

# POGONSKI STROJEVI- MOTORI

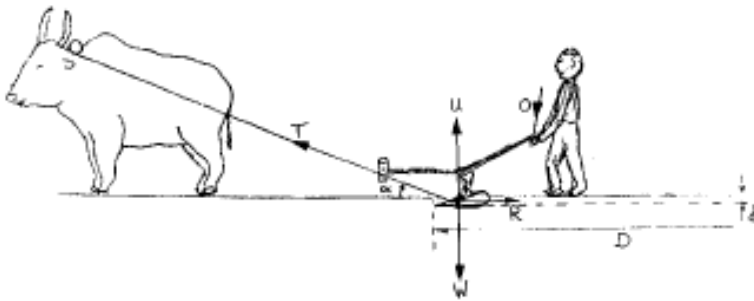
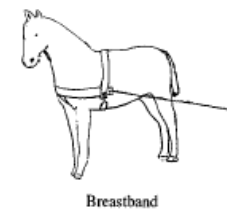
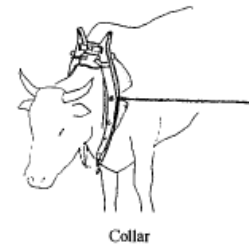
**Definicija:** Pogonski strojevi pretvaraju određeni oblik energije iz prirode u mehaničku energiju koja služi za pogon radnih strojeva.

# Podjela pogonskih strojeva

- Živi (animalni) pogonski strojevi
- Vodni (hidraulički) pogonski strojevi
- Vjetreni pogonski strojevi
- Toplinski pogonski strojevi
- Električni pogonski strojevi (elektro motori)

# Živi (animalni) motori

- Radna stoka (konji, volovi, magarci, bivoli, mazge, mule...)
- Čovjek (ljudska radna snaga)



# Vučna snaga različitih radnih životinja

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Animal	Average Weight (kg)	Approximate Draught Capability (N)	Average Speed (m/s)	Power Developed (W)
Bullock	500–900	600–800	0.56–0.83	560
Cow	400–600	500–600	0.70	340
Water buffalo	400–900	500–800	0.80–0.90	560
Light horse	400–700	600–800	1.0	750
Mule	350–500	500–600	0.9–1.0	520
Donkey	200–300	300–400	0.70	260
Camel	450–500	400–500	1.1	500
Man	60–90	300	0.28	75

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# Hranidbene potrebe radnih volova

Table 7.4. Feed requirements for work oxen (adapted from FAO, 1972)

Weight of ox (kg)	Maintenance Ration (MJ)	Light Work		Medium Work		Heavy Work	
		Work Ration (MJ)	Total Ration (MJ)	Work Ration (MJ)	Total Ration (MJ)	Work Ration (MJ)	Total Ration (MJ)
250	29.9	15.6	45.5	29.9	59.8	45.5	75.4
300	33.8	16.9	50.7	33.8	67.6	50.7	84.5
350	37.7	19.5	57.2	37.7	75.4	57.2	94.9
400	41.6	20.8	62.4	41.6	83.2	62.4	104.0
450	45.5	23.4	68.9	45.5	91.0	68.9	114.4
500	49.4	24.7	74.1	49.4	98.8	74.1	123.5

*Note.* 1 kg of maize or other cereal grain yields about 13 MJ of metabolizable energy.

