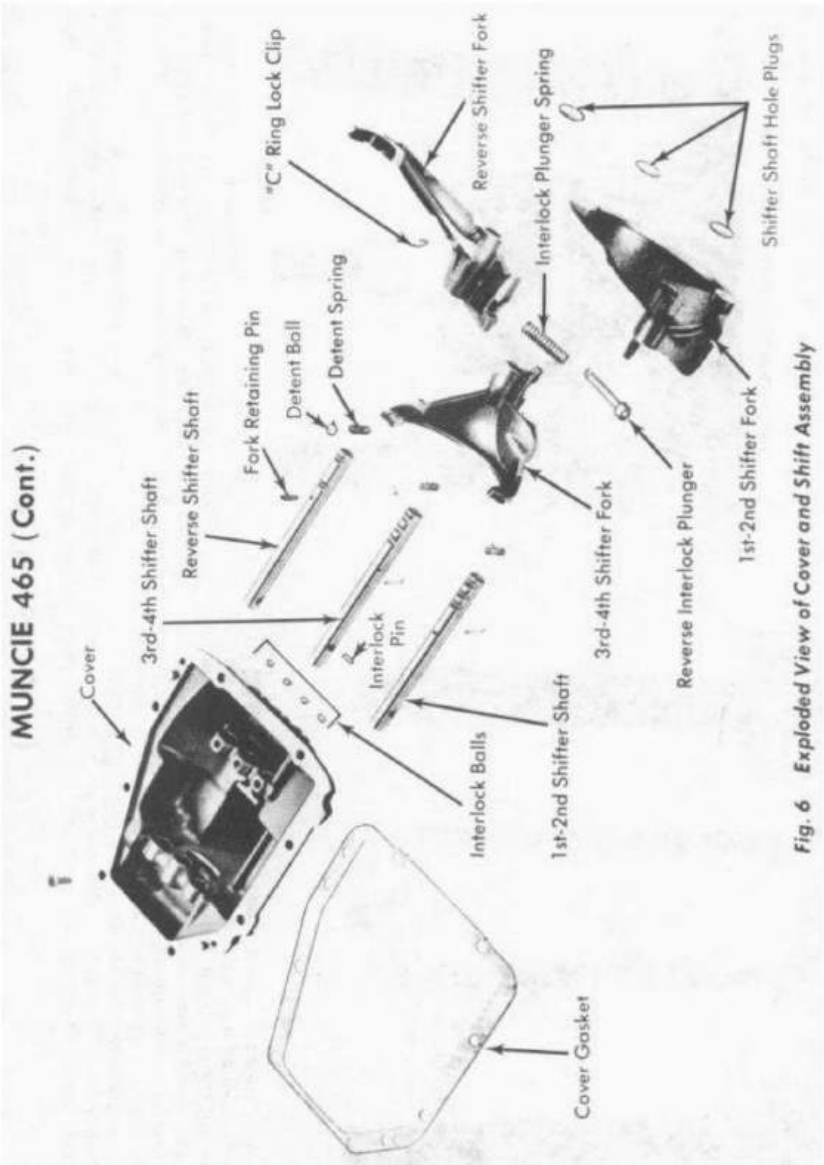


Fig. 6 Exploded View of Cover and Shift Assembly

Reassembly – Press bearing and new oil slinger onto drive pinion. Slinger should be located flush with bearing shoulder on drive pinion. Install snap ring on pinion to secure bearing, then install retainer ring in groove on outside diameter of bearing. Ensure bearing turns freely after installed on shaft. Install snap ring in mainshaft pilot bearing bore (if previously

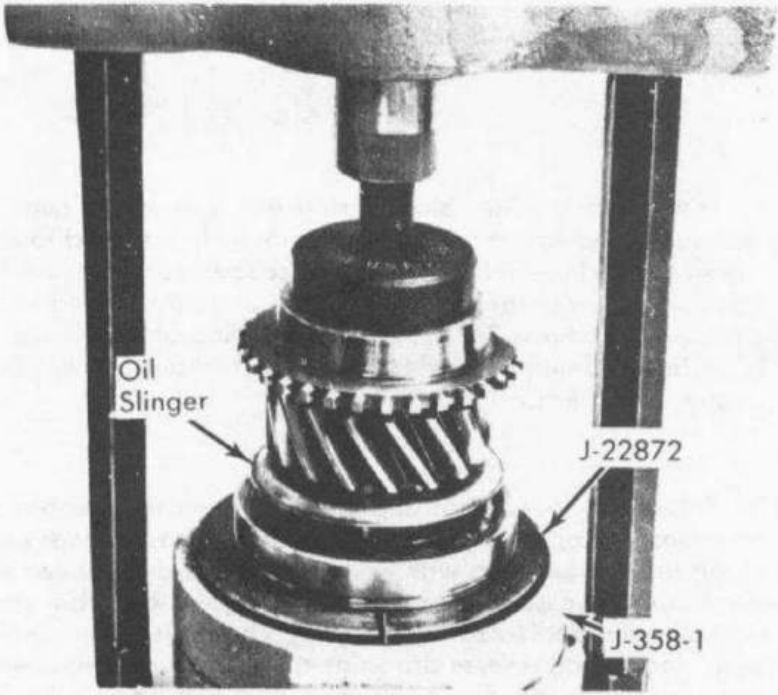


Fig. 7 Installing Drive Gear Bearing

removed). Apply grease to bearing surface and install roller bearings and bearing retainer. **NOTE** – *Roller bearing retainer holds bearings in position and is pushed forward into recess by mainshaft pilot during final assembly.*

DRIVE PINION OIL SEAL

Remove retainer, and oil seal assembly. Pry oil seal from retainer and replace with a new seal. Install new seal with suitable installer tool (J-22833). Insert seal in retainer so lip of seal is toward flange of installer tool. Install retainer with a new gasket and tighten bolts.

