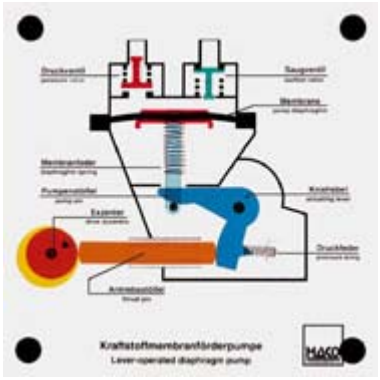
HAKO Overheadmodels - Section 2

Fuel supply, mixture preparation in petrol and diesel engines, supercharging, cooling, lubrication

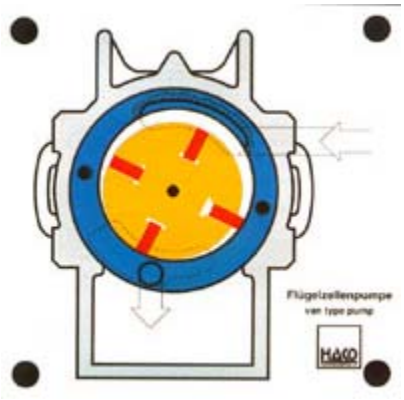


Order no. 166
Diaphragm fuel pump

- delivery and suction stroke
- function of the valves
- principle of elastic delivery

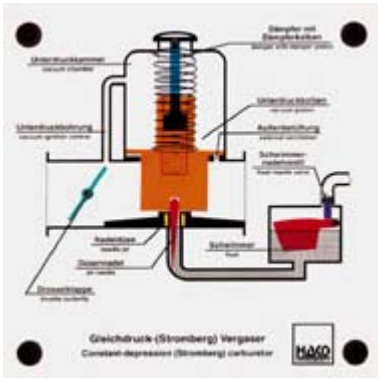
Order no. 125
Roller-cell pump

- function of the pump
- centrifugal force causes rollers to seal



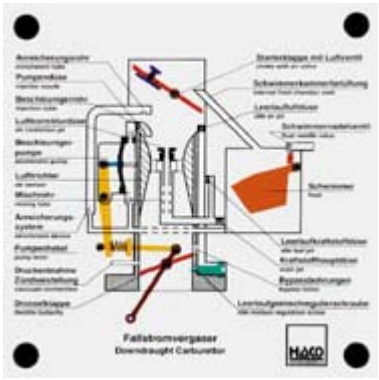
Order no. 124
Vane-pump

- function of the pump
- centrifugal force causes apex seal to fit
- apex seal don't fit at slow rotation



Order no. 147
Constant-vacuum carburetor

- function of float, float-needle and damper piston

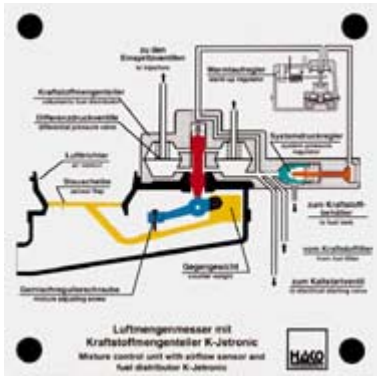


Order no. 165
Downdraught carburetor

- function of float, choke, air valve, throttle, accelerator pump and idle mixture regulation screw (all can be moved)

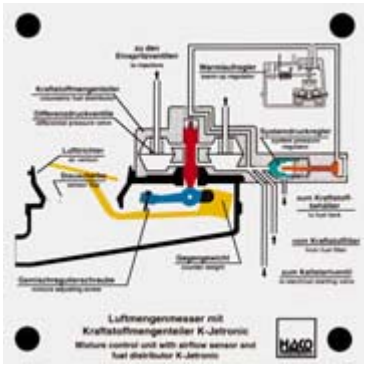
Order no. 173
Electronic system (carburetor)

- adjustable: float, idle mixture regulation screw, choke actuator, control needle, choke plate, throttle and throttle potentiometer

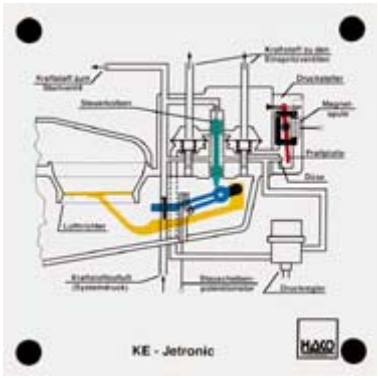


Order no. 148
Air-flow sensor with fuel distributor K-Jetronic

- function of the air-flow sensor plate
- actuating the control plunger
- CO-value setting by means of the M3 screw (idle mixture adjusting screw)

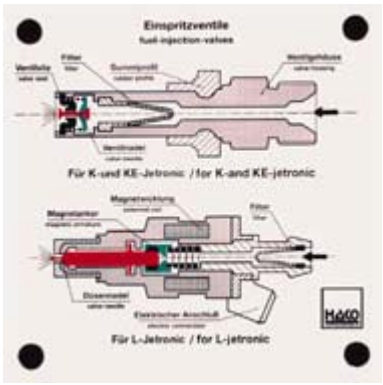


- function of the primary-pressure regulator
- primary-pressure regulator and warm-up regulator acting in combination on the control pressure at the control plunger



Order no. 177
KE-Jetronic fuel injection

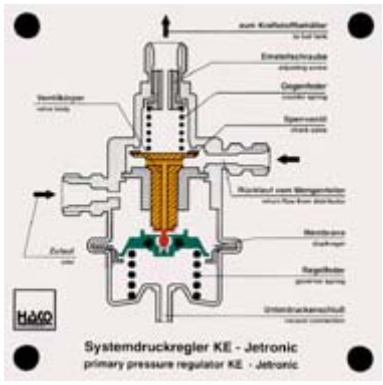
- rebound plate, diaphragms, sensor plate, control plunger and sensor-plate potentiometer can be actuated
- the idle-mixture adjusting screw ca be adjusted. Thus, it can be shown how the control plunger is lifted



