PROJECT: MSS54

MODULE: INJECTION

INJECTION TRANSITIONS

AUTHORIZATION

AUTHOR (ZS-M-57)_______________________ DATE _________

APPROVED (ZS-M-57) _________________ DATE _________

APPROVED (EA-E-2) __________________ DATE _________

	Department	Date	name	file name
author	ZS-M-57	02.08.04	Riksén	4.03

x	redefinition		functional change		malfunction

Description:

1. Balancing of injected and burned fuel masses during operating mode transitions

Reason:

1. In some operating modes, fuel is stored in the intake manifold and only sucked in during the next working cycle

Current documentation: Chapter 4.03

Previous changes

version	Date	Description
	August 2, 2003	First Version
S360	10.09.04	Variable list revised/ B.Riksén

	NAME	DEPARTMENT	DATE
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1 FUNCTIONAL DESCRIPTION

1.1 PHYSICAL BACKGROUND

This module is used to balance the injected and burned fuel masses. This is
Operating mode transitions are necessary because in some operating modes fuel is stored in the intake manifold and is only sucked in during the next working cycle.
The wall film is not taken into account in this module.
The calculation must be individual for each segment or cylinder.

1.2 FES (EARLY ENTRY CLOSES) AND SES (LATE ENTRY CLOSES)

In FES mode, the amount of air-fuel mixture required is determined by the valve opening times.

At high speeds, the FES operating mode is no longer possible due to the minimal valve opening times and a change to the SES operating mode occurs.
In the SES operating mode, the full load quantity is first drawn in, after BDC the quantity not required is pushed back into the intake manifold and only then is the inlet valve closed. The quantity pushed back into the intake manifold is then available again for the next working cycle. In the stationary case, the stationary adjusted fuel mass is injected during the second working cycle, in the non-stationary case, ie when the operating mode and load change, the conditions change, so that a balance must be made between the burned and the upstream fuel mass.

1.2.1 OPERATION WITH FES

In FES mode, no mixture is pushed back into the cylinder, so no balancing of the fuel quantity is necessary.

1.2.2 TRANSITION FROM FES TO SES

When the intake closes early (FES), no mixture is pushed back into the intake port, i.e. the mixture in the intake manifold is zero. (The wall film is not taken into account.) When operating with SES, the cylinder is completely filled with mixture, homogenized in the cylinder and part of the charge pushed back into the intake manifold. To achieve a stoichiometric mixture, the amount of fuel for full load at lambda = 1 must be injected in the first working cycle and enriched to the desired air ratio using the correction factor. In the following working cycles, it must be ensured that the mixture in the cylinder and the pushed-back portion have the applied lambda homogeneously.

1.2.3 OPERATION WITH SES (INCL. CYLINDER DEACTIVATION WITH SES)

When operating with SES, the currently required full load quantity for lambda = 1 and the fuel quantity that flowed back in the previous AS are decisive for the injection. The currently required stationary fuel quantity is not taken into account during injection. This is then included in the fuel quantity that flowed back in the current AS and is therefore only taken into account in the following AS.

For each segment or cylinder there is an individual, stored quantity.

mk_korr = mk_vollast – mk_gespeichert [tpu_segm_index] corrected injection quantity

mk_gespeichert [tpu_segm_index] = mk_vollast – mk_stat amount stored in the intake manifold

1.2.4 TRANSITION FROM SES TO FES

When switching from SES to FES, the amount of fuel stored in the previous AS is in the intake manifold. If this amount is greater than that required for the AS, the corrected injection amount is limited to zero and the stored fuel amount is set to zero. The correction made is a one-off. If there is still fuel stored in the intake manifold after this AS, the next combustion will be too rich.

(This case occurs when a transition from SES to FES occurs and the load is less than 0.7, ie, less than half full load.)

mk_korr = mk_stat - mk_gespeichert [tpu_segm_index]

If (mk_stat <= mk_stored [tpu_segm_index]) mk_korr = 0

1.3 2V OPERATION

In 2V operation, only one of the two intake valves is opened alternately. However, for reasons of symmetry, the injected fuel mass is always evenly distributed between both intake valves, so that only part of the injected quantity can be sucked into the cylinder.
In alternating 2V operation, fuel is alternately stored in front of the closed intake valve and sucked in during the next working cycle. A balance must be formed from the last and the current AS.

When switching to 2V operation, an additional quantity (upstream fuel quantity) must be injected. The additional quantity must not be twice the required quantity, otherwise no injection would be necessary in the following AS. In the following n work cycles, the additional quantity is recalculated. In order to define the engine behavior, a fuel capture level is defined that defines the ratio of the intake to the injected fuel mass. A capture level greater than 0.5 and less than 1 results in a regulation of the additional quantity.

If the 2V operating mode is exited, the current injection quantity is reduced by the excess quantity and the excess quantity is subsequently set to zero. The capture level assumes the value 1, whereby the upstream fuel mass in the next AS also becomes zero.