MAINSHAFT

Disassembly – Remove first speed gear and thrust washer. Remove snap ring in front of 3rd-4th synchronizer assembly. Withdraw reverse driven gear. Press behind second speed gear to remove 3rd-4th synchronizer, third speed gear, and second speed gear with third gear bushing and thrust washer. Remove second speed synchronizer ring. Support second speed synchronizer hub on front face and press mainshaft through first gear bushing and second speed synchronizer hub. Split second gear bushing with a chisel and remove bushing from shaft. **NOTE** – *Use care not to damage mainshaft.*

Cleaning & Inspection – 1) Wash all parts in clean solvent and inspect mainshaft for scoring or wear at thrust surfaces and splines. Check synchronizer hub and sleeve for excessive wear. Sleeve should slide freely on synchronizer hub. Check fit

of synchronizer hub on mainshaft splines. Check that 3rd-4th speed synchronizer sleeve slides freely on 3rd-4th speed synchronizer hub, but hub should be a snug fit on shaft splines.

2) Inspect 3rd speed gear thrust surfaces for scoring. Check 3rd speed gear mainshaft bushing for wear. Note that the 3rd speed gear must be a running fit on mainshaft bushing and bushing, a press fit on shaft.

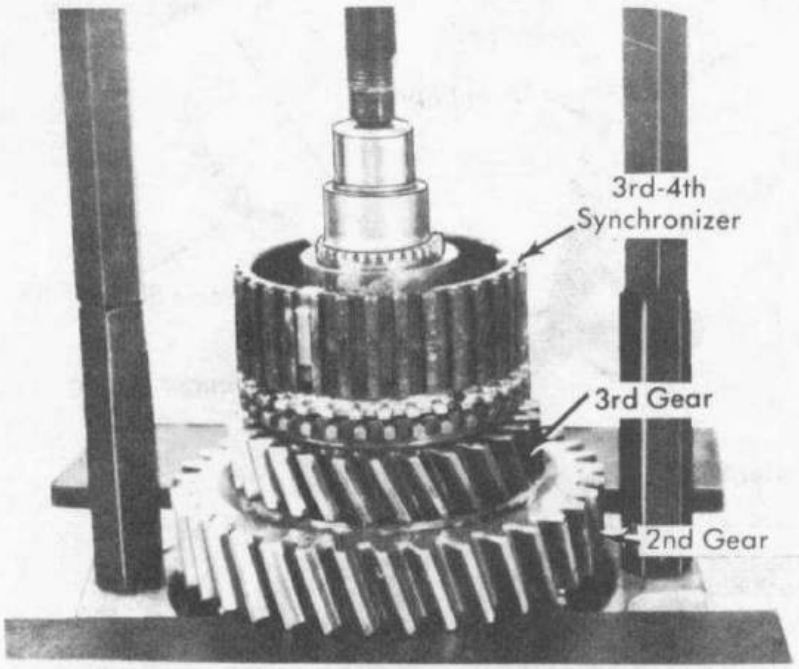


Fig. 8 Disassembling Mainshaft

3) Check 2nd speed gear and thrust washer for scoring or excessive wear. Check synchronizer springs for looseness or breakage. Inspect 2nd speed gear synchronizer blocker ring and bronze synchronizer cone on 2nd speed gear for excessive wear or damage. Also inspect 3rd speed gear synchronizer cone for wear.

4) The 1st-Reverse sliding gear must have a sliding fit on synchronizer hub and must not have excessive radial movement or rotational play. If gear is not free on hub, check for burrs on front end of half-tooth internal splines. Remove burrs by honing as necessary. Check all gears for excessive tooth wear or damage.

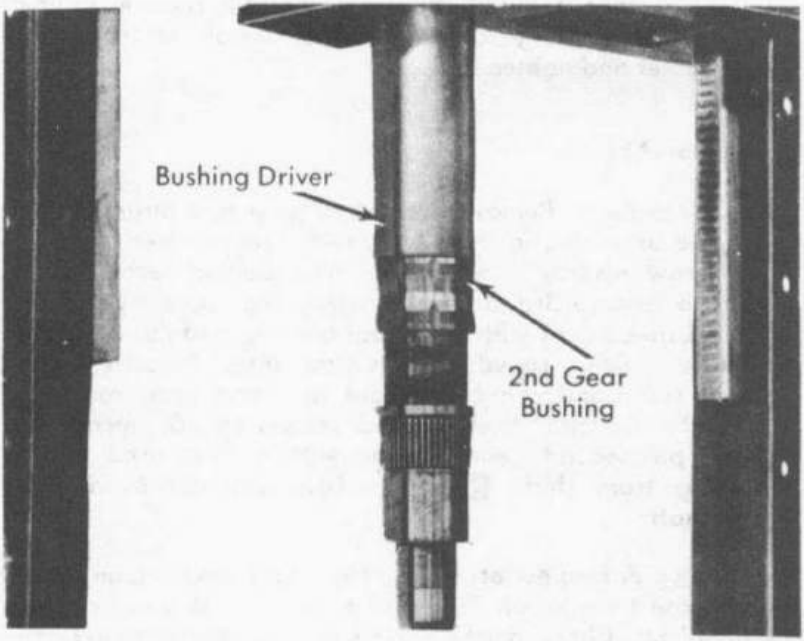


Fig. 9 Installing 2nd Gear Bushing

Reassembly – 1) Lubricate 2nd speed gear bushing with oil and press onto mainshaft until it bottoms on shoulder (see illustration). **CAUTION** – *Bushings for 1st, 2nd and 3rd speed gears are sintered iron, use care when installing.* Press 1st-2nd speed synchronizer hub onto mainshaft until it bottoms on shoulder. Install 1st-2nd speed synchronizer keys and springs (if removed). Using an arbor press, and tool (J-22873), press 1st speed gear bushing on mainshaft until it bottoms against hub. **NOTE** – *Lubricate all bushings with oil before installing gears.*