Order no. 261
Fuel injection valves

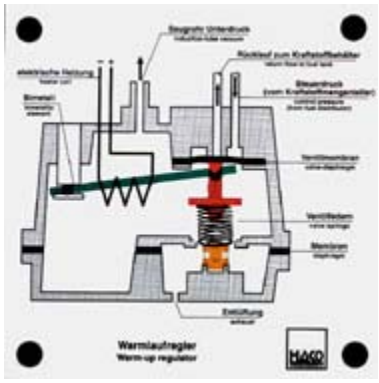
For K- and KE-Jetronic:
- the valve needle is opened by overpressure (3.3bar)
- interaction of valve needle, valve seat and spring

For L-Jetronic:
- function of the magnetic armature
- function of the valve needle



Order no. 325
Primary pressure regulation KE-Jetronic

- function of the diaphragm and of the valve body
- observation of the exact primary pressure
- closing of the return line when engine is turned off



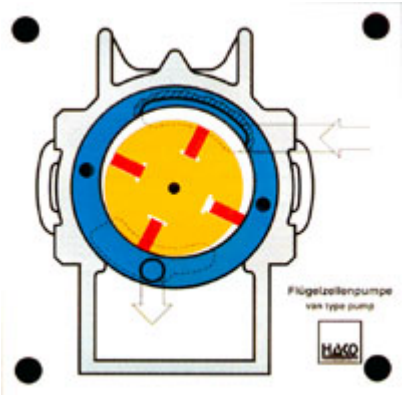
Order no. 149
Warm-up regulator K-Jetronic

- function of the bimetal spring
- function of the valve diaphragm
- function of the valve springs
- function of the vacuum diaphragm

Order no. 195
Airflow adjustment by adequate shape of the air funnel

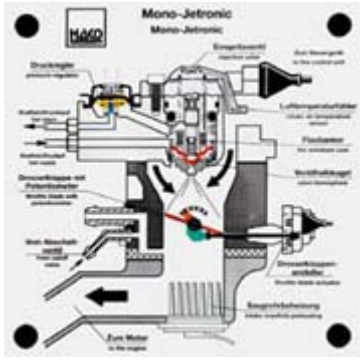
- different angles of the air funnel cause a good adjustment of mixture ratio to loadl

- different openings of the air funnel, which depend on height of the opening and angle of the air funnel, can be read



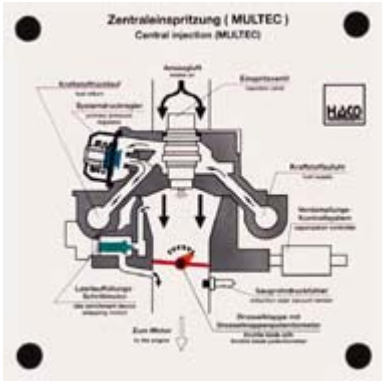
Order no. 182
L-Jetronic fuel injection

- throttle, sensor flap and auxillary-air device can be actuated
- adjusting idle-speed adjusting screw and idle-mixture adjusting screw
- function of throttle and sensor-flap potentiometer



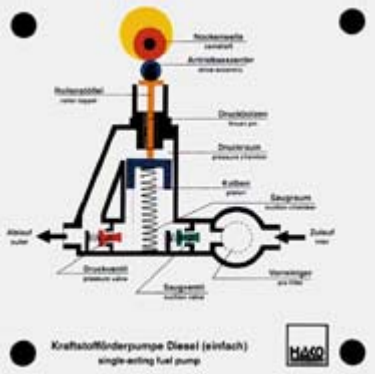
Order no. 272
Central injection Mono-Jetronic

- actuating the throttle blade
- moving the throttle-blade actuator
- moving the diaphragm in the pressure regulator
- moving the pintle-type nozzle valve
- interaction of different elements



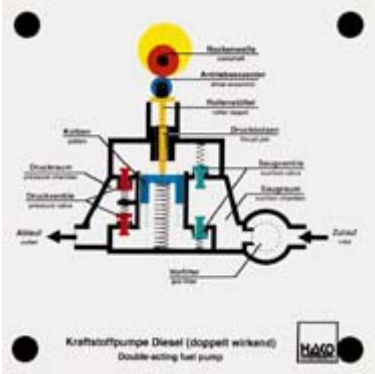
Order no. 271
Central injection Multec

- moving the throttle blade
- changing the bypass cross section by means of the stepping motor and thus adjusting the idle speed
- moving the diaphragm of the primary pressure regulator
- interaction of different elements



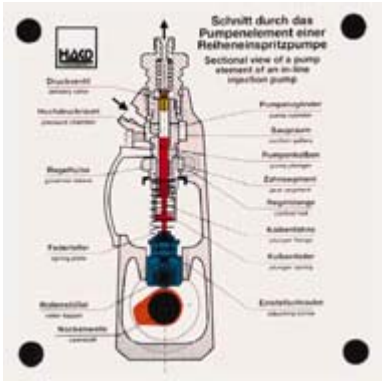
Order no. 126
Single-acting fuel pump for Diesel engines

- function of the pump
- elastic supply
- co-ordinated displacement of the valves