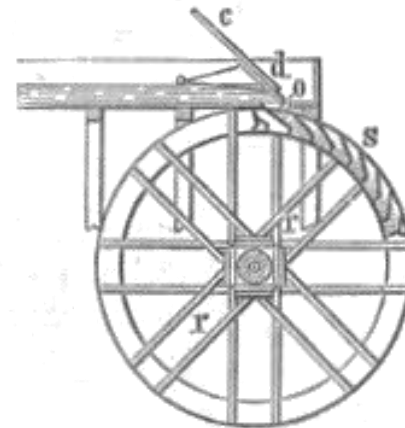
# VODNI (HIDRAULIČKI) MOTORI

- Koriste potencijalnu i kinetičku energiju vode – vodna kola i vodne turbine

Peltonova turbina

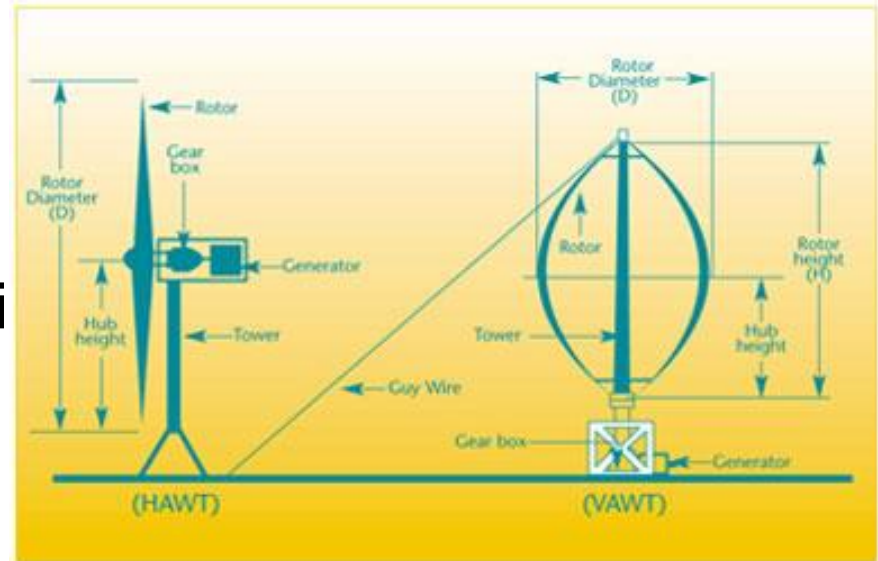


Nadljevno vodno kolo



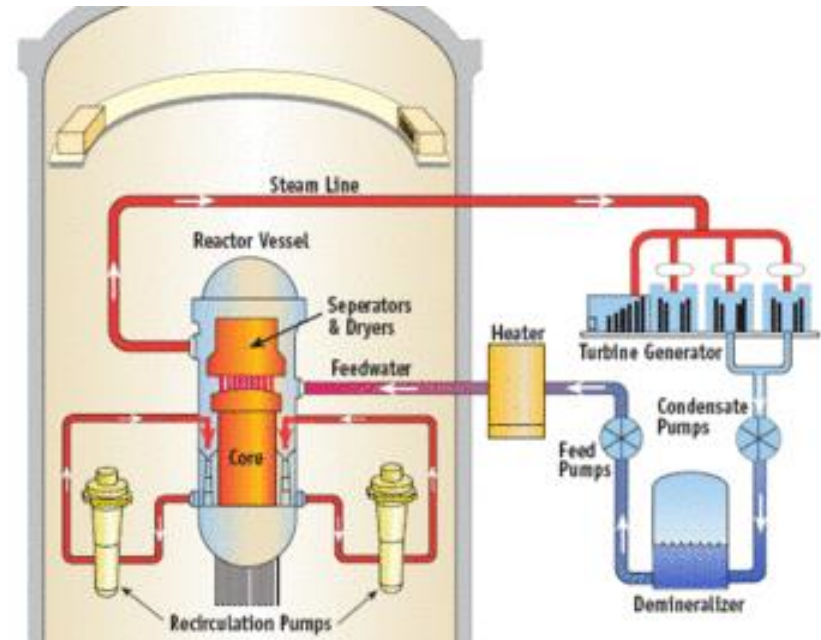
# VJETRENI MOTORI

- Koriste kinetičku energiju strujanja zračnih masa.
- Služe za proizvodnju el. energije, crpljenje vode, pogon mlinova i sl.
- Danska proizvodi 10 % el. energije pomoću vjetrorenih turbina (do 2030. planiraju proizvoditi 50 % na taj način!)



# Nuklearna energija

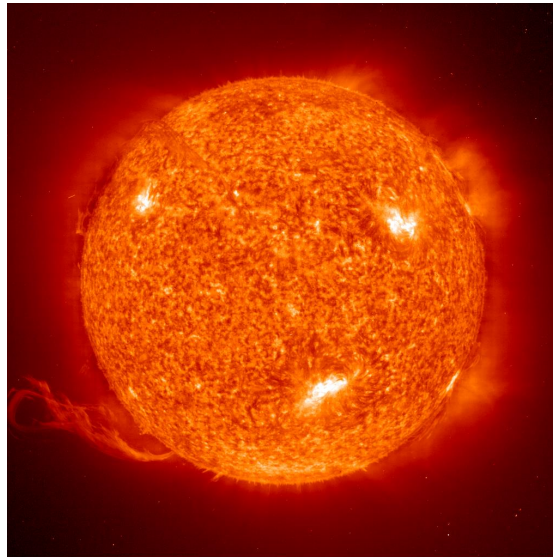
- Reaktor nove generacije (reaktor, parna turbina, električni generator)