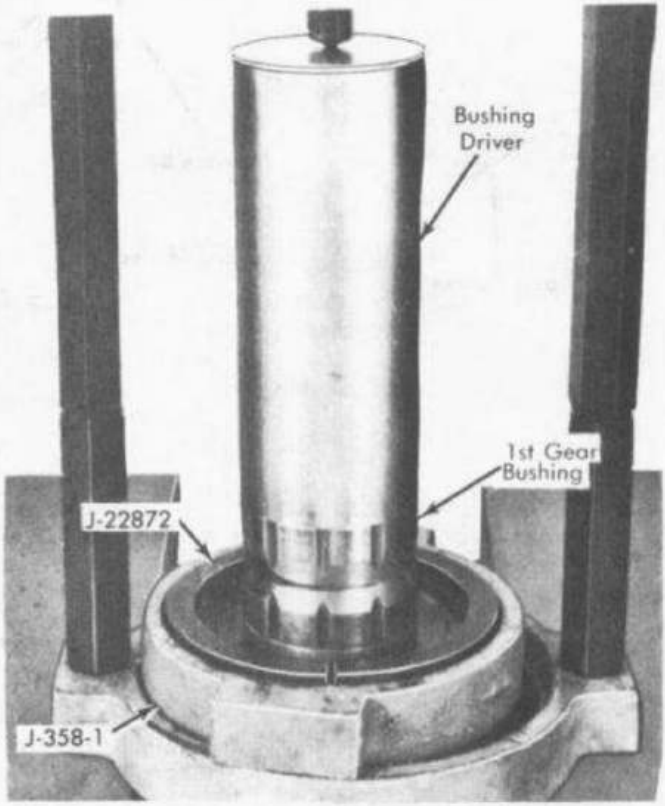


Fig. 10 Installing 1st Gear Bushing

2) Install synchronizer blocker ring and 2nd speed gear on mainshaft and against synchronizer hub. Index synchronizer key slots with keys in hub. Install 3rd speed gear thrust washer on mainshaft with tang in slot on shaft and against 2nd speed gear bushing. Press 3rd speed gear bushing on mainshaft using arbor and suitable tool (J-22875), until it bottoms on thrust washer (see illustration).

3) Install 3rd speed gear and 3rd speed synchronizer blocker on mainshaft, against 3rd speed gear thrust washer. Index synchronizer ring key slots with keys and drive 3rd-4th speed synchronizer hub assembly onto mainshaft using an arbor press and suitable tool (J-22873). Retain synchronizer assembly with snap ring. Install reverse driven gear with fork groove toward rear. Install 1st speed gear on mainshaft and against 1st-2nd speed synchronizer hub. Install 1st speed gear thrust washer.

COUNTERGEAR & SHAFT

Disassembly – Remove front countergear shaft snap ring and thrust washer. Discard snap ring. Install suitable press plates (J-22832) on countershaft with open side to spacer (see illustration). Support assembly in an arbor press and press countershaft out of clutch countergear assembly. **NOTE** – *Countergear is a slip fit and pressing may not be required.* Remove clutch countergear rear retaining ring and discard. Remove and discard third speed countergear retaining ring. Position assembly on an arbor press and press shaft from third speed countergear.

Cleaning & Inspection – Wash countergear components in clean solvent and inspect gear teeth for wear and damage.