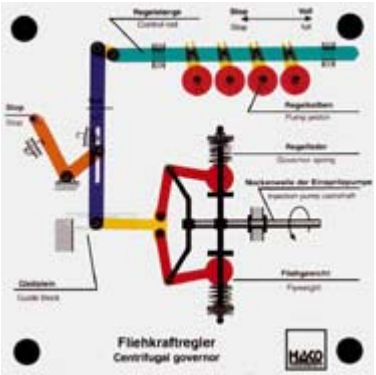
Order no. 127
Double-acting fuel pump for Diesel engines

- same as Order no. 126 but with two delivery strokes



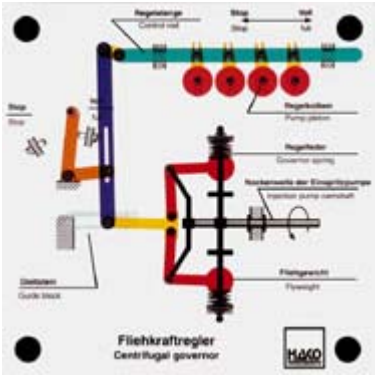
Order no. 260
Pump element of an in-line injection pump

- moving the camshaft and the cam
- stroke of the pump piston, spring effect
- motion and function of the delivery valve
- interaction of all pump elements



Order no. 133
Centrifugal governor of a Diesel engine (idle and max. speed control)

- control of fuel delivery rate when accelerating - function of the centrifugal weights



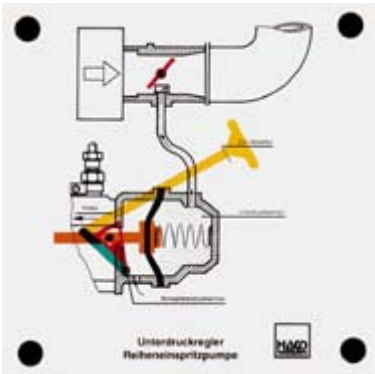
- function of the idle-speed governor spring
- function of the maximum-speed governor spring

Order no. 134
Centrifugal governor of a Diesel engine (variable-speed governor)

- function of the governor at any load range
- especially suited for master classes and work training

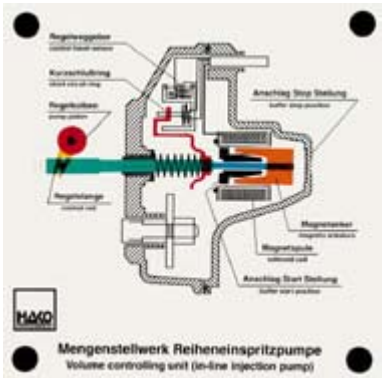
Order no. 137
Injection-timing device of an in-line pump

- function of the centrifugal weights
- function of the retracting spring
- injection advance caused by the centrifugal weights acting on the camshaft



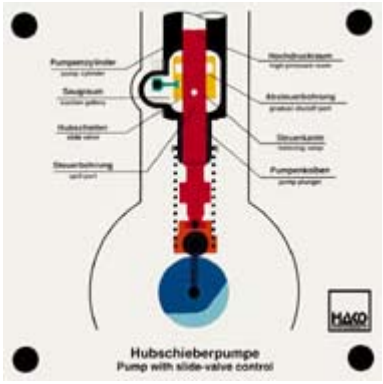
Order no. 132
Vacuum governor of a Diesel in-line type injection pump

- actuating the throttle
- any diaphragm position between full-load and stop possible
- starting enrichment and cut-off



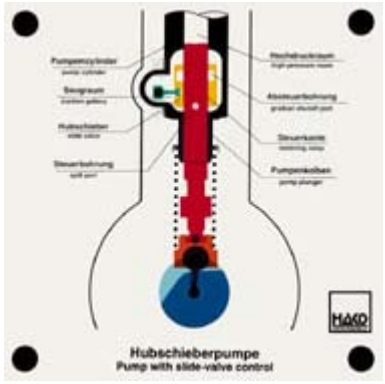
Order no. 386
Volume controlling unit (in-line injection pump)

The volume control is achieved by a solenoid coil which is actuated by the control unit. The control travel sensor informs the control unit of the position of the control rod.



Order no. 389
Pump with slide-valve control

The slide-valve, which is moved via a rod by a magneto, enables the start and the end of the injection to be determined by the control unit. The point where the pump plunger covers the hole in the control slide valve is the start of injection.



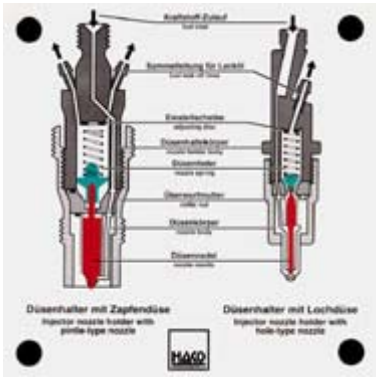
The end of injection is reached when the metering ramp reaches the gradual shut-off port in the slide valve.

Order no. 259
Delivery valves

- opening the delivery valve when delivery starts
- closing the delivery valve when delivery ends
- relieving the pressure line with the the relief plunger

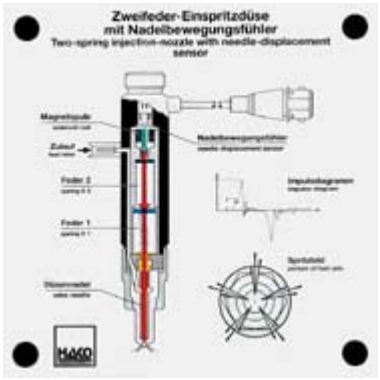
With a reverse flow damping valve:

- the leaf valve can be lifted and closed
- damping the pressure vibrations with the reverse flow damping valve