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mk_stored [tpu_segm_index] = mk_corr * (1 – kr_fang)	before the valve is closed
mk_Zyl = mk_korr * kr_fang + mk_gespeichert [tpu_segm_index]	in the cylinder
mk_korr = mk_stat – mk_Übergang	injected fuel mass

This results in the following by inserting Eq. 3 into Eq. 2 and with the condition: mk_Zyl = mk_stat

mk_transition =(mk_stat – mk_stored [tpu_segm_index])/kr_fang – mk_stat

mk_korr = (mk_stat – mk_gespeichert [tpu_segm_index])/kr_fang

mk_stored [tpu_segm_index] = mk_korr * (1 – kr_fang)

kr_fang = variable from the map over load and speed with the dimension [5,5]

1.4 OVERHEAT SWITCH-OFF (SA) AND CYLINDER SWITCH-OFF (ZAS)

In the SA and ZAS operating modes, the intake valves are kept closed. If fuel was stored in the previous AS, it remains stored in the intake manifold and is available again in the next active AS.

The last stored fuel quantity must remain stored internally in the computer and will be taken into account again in the next active AS.

1.5 FUEL BALANCE

In summary, the fuel mass balance is as follows:

if (SES)

mk_korr = ((mk_vollast – mk_gespeichert [tpu_segm_index]) / kr_fang)

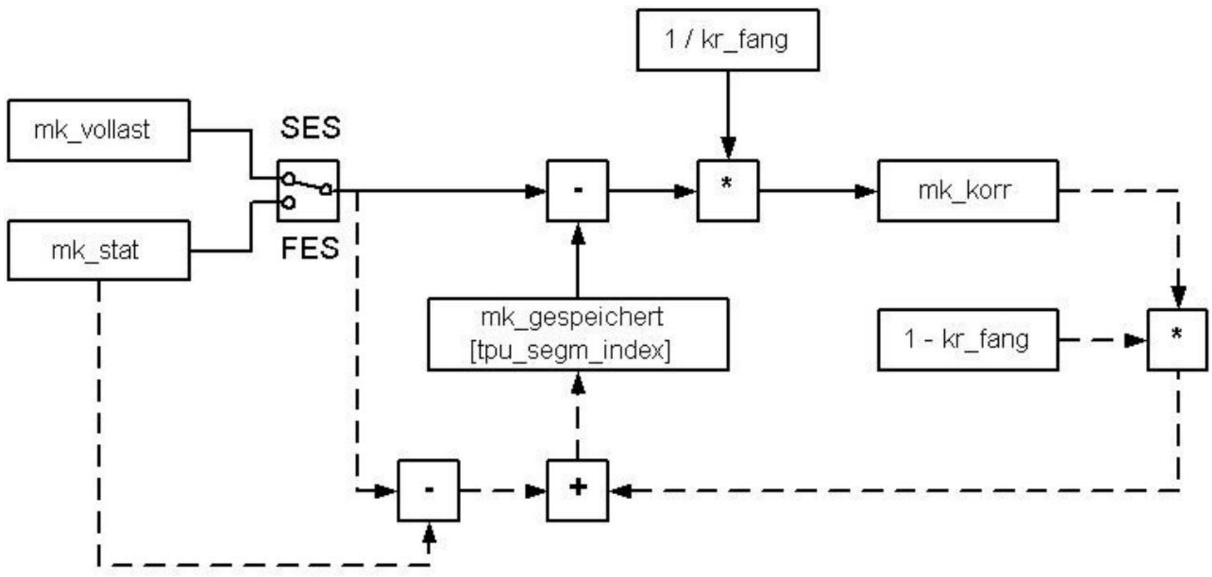
mk_gespeichert [tpu_segm_index] = mk_vollast – mk_stat + (mk_korr * (1.0 – kr_fang))

else if (FES)

if (mk_stat <= mk_stored [tpu_segm_index]) mk_korr = 0

else mk_korr = ((mk_stat – mk_gespeichert [tpu_segm_index]) / kr_fang)

mk_stored [tpu_segm_index] = (mk_korr * (1 – kr_fang))



1.6 APPLICATION INSTRUCTIONS

- Application of kr_fang between 0.51 and 1; for 4V and 3V operation kr_fang must be = 1

2 MODULE DATA

The function is calculated in the slave.

	angle	background	1ms	10ms	20ms	100ms	1s
task	x						

variables

variable	Initialization 0	Unit mg /	Area Quant.	Impl.		Page
mk_stat		Asp	0 - 131.07	0.01	uword	
mk_vollast	0	mg / Asp	0 - 131.07	0.01	uword	
mk_stored [tpu_seg_to_datagrave]	0	mg / Asp	0 - 131.07	0.01	uword	
mk_korr	0	mg / Asp	0 - 131.07	0.01	uword	
kr_fang	0			0.001	uword	

	Department	Date	name	file name
author	ZS-M-57	02.08.04	Riksén	4.03

parameter

app size	support points	Unit	Area Quant.	Impl. ubyte		Page
B_TIUEB			0-1	1		
	0: Tiueb inactive / 1: Tiueb active					

characteristics

app size	support points	Unit	Area Quant.	Impl.		Page

maps

Appl size	support points	Unit	Range Quant.	Impl. 0.51p to 1p		Page
kf_ti_kr_fang	5xn, 5xwi	-			uword	4