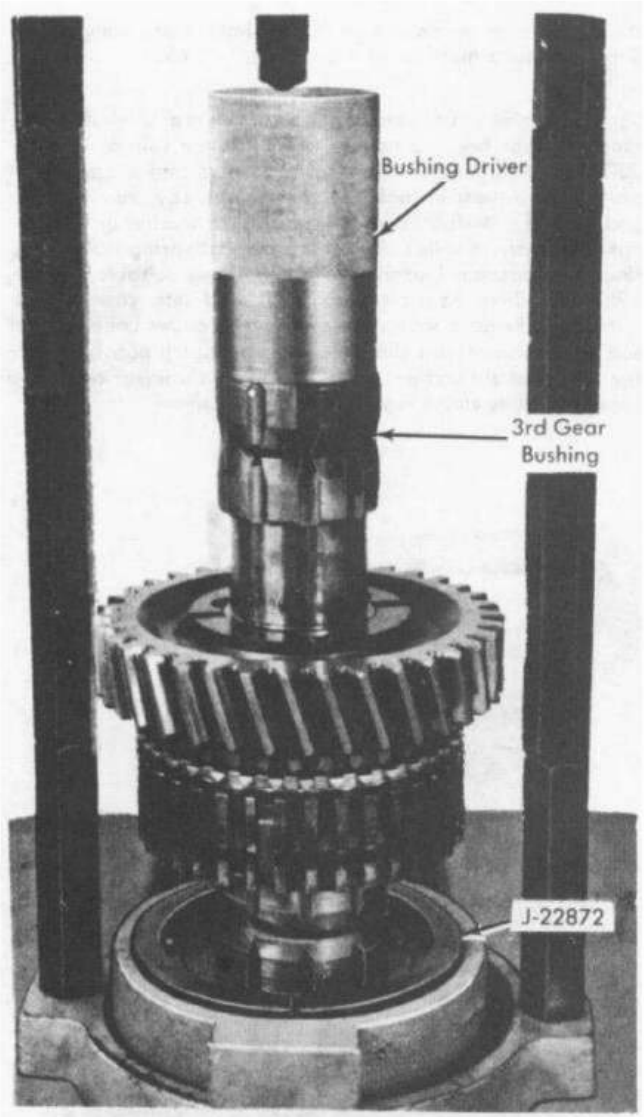


Fig. 11 Installing 3rd Gear Bushing

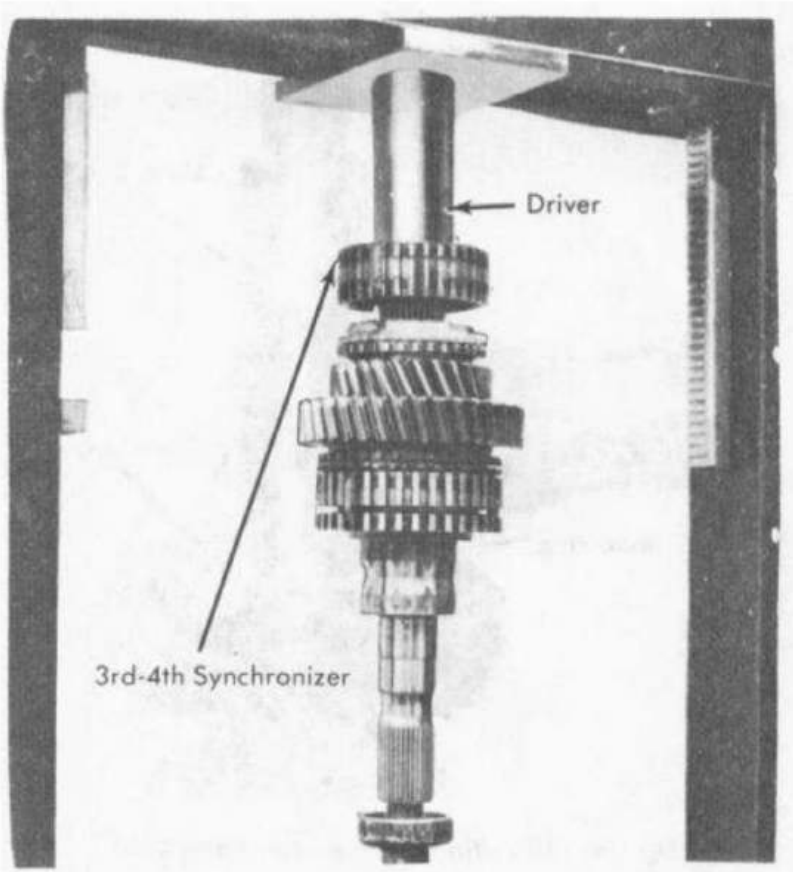


Fig. 12 Installing 3rd-4th Synchronizer

Reassembly – Position third speed countergear on shaft with marked surface toward front of shaft, then press gear on shaft with arbor press. Install a new snap ring. Install a new-countergear rear snap ring using suitable sleeve tools (J-22830 & J-22873) and snap ring pliers as follows: Install inner sleeve over shaft and place snap ring over tool. Push outer tool down on snap ring until it engages groove on shaft. Using snap ring pliers, carefully expand ring until it just slides onto splines, then push ring down until it engages groove on shaft. **CAUTION** – *Do not over-stress snap ring.* Position clutch countergear and spacer on shaft using a suitable driver (J-22873). Install countergear thrust washer and retaining ring.

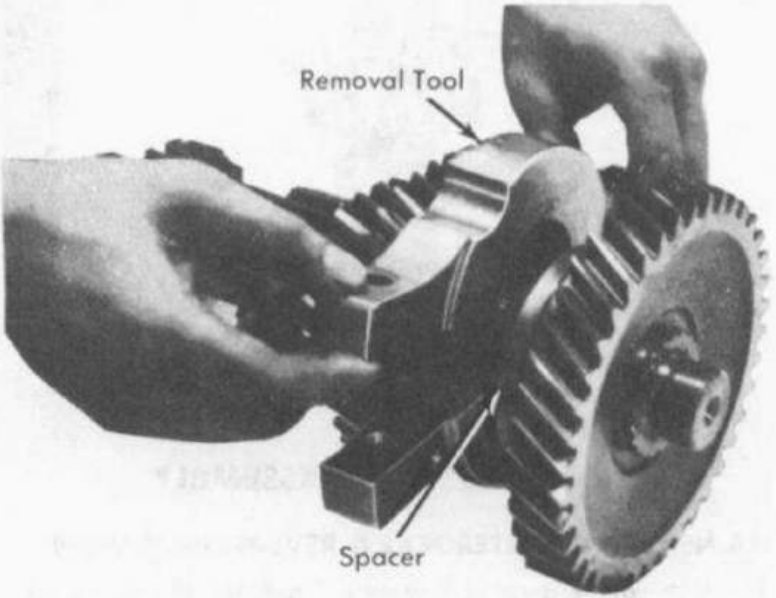


Fig. 13 Removal of Countergear

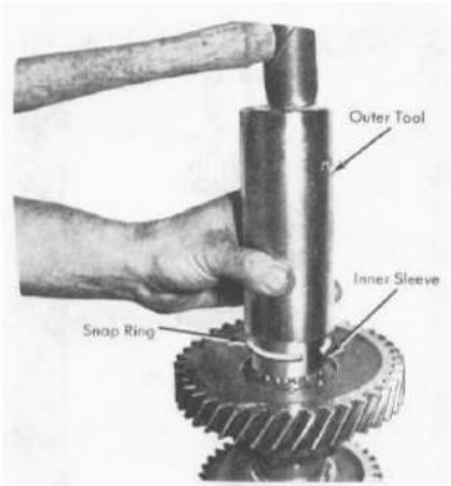


Fig. 14 Installing Countergear Snap Ring

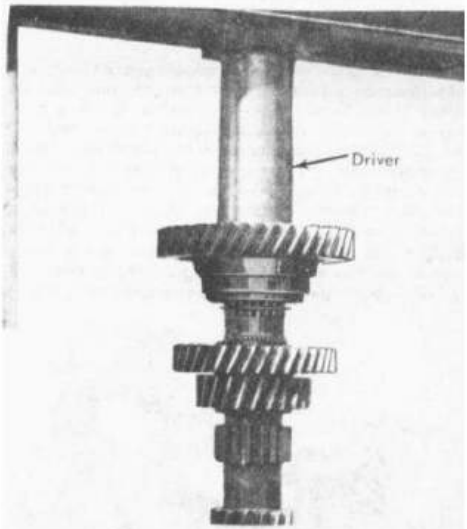


Fig. 15 Installing Countergear

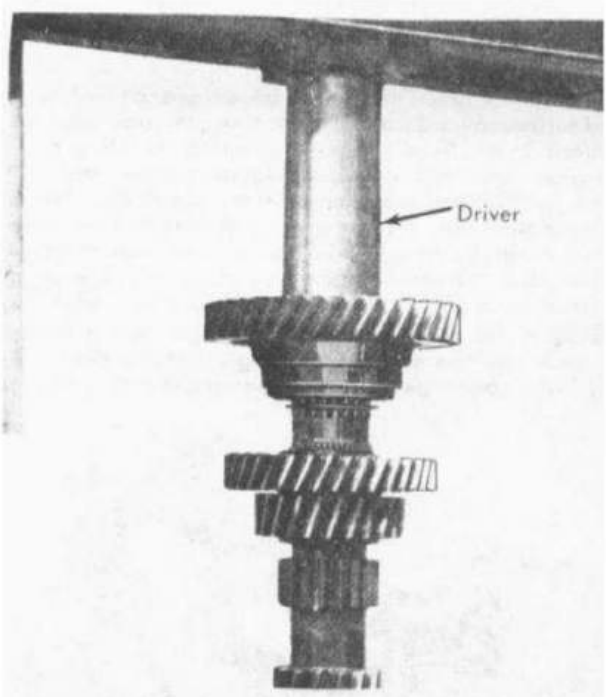


Fig. 15 Installing Countergear

TRANSMISSION REASSEMBLY

MAINSHAFT, COUNTERGEAR & REVERSE IDLER GEA

1) Place countergear in bottom of case. Install reverse gear in case with gear teeth toward front. Install idler

shaft from rear to front with slot in shaft end facing down. Shaft slot face must be at least flush with case.