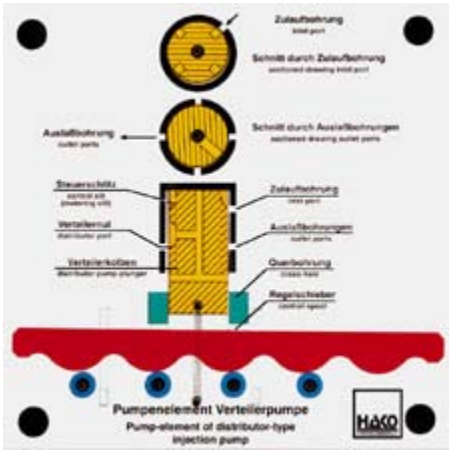
Order no. 208
Injection-nozzle holder with hole-type nozzle and pintle-type nozzle

- two injection nozzles on one overhead model
- similar to real injection procedure, the nozzle needles can be moved



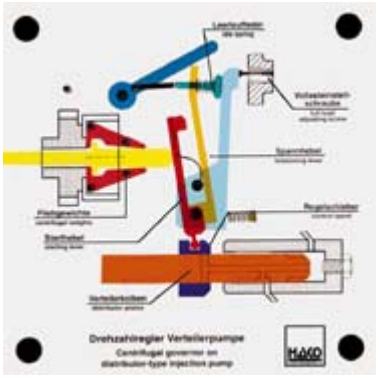
Order no. 291
Two-spring injection-nozzle with needle-displacement sensor

- low fuel injection (the valve needle is lifted against the weak spring #1
- high fuel injection (the valve needle is lifted against stiff spring #2)
- the needle-displacement sensor senses start of injection



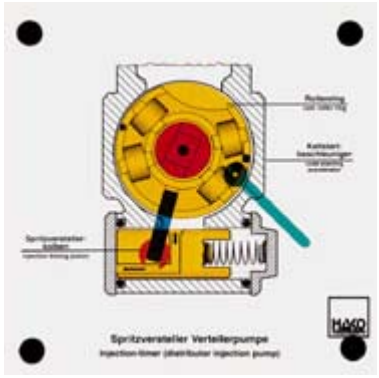
Order no. 180
Pump element of a distributor-type injection pump

- actuating the lifting disk (cams shown in a plane)
- control piston is lifted
- actuating the controll sleeve
- cross section of the outlet port can be turned to show the process of distribution



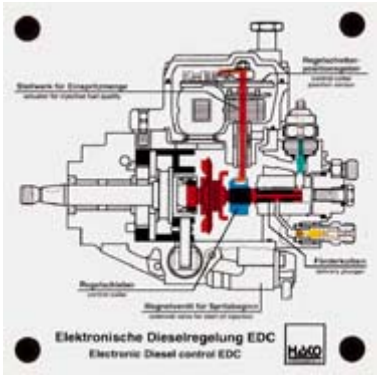
Order no. 135
Speed governor of a distributor-type injection pump

- injection control while accelerating
- the distributor plunger pumping action is cut off
- function of the idle spring
- function of the centrifugal weights
- function of the control sleeve



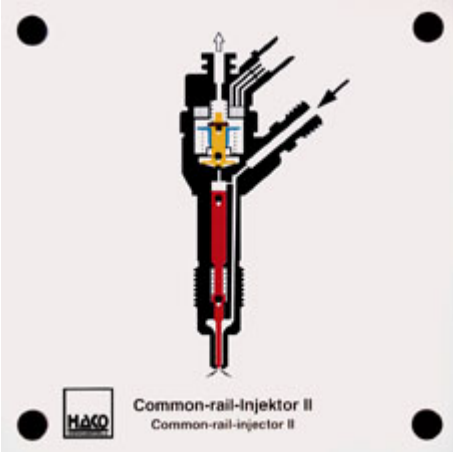
Order no. 136
Injection-timing device of a distributor pump

- injection timing device in motion
- rotating the roller ring
- function of the cold-start accelerator



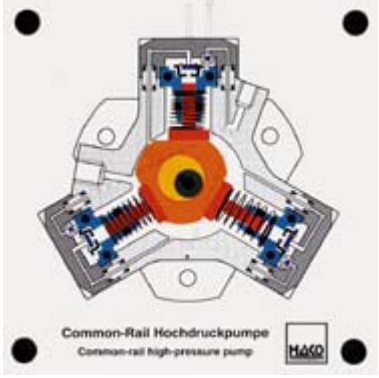
Order no. 210
Electronically controlled distributor-type injection pump

- rotating the transducer's eccentric shaft displaces the control sleeve
- actuating the cut-off valve
- function of the pressure valve piston
- moving the distributor piston (a folio with all sensors and a control unit is enclosed)



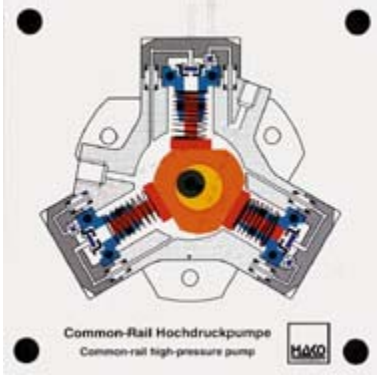
Order no. 455
Common-rail injector II

Opening and closing of the nozzle needle with pilot injection, main injection and subsequent injection. Opening and closing of the spherical valve on the ball support as a function of the solenoid valve and the high pressure on the valve actuation piston.