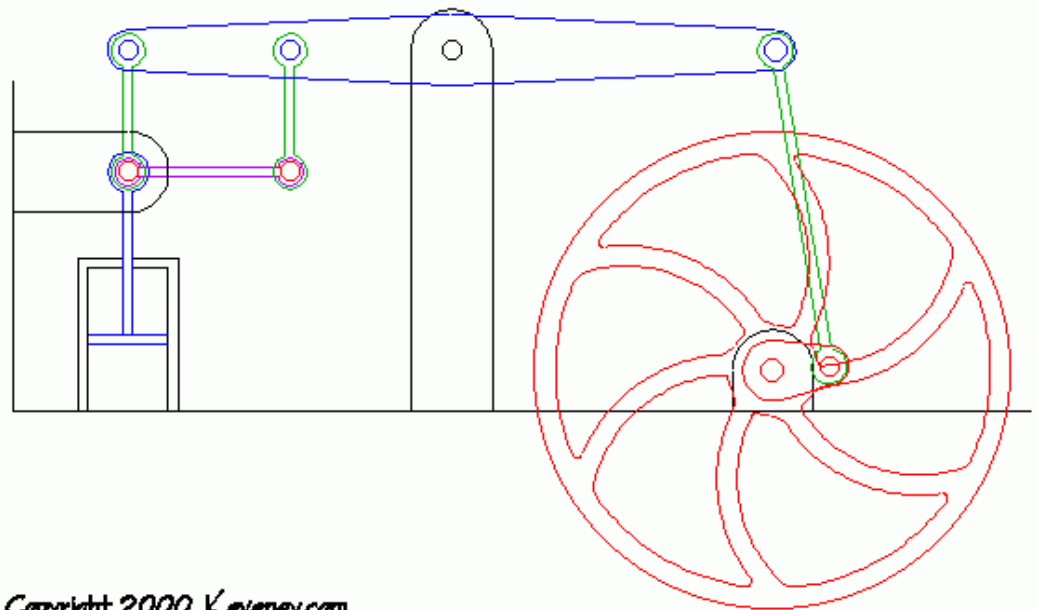
# TOPLINSKI MOTORI

- Motori s vanjskim izgaranjem
  - Parna turbina
  - Stapni parni stroj
- Motori s unutrašnjim izgaranjem
  - Klipni motori SUI
  - Reaktivni motori SUI