2) Install mainshaft assembly in case with rear of shaft extending out rear bearing hole in case. Position suitable tool (J-22874-5) in pinion gear case front opening and engage front part of mainshaft in tool (see illustration). Lay case on front end. **NOTE** – *Install 1st speed gear thrust washer on shaft, if not previously installed.* Install mainshaft bearing outer snap ring and position bearing on shaft. Using suitable tool (J-22874-1), drive bearing onto shaft and into case (see illustration). Remove tools and install synchronizer cone on pilot end of mainshaft and slide rearward to clutch hub. **NOTE** – *The three cut out sections of 4th speed synchronizer cone must align with three clutch keys in clutch assembly.*

DRIVE PINION

Install drive pinion bearing outer snap ring. Position cutout portion of pinion gear teeth for mainshaft clearance when installing drive pinion. Raise mainshaft to engage drive pinion and 4th speed synchronizer, and tap bearing outer race with a plastic head hammer to install pinion. Install drive pinion bearing retainer using a new gasket and tighten bolts.

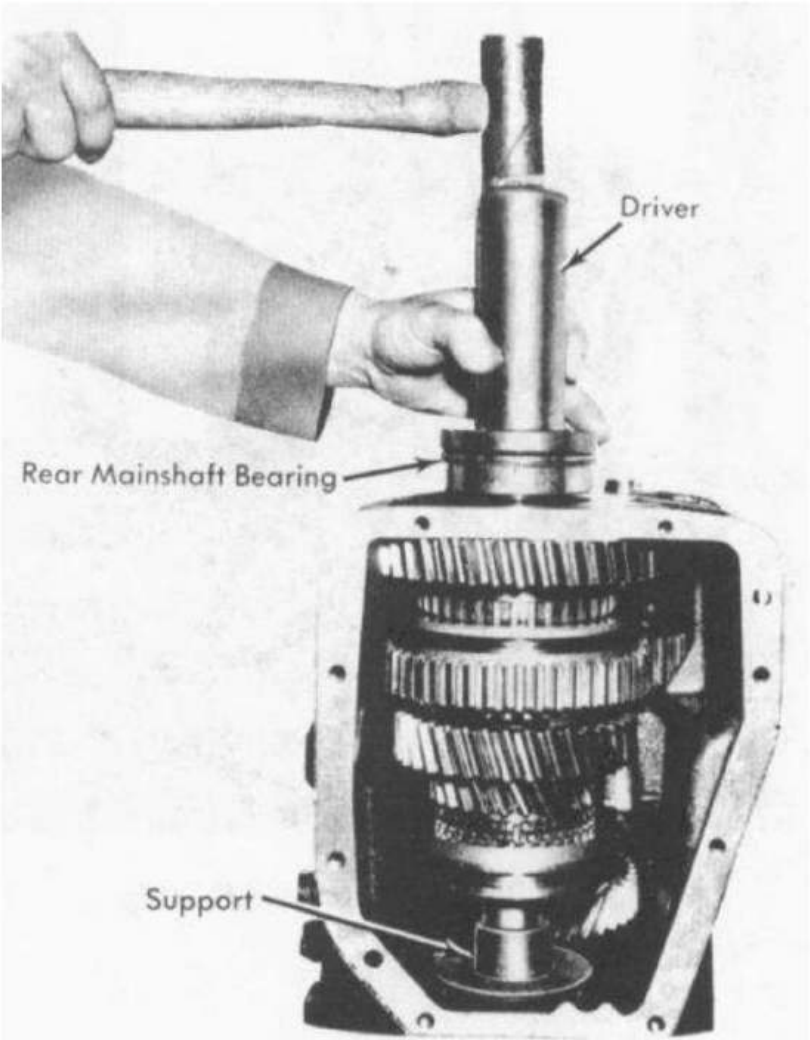


Fig. 16 Installing Rear Mainshaft Bearing

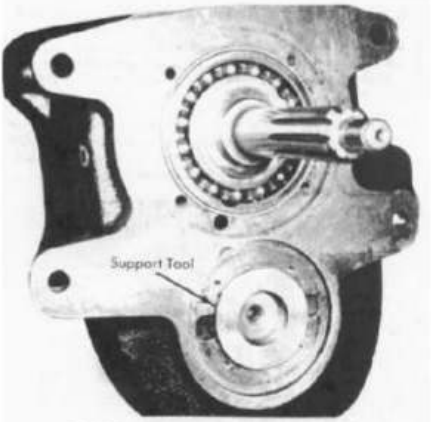


Fig. 17 Countergear Front Support Tool

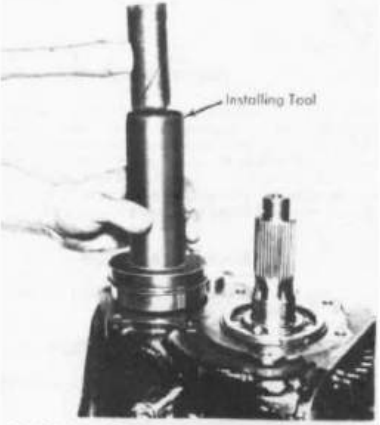


Fig. 18 Installing Rear Countergear Bearing

COUNTERSHAFT

Install suitable tool (J-22874-2) in countergear front bearing opening in case to support countergear (see illustration). Lay transmission case on front end and install outer snap ring on countergear rear bearing. Then position bearing on countergear and using suitable tool (J-22874-2), drive bearing into place (see illustration). Install snap ring on countershaft at rear bearing and remove tool. Tap countergear front bearing assembly into case and install front bearing cap with new gasket. Tighten cap screws.