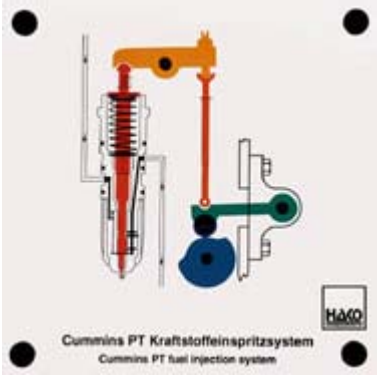


Order no. 404
Common rail high pressure pump

B turning the operating lever the function of the eccentric cam and the pumping effect of the pump piston can be seen. In addition the aspiration of the fuel via the membrane valve from the interior of the

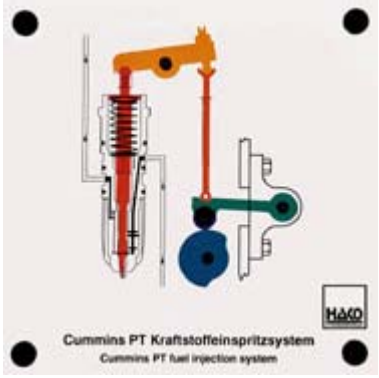


pump and the discharge of the fuel via the ball valve into a cellector line to the rail can be demonstrated.



Order no. 355
Cummins PT fuel injection system

- injection process via cam, cam follower and rocker arm directly to the injector needle
- fuel delivery control

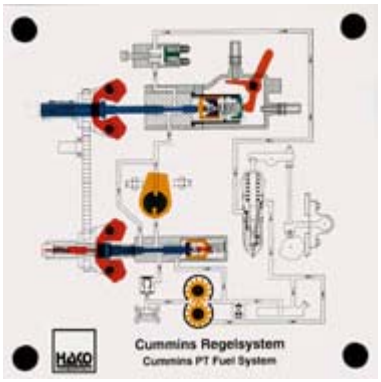


- generation of extremely high injection pressures

Order no. 314
Hydraulic cold-start injection advance KSB

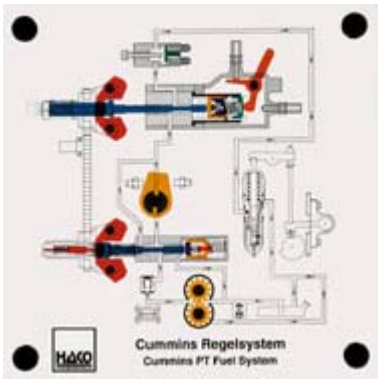
Model of the whole system
- actuating pressure control valve and pressure-holding valve
- when the pressure decreases, the injection-

timing piston is moved
- turning the roller ring into advance direction

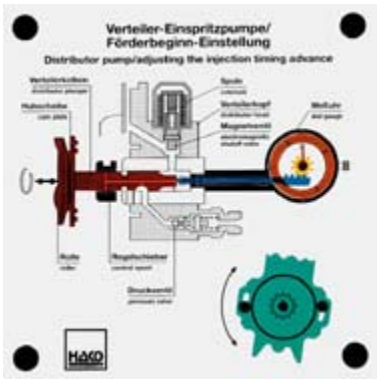


Order no. 356
Cummins PT fuel system

- function of the gear wheel pump
- function of the PTG flyweight governor
- function of the VS governor
- function of the throttle shaft

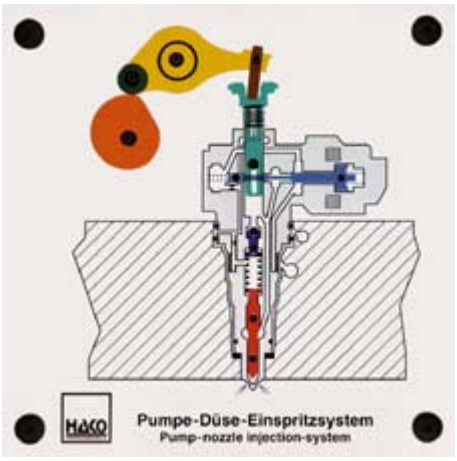


- function of the VS throttle shaft
- function of the cut-off solenois valve



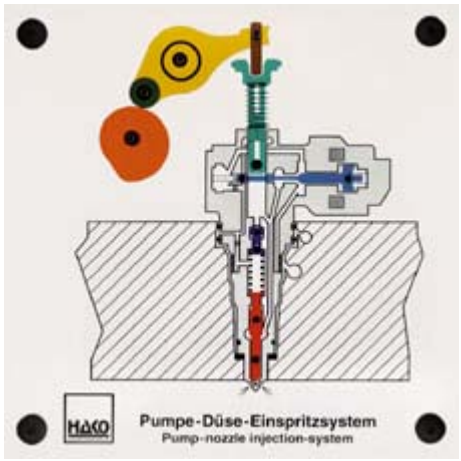
Order no. 317
Distributor pump (adjusting the injection timing advance)

- planning the work process to adjust the injection timing advance
- TDC-position of the pump plunger
- setting the dial gauge
- turning the pump flange to adjust injection timing advance



Order no. 440
Pump-nozzle injection system II

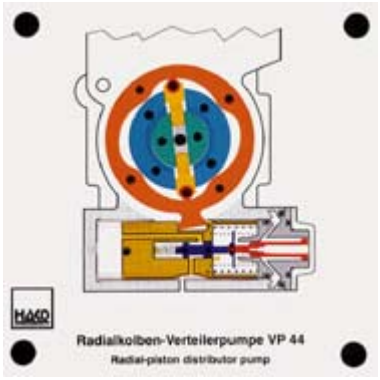
Latest generation of the pump-nozzle unit system
Generation of high pressure (2000 bar)
Function of injection cam and rocker arm
Function of the high pressure injection element