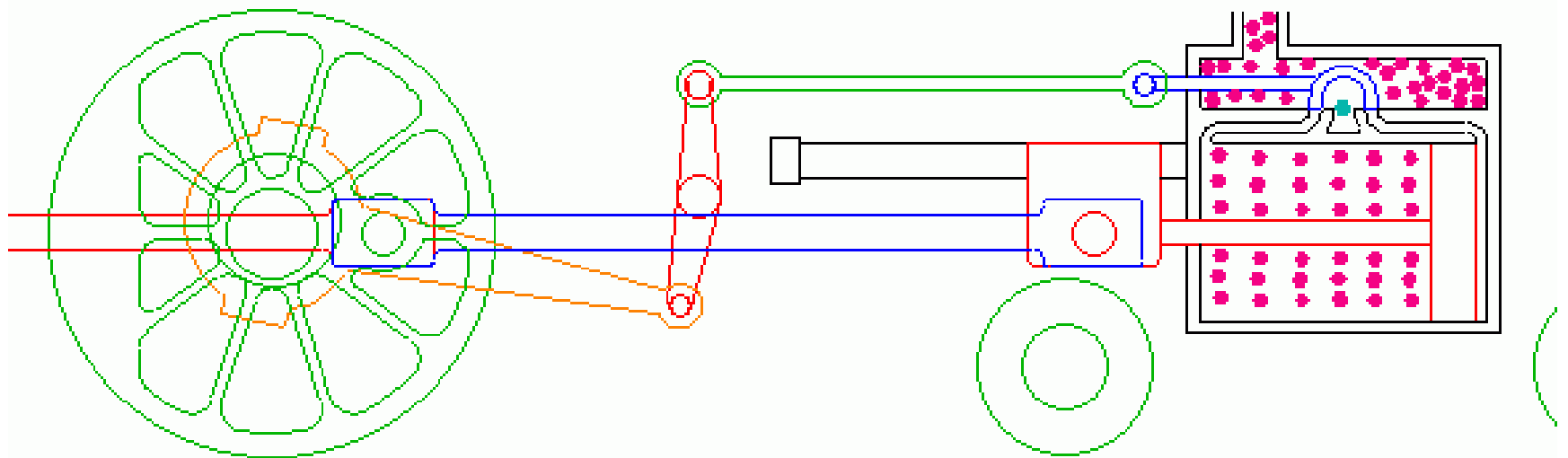


# Motori s vanjskim izgaranjem

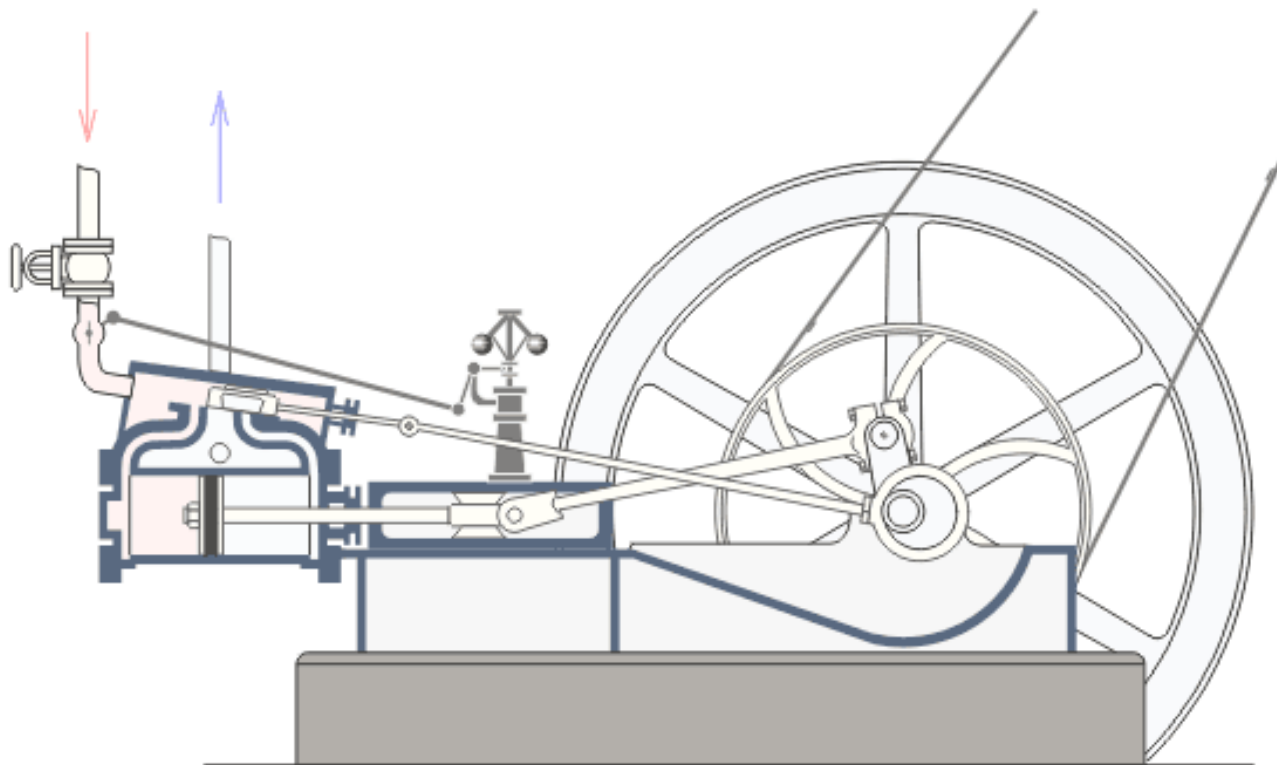
- Stapni parni stroj  
(James Watt)