OUTPUT YOKE & REAR BEARING RETAINER

Slide speedometer drive gear over mainshaft to bearing. Install rear bearing retainer with new gasket and ensure that snap ring ends are in lube slot and cutout in bearing retainer. Install bolts and tighten as specified. Install brake backing plate assembly if equipped. On models with a transfer case, install rear bearing lock nut and washer using suitable tool (J-23070), tighten nut and bend washer tangs to fit slots in nut. Install parking brake drum and/or universal output yoke. Apply a light coat of oil to seal surface. Lock transmission in two gears at once, install universal joint output yoke lock nut and tighten.

COVER & SHIFT FORK MECHANISM

Move transmission gears to neutral except reverse idler gear which should be engaged about ⅜". Install cover with new gasket, shifting forks must slide into their proper positions on clutch sleeves and reverse idler gear. Forks must be positioned as in removal. Install cover bolts and tighten.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Cover-to-Case Bolts	23
Countergear Front Cover Bolts	25
Drive Pinion Bearing Retainer	14
Drain & Filler Plugs	33
Output Yoke	95
Power Take-Off Cover	17
Parking Brake	22
Rear Bearing Retainer	23
Rear Mainshaft Bearing Lock Nut (4-WD)	100
Transmission-to-Clutch Housing	75

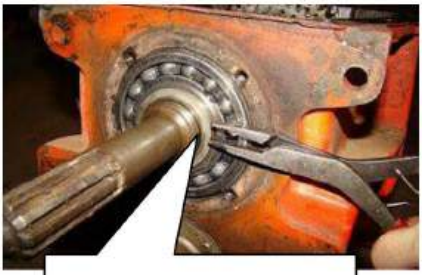
6.10.5 **Gearbox renovation - Image gallery**

Put the gear in half-way "reverse" to be able to open the top cover

Remove the front and rear bearing holder

Inspect the shifters. Pay extra attention to the 3rd gear shifter.

In addition to the hydraulic press, this is a necessary tool



Slight heating of the locking ring may be necessary

Dismantle bearings with a knife puller

The gears are removed from the main shaft and placed in order. Make sure that the shaft groove faces backwards towards the cardan.

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Straight 16-Cylinder

Transmission

For your own notes:

7 Speed control

7.1 Speed controller

7.1.1 Speed controller – General information

The speed controller…. TBD

7.1.2 Speed controller – Setting value

- 3000 revolutions per minute

7.1.3 Purpose of the speed limitation

- Reduce wear on chain drives, which are exposed to high centrifugal forces at high speeds.
- To some extent because the fan is not thermostatically controlled.
- Pressure oil pump speed must be limited due to the risk of cavitation.
  The pumps operate at double the speed compared to their original working conditions, as they are located against the engine shaft rather than the camshaft.
- The speed of the water pump must be limited due to the risk of cavitation. The gear ratio has been designed to provide high flow at low speed.
- The engine's plain bearings are at risk due to air bubbles in the pressurized engine oil, which is due to high oil flow through the engine. Air in the oil can cause cavitation damage.
- Due to the poor dimensioning of the pressure pipes, it is unlikely that it will be possible to obtain full oil pressure/flow through the engine at high speeds.

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Straight 16-Cylinder

Speed control

For your own notes:

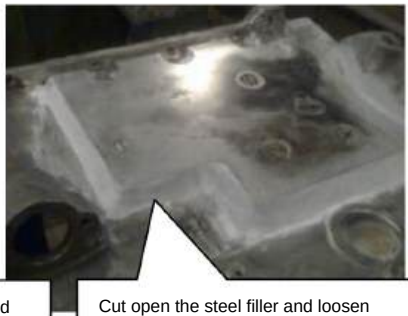
8 Sealing surfaces

8.1 Leakage – Potential joints.

Here are collected various thoughts on where it could start to leak, e.g. oil. Of course it can leak a little bit here and there, but during the work on the engine's design and manufacture, some experience has emerged on this subject.

8.1.1 Under the plate which attaches the engine plates

The plate covering the fuel pump hole is sealed with Form-a-gasket, but without a gasket. Tested with white spirit.



Cut open the steel filler and loosen the screws to access the cover.

Milling has been carried out at the fuel pump, oil dipstick and engine mount.

8.1.2 **Return oil filter holder**

Holder for return oil filter leaked a little during testing. Sealed by filling the adapter with a splash of Lock-Tite and pressurizing to about 3 bar. Pressed in a water bath and only a small bubble - which did not release from the substrate - was visible.

Screw holes at intermediate pieces

More text and images

9 Test at startup

Below are a number of points that can serve as support when starting up after a rebuild, renovation or something else radical, such as a longer period of downtime. It may be appropriate to add more checkpoints if there is the slightest doubt about any technical subject.

Measure:	Time:	Remark
Checking the amount of lubricating oil. (Assuming the oil does not need to be changed due to age)	Before starting, after the engine has been idle for a long period. Empty the compartments in the tray. Pour back the correct amount. with the engine level and the taps open. Close the taps afterwards.	
Checking the coolant level. (Assuming the coolant does not need to be changed due to age)	Before starting	
Checking drive belts	Before starting.	Check for cracks, belt tension.
Checking oil pressure	When starting the electric pump	Should be between 2.5 – 6 kp/cm² Melling pumps' overflow valve opens at **4.14 ATÖ** (60psi)
Checking oil pressure	Immediately after starting motor.	Should be between 2.5 – 6 kp/cm² at 2000 rpm
Differential pressure control at return filter.	As soon as possible after cold engine start	Read value: Max 1.0 kp/cm². (Filter bypass opens at 1.4 kp/cm²)
Checking differential pressure at return filter.	As soon as the engine has reached normal operating temperature.	Read value: Max 1.0 kp/cm². (Filter bypass opens at 1.4 kp/cm²)
Retightening of Cylinder Head.	After 10 minutes of operation when a new cylinder head gasket has been installed.	Tighten according to instructions after the engine has cooled down.

Söderström - HERCULES 1934

Straight 16-Cylinder

Other

Check ignition timing. As soon	as possible after start.	NOTE! As little difference as possible between distributors.
Checking Carburetor Settings.	As soon as possible after start.	