Function of the solenoid valve
Pre-injection and main injection

Order no. 405
Pump-lines-nozzle

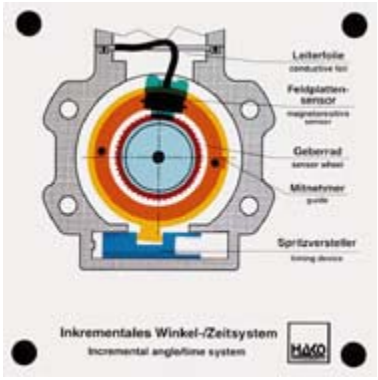
Combined effect of piston, connecting rod and crankshaft and onward transmission of the power via gear wheels and the cam to the pump piston. Function of the injection nozzle and the solenoid valve in controlling the start of injection and the rate of injection



Order no. 394
VP 44 radial-piston distributor pump

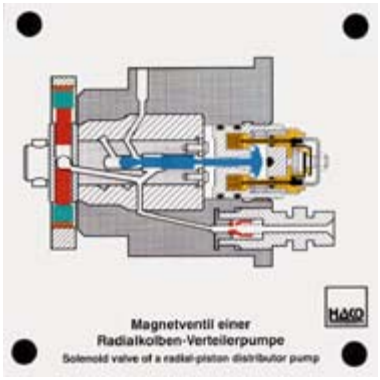
- function of the high pressure pump
- combined effect of cam ring and roller tappet on piston
- function of the fast injection timing device with relief piston

- injection timing



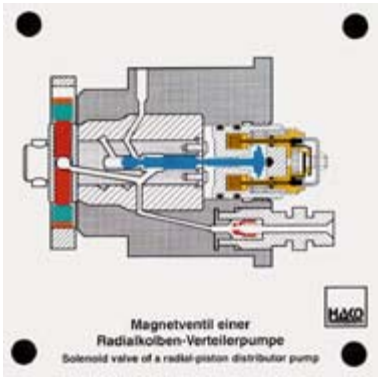
Order no. 396
Incremental angle/timing system

- function of the magnetoresistor sensor
- function of the induction sensor
- function of the driver
- function of the injection timing device

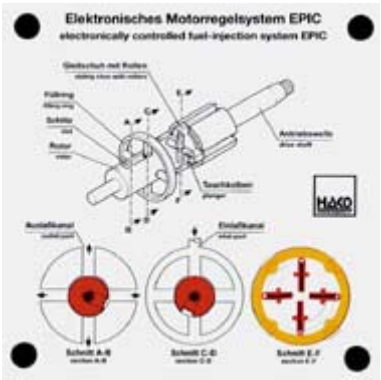


Order no. 412
Solenoid valve of radial-piston distributor pump

- function of the high pressure pump
- opening and closing of the solenoid valve to control the point of injection and the rate of injection

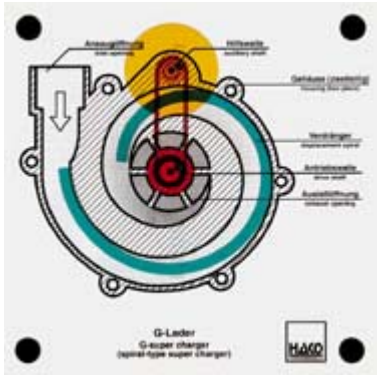


- return flow with solenoid valve open
- injection with solenoid valve closed
- function of the return flow throttling valve



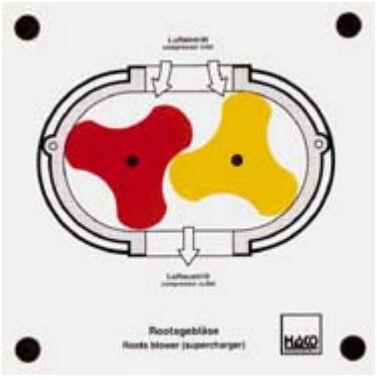
Order no. 281
Electronically controlled fuel-injection system EPIC

EPIC = Electronically Programmed Injection Control
- function of the high pressure pump (section E-F)
- filling procedure (section C-D)
- fuel distribution to the cylinders (section A-B)



Order no. 161
Spiral-type supercharger

- function of drive shaft and auxillary shaft
- motion of the displacement spiral
- in the housing, air is compressed by the displacement spiral from the outside to the inside



Order no. 205
Roots blower

- function of a roots blower
- the rotors are driven by spur gears
- roots blowers are used as chargers for Otto and Diesel engines

Order no. 358
Variable geometry turbocharger

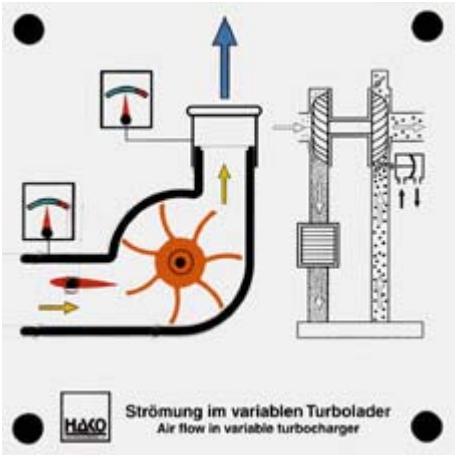
- guide vane adjustment via setting ring
- different turbine wheel flow depending on guide vane adjustment

- objective: torque increase in lower speed range
- in upper speed range bypass is no longer necessary

Order no. 414
Turbocharger with variable blade geometry

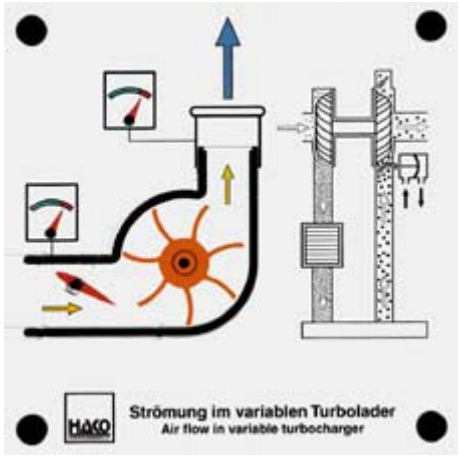
Function of the turbine and blower wheels. Adjustment of the guide vanes by means of the adjusting ring. Charging-pressure control via the vacuum call by turning the adjusting ring. Boost pressure control with variable geometry.