# Parni stroj lokomotive



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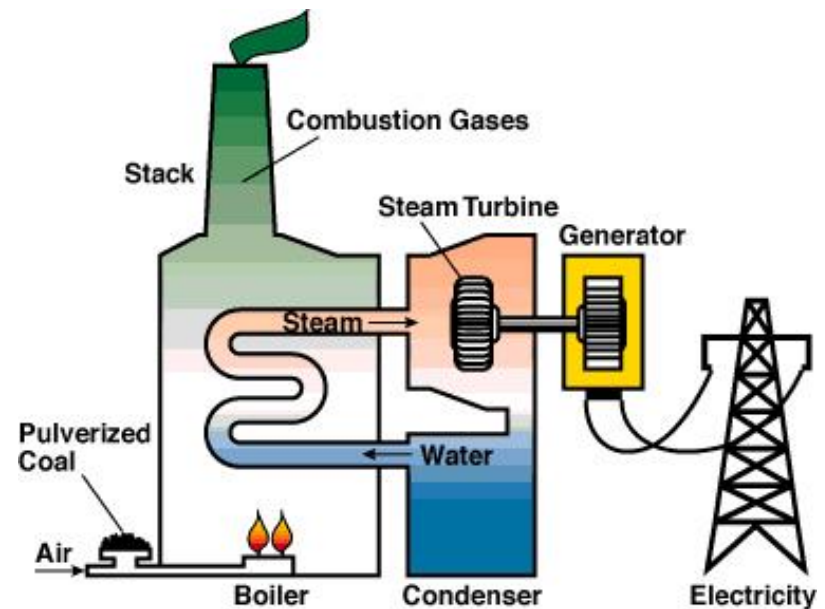