10 Spare parts and assembly materials

10.1 O-rings

Compilation of O-rings included in the engine. For more information, see the respective section.

10.1.1 O-ring 1,78mm

Location	Dimension	Anm.
Chain tensioner	Ø6.75	
Overflow valve at electric pump – Hatt Radial clamping screw at thrust bearing - Cap	Ø25,12	

10.1.2 O-ring 2,4mm

Location	Dimension	Anm.
Deaeration centrifuge.	Ø12	
Oil purifier cyclone.	Ø14.3	

10.1.3 O-ring 2,62mm

Location	Dimension	Anm.
Thrust bearing at M12 hole.	Ø15.08	
Check valve.	Ø18.72	
Oil purifier cyclone.	Ø20.29	
Magnetic plug in the bottom of the trough. Overflow valve at electric pump – Base.	Ø20.63	
Oil purifier cyclone.	Ø44,12	
Upper cooling pipe to thermostat bridge	Ø45,69	
Oil purifier cyclone.	Ø55.24	

10.1.4 O-ring 3mm

Location	Dimension	Anm.
Return filter holder at oil outlet to tank Ø24.2		
Return filter holder against trough	Ø32.2	
Holder for distributor	Ø34.2	
Oil purifier cyclone.	Ø74.5	
Deaeration centrifuge.	Ø137	

10.1.5 O-ring 3,53mm

Location	Dimension	Anm.
Oil purifier cyclone.	Ø107.54	
Deaeration centrifuge.	Ø129,77	Check it out! (all Ø130x4)

10.1.6 O-ring 4mm

Location	Dimension	Anm.
Oil purifier cyclone.	Ø125	Check!
Deaeration centrifuge.	Ø130	Check!129.77x3.53

10.1.7 O-ring 5,7mm

Location	Dimension	Anm.
Rear bearing on main shaft – Thrust bearing Ø119.2		

10.2 Sealing / Bonding Materials

10.2.1 FORM-A-GASKET - Gasket adhesive

PROPERTIES OF UNCURED MATERIAL Typical Value Chemical Type Modified resin, fillers & alcohol Appearance Dark brown liquid Odor Alcoholic Specific Gravity 1.1 Viscosity Viscous liquid Flash Point, TCC 16ºC

Temperature Resistance -54º - 204ºC

TYPICAL CURING PERFORMANCE Permatex

Aviation Form-A-Gasket® No. 3 Sealant once applied, develops into a pliable, tacky seal by solvent evaporation. Dry times will vary with temperature, humidity and gap.

10.2.2 LocTite 5910 - Motorsilikon

Engine silicone used on most sealing surfaces in Herkules 1934. For example: *Engine block* to *sump, spacers, transmission cover, etc.*

LOCTITE® SI 5910®

Known as LOCTITE® 5910
May 2014

PRODUCT DESCRIPTION

LOCTITE® SI 5910® provides the following product characteristics:

Technology	Silicone
Chemical Type	Oxime silicone
Appearance (uncured)	Black paste[LMS]
Components	One component - requires no mixing
Viscosity	Thixotropic paste
Cure	Room temperature vulcanizing (RTV)
Application	Sealing
Specific Benefit	Excellent resistance to automotive engine oils.

Typical applications include stamped sheet metal covers (timing covers and oil sumps) where good oil resistance and the ability to withstand high joint-movement is required. The thixotropic nature of LOCTITE® SI 5910® reduces the migration of liquid product after application to the substrate.

TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific Gravity @ 20 °C 1.34

Flash Point - See SDS

Extrusion Rate, g/min:
Pressure 0.62 MPa, time 15 seconds, temperature 25 °C:
Semco Cartridge 300 to 650[LMS]

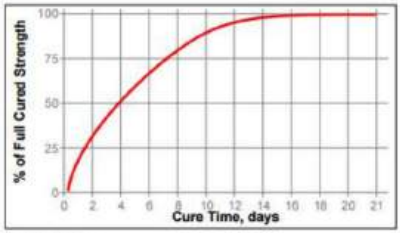
TYPICAL CURING PERFORMANCE

Surface Cure

Tack Free Time, minutes:
Cured @ 25 °C / 50±5 % RH ≤40[LMS]

Cure Speed

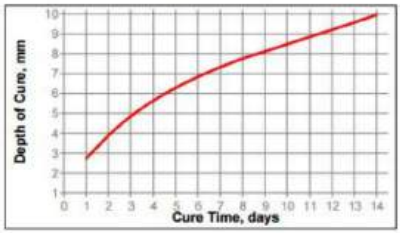
The graph below shows shear strength developed with time on Aluminum lapshears at a bond gap of 0.5 mm. Cure condition 23±2 °C, 60±5% RH. Strength is determined according to ISO 4587.



Depth of Cure

The depth of cure depends on temperature and humidity. Depth of cure was measured on strip pulled from a ramped PTFE mold (maximum depth 10 mm).

The graph below shows the increase in depth of cure with time at 23±2 °C / 50±5 % RH.



TYPICAL PROPERTIES OF CURED MATERIAL

Cured for 1 week @ 25 °C / 50±5 % RH

Physical Properties:

Shore Hardness, ISO 868, Durometer A		30
Elongation, ISO 37, %		≥400[LMS]
Tensile Strength, ISO 37	N/mm² (psi)	≥1.7[LMS] (≥247)
Tensile Strength, at 100% elongation, ISO 37	N/mm² (psi)	0.6 to 1.0[LMS] (87 to 145)

LocTite 5910 - Motorsilikon (forts.)