- adjustment of the guide vanes by means of the vacuum cell
- control of the vacuum cell
- function of the solenoid valve
- pressure control by the solenoid valve and control unit

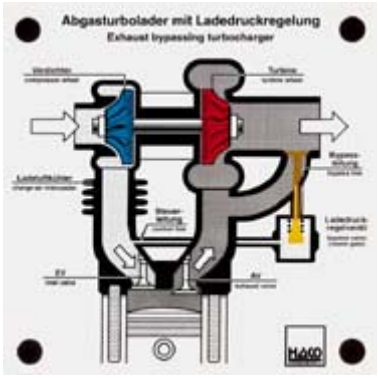


Order no. 442
Air flow in a variable turbocharger

With the help of the fan supplied, air is pressed into the turbo charger; function of the guide vanes



If the engine speed is too low, the cross-section is reduced, the output rotor turns more quickly



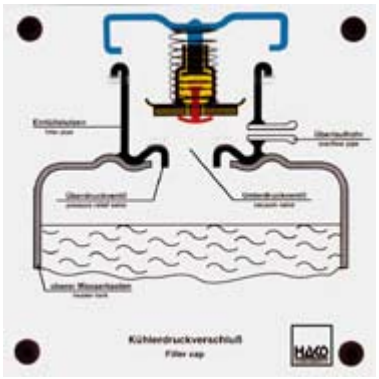
Order no. 243
Exhaust-gas turbocharger

The model shows an exhaust-gas turbocharger in longitudial section. The function of the charged.pressure control can be demonstrated.

Order no. 416
Pressure-wave supercharger

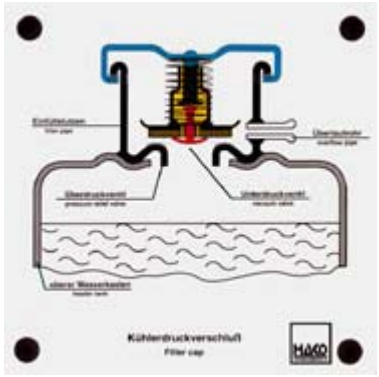
- the opened-up drum can be used to demonstrate the supercharging by sliding the gas column

- the gas column slide is moved along a curved path, so that the actual flow conditions can be shown

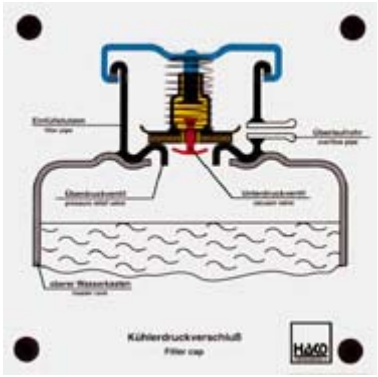


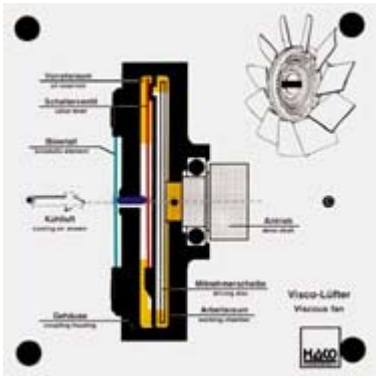
Order no. 213
Radiator cap

- function of pressure valve and vacuum valve
- putting on the radiator cap pretensions the pressure spring and thus makes a higher pressure buid-up in the radiator possible. (The boiling point is risen)



- the pressure relief valve opens when the pressure gets too high
- the vacuum valve opens when the engine cools down



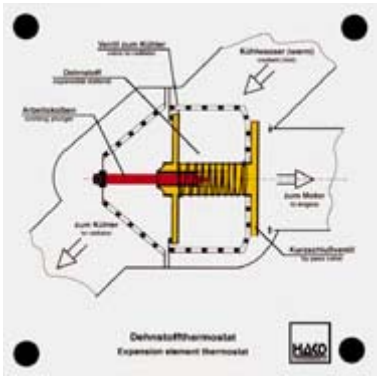


Order no. 214
Visco blower

- this model can be easily operated from the outside by means of two levers
- right lever: The liquid is pumped from the working chamber to the reservoir chamber and vice versa
- left lever: The bimetal spring is bent and thus the valve between the two chambers opened

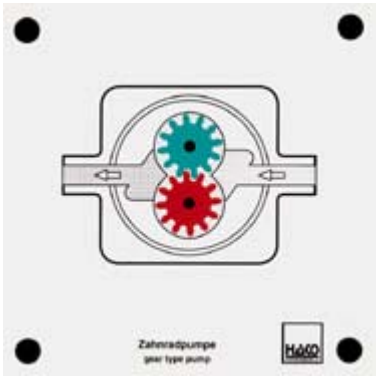
Order no. 226
Rotary pump

- the model demonstrates that cooling- water pumps work on the same principle as rotary pumps



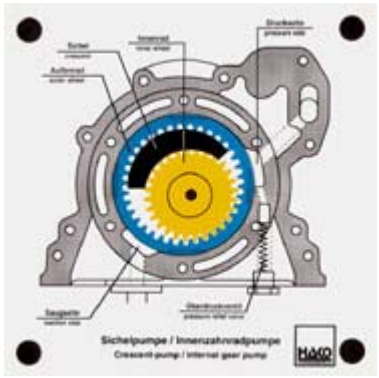
Order no. 143
Expansion element regulator