TDS LOCTITE® SI 5910®, May 2014

Electrical Properties:

Volume Resistivity, IEC 60093, Ω·cm	1.69×10^{14}
Surface Resistivity, IEC 60093, Ω	2.81×10^{16}
Dielectric Constant / Dissipation Factor, IEC 60250:	
1 kHz	4.53 / 0.019
100 kHz	4.09 / 0.009
1 MHz	4.05 / 0.008
10 MHz	4.08 / 0.017

TYPICAL PERFORMANCE OF CURED MATERIAL

Adhesive Properties

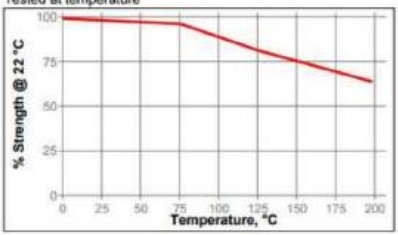
After 21days @ 23 °C / 60±5% RH and 0.5 mm gap
Lap Shear Strength, ISO 4587:

Mild steel	N/mm²	0.9 to 1.4
	(psi)	(130 to 200)
Aluminum 2024-T3	N/mm²	0.6 to 1.4
	(psi)	(90 to 200)
Alclad	N/mm²	1 to 1.6
	(psi)	(145 to 230)
Zinc dichromate	N/mm²	1 to 1.6
	(psi)	(145 to 230)

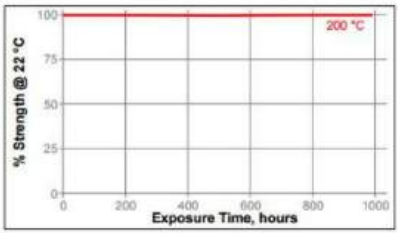
TYPICAL ENVIRONMENTAL RESISTANCE

Cured for 21 days @ 23 °C / 60±5% RH
Lap Shear Strength, ISO 4587:
Alclad

Hot Strength
Tested at temperature



Heat Aging
Aged at temperature indicated and tested @ 22 °C



Environmental Aging - Effect on bulk properties
Cured for 21 days @ 23±2 °C / 60±5% RH, 2 mm thick film
Tensile strength, ISO 37, N/mm² (Elongation, at break, %):

Environment	100 h	500 h	1000 h
22 °C	1.7(700)	2.4(600)	1.9(560)
150 °C	2.2(400)	2.2(450)	2.3(470)
175 °C	2.2(380)	2.1(350)	1.4(330)
200 °C	2.2(370)	2.0(340)	1.4(300)
5W40 oil, 120 °C	1.9(520)	2.3(490)	2.1(590)
Motor oil, 150°C	1.9(520)	1.8(450)	2.6(600)
Water/glycol	1.0(620)	0.6(540)	0.9(570)

GENERAL INFORMATION

This product is not recommended for use in pure oxygen and/or oxygen rich systems and should not be selected as a sealant for chlorine or other strong oxidizing materials.

For safe handling information on this product, consult the Safety Data Sheet (SDS).

Directions for use:

1. For best performance bond surfaces should be clean and free from grease.
2. Moisture curing begins immediately after the product is exposed to the atmosphere, therefore parts to be assembled should be mated within a few minutes after the product is dispensed.
3. The bond should be allowed to cure (e.g. seven days), before subjecting to heavy service loads.
4. Excess material can be easily wiped away with non-polar solvents.

10.2.3 LocTite XXXX – Threadlocker - Weak

For screws with less stress.

10.2.4 LocTite XXXX – Threadlocker - Medium

For screws with normal stress. Applies to most screw connections.

10.2.5 LocTite XXXX – Gänglåsning - Stark

For screws with higher stress. Applies only to a few screw joints.

10.2.6 LocTite 640 – Cylindrical Locking - Slow

Cylindrical locking, Permanent - Slow. For example to *the Distributor Shaft.*

Shear strength 22N/mm²

LOCTITE® 640™

December 2013

PRODUCT DESCRIPTION

LOCTITE® 640™ provides the following product characteristics:

Technology	Acrylic
Chemical Type	Urethane methacrylate
Appearance (uncured)	Green liquid[LMS]
Fluorescence	Positive under UV light[LMS]
Components	One component - requires no mixing
Viscosity	Low
Cure	Anaerobic
Secondary Cure	Activator
Application	Retaining
Strength	High

LOCTITE® 640™ is designed for the bonding of cylindrical fitting parts. The product cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration. Typical applications include retaining keys and splines, eliminating backlash in worn assemblies, retaining bearings in place - preventing spin out, retaining rotor to shafts in fractional and subfractional horsepower motors, retaining bushings and sleeves in housings and on shafts, augmenting press fits, restoring the fit to worn assemblies or out of tolerance parts.

Mil-R-46082B
LOCTITE® 640™ is tested to the lot requirements of Military Specification Mil-R-46082B. **Note**: This is a regional approval. Please contact your local Technical Service Center for more information and clarification.

ASTM D5363
Each lot of adhesive produced in North America is tested to the general requirements defined in paragraphs 5.1.1 and 5.1.2 and to the Detail Requirements defined in section 5.2.

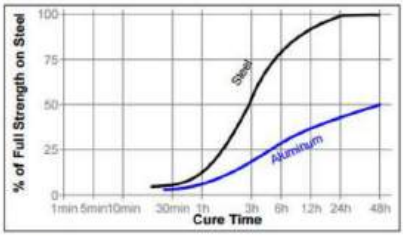
TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific Gravity @ 25 °C	1.2
Viscosity, Falling Ball 'D', @ 25 °C, mPa·s (cP)	450 to 750[LMS]
Viscosity, Cannon Fenske, ISO 3104, mPa·s (cP): #400	*450 to 750[LMS]

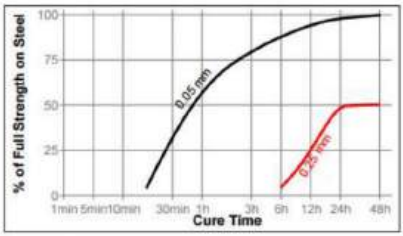
* Applies to material made in N. America
Flash Point - See SDS

TYPICAL CURING PERFORMANCE

Cure Speed vs. Substrate
The rate of cure will depend on the substrate used. The graph below shows the shear strength developed with time on steel pins and collars compared to different materials and tested according to ISO 10123.



Cure Speed vs. Bond Gap
The rate of cure will depend on the bondline gap. The following graph shows the shear strength developed with time on steel pins and collars using Activator 7471™ at different controlled gaps and tested according to ISO 10123.



Cure Speed vs. Temperature
The rate of cure will depend on the temperature. The graph below shows the shear strength developed with time at different temperatures on steel pins and collars using Activator 7471™ and tested according to ISO 10123.