Function of the expansion element. The valve can be moved back and forth. When warming up the engine, the dual valve opens the large cooling-water circuit, which circulates through radiator and engine and closes the smal one which circulates only in the engine block and vice versa when cooling down the engine



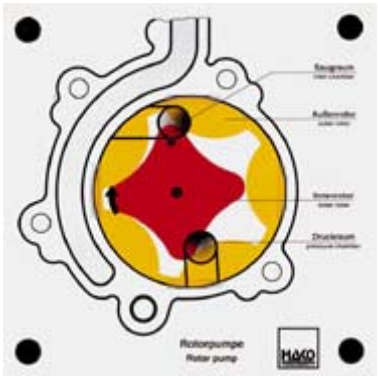
Order no. 128
External gear pump

- oil flow through the pump
- function of the pump



Order no. 206
Internal gear pump

- function of an internal gear pump: increasing and decreasing the volume of suction and pressure chamber
- internal gear pumps are used as engine-oil pumps and oil pumps in automatic transmissions



Order no. 129
Rotor pump

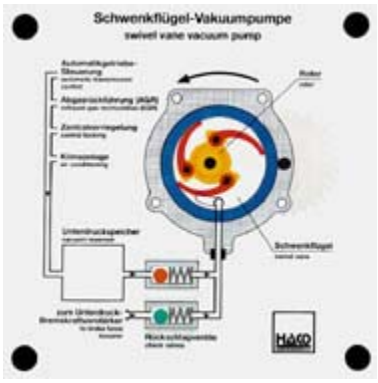
- an increase or decrease in volume of the chambers between inner and outer rotor causes suction or pressure

Order no. 411
Vane-type compressor

- function of vane-type compressor for the mechanical supercharging of an engine
- pumping effect produced by increasing and reducing the space

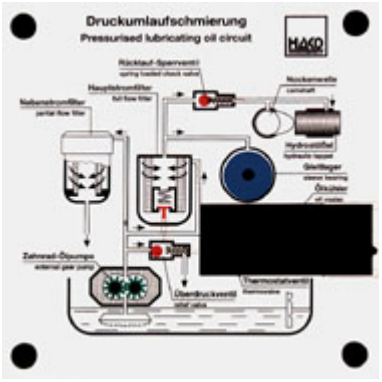
Order no. 428
One-vane vacuum pump

This new construction is the simplest, yet at the same time most powerful vacuum pump for Diesel and Otto engines. Turning the rotor by a lever makes the enlargement and reduction of the area in each revolution clearly recognisable.



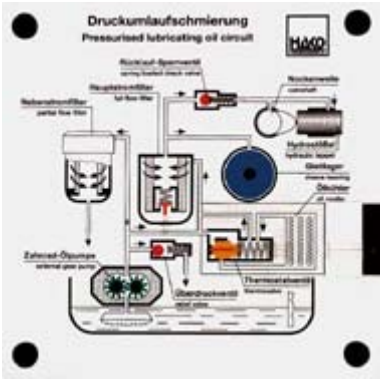
Order no. 288
Swivel vane vacuum pump

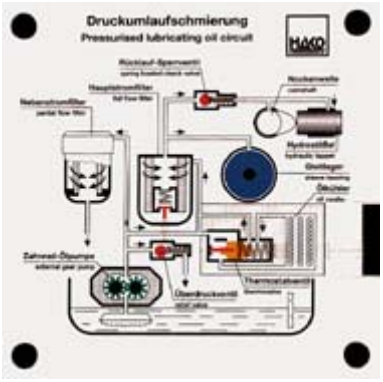
- vacuum created by continuous volume reduction of inlet side
- function of ball valves



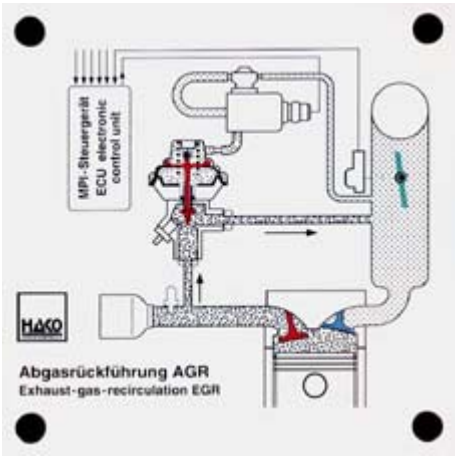
Order no. 284
Pressurised lubricating oil circuit

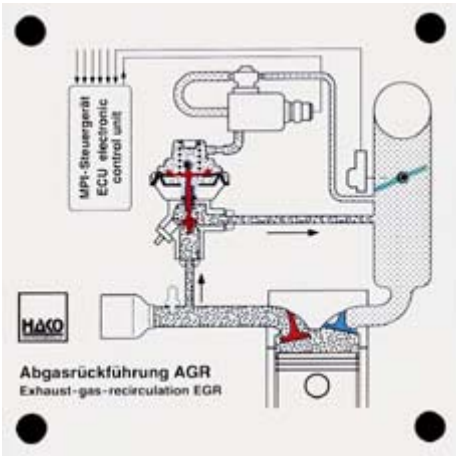
- lubricating oil circuit in full flow and partial flow
- functions of relief valve, spring-loaded check valve and bypass valve





- lubricating oil circuit with thermostatically controlled oil cooler
- function of the thermostat
- plain bearing lubrication, wedge-shaped oil film





Order no. 454
Exhaus gas recirculation / EGR

Interaction of throttle valve and EGR valve. Opening of the EGR valve in the part load area. Closing of the EGR valve in idling and under full load