# Turbinski motori – parna turbina

Parna turbina

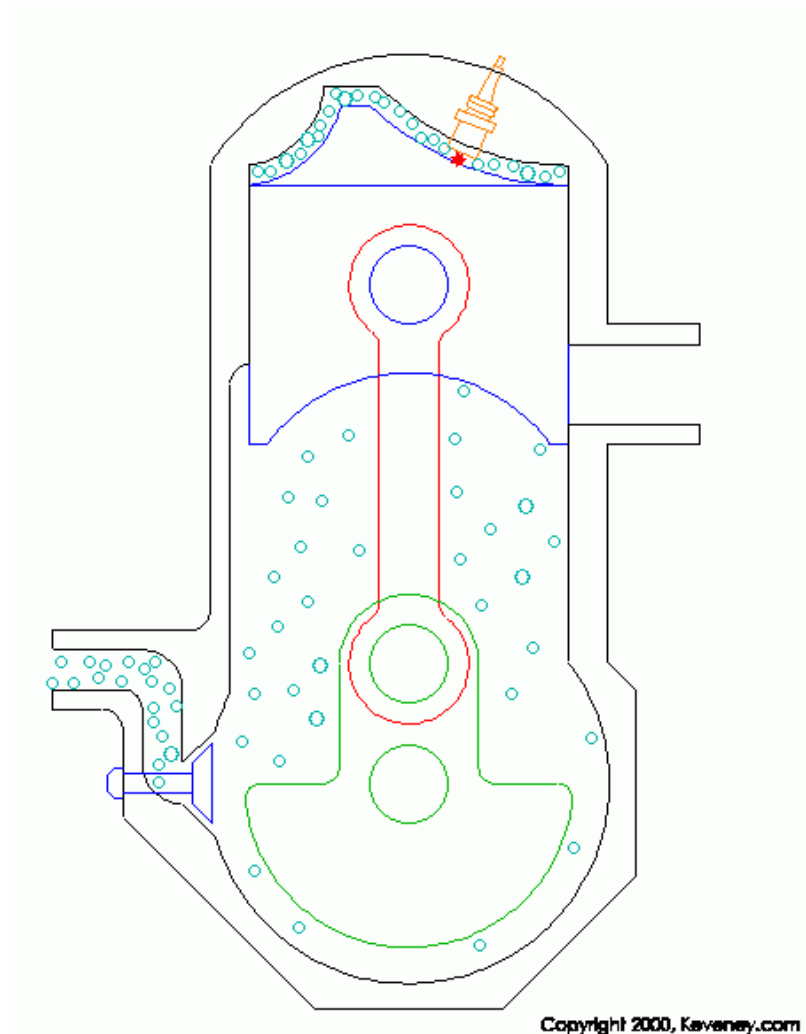


Termoelektrana na ugljen

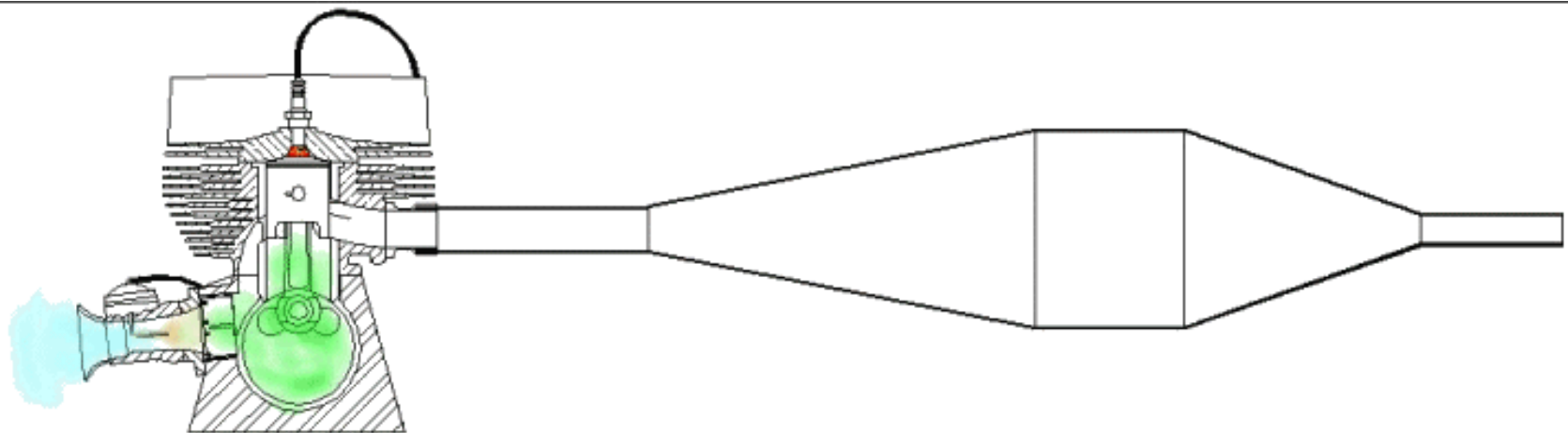


# Klipni motori SUI

- 2-taktni klipni motori

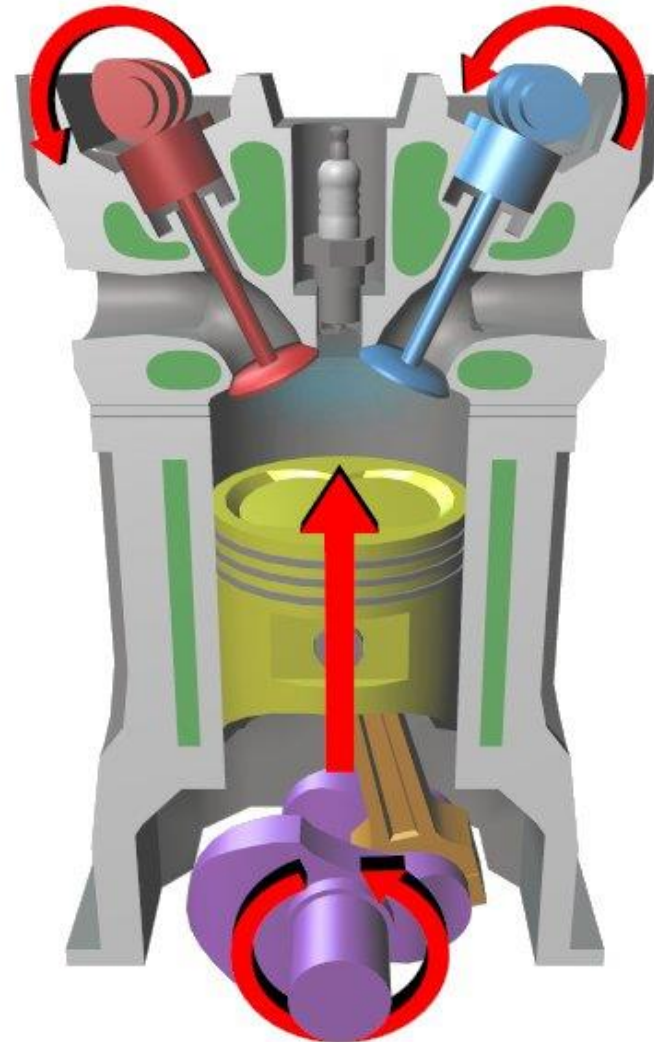


# 2-taktni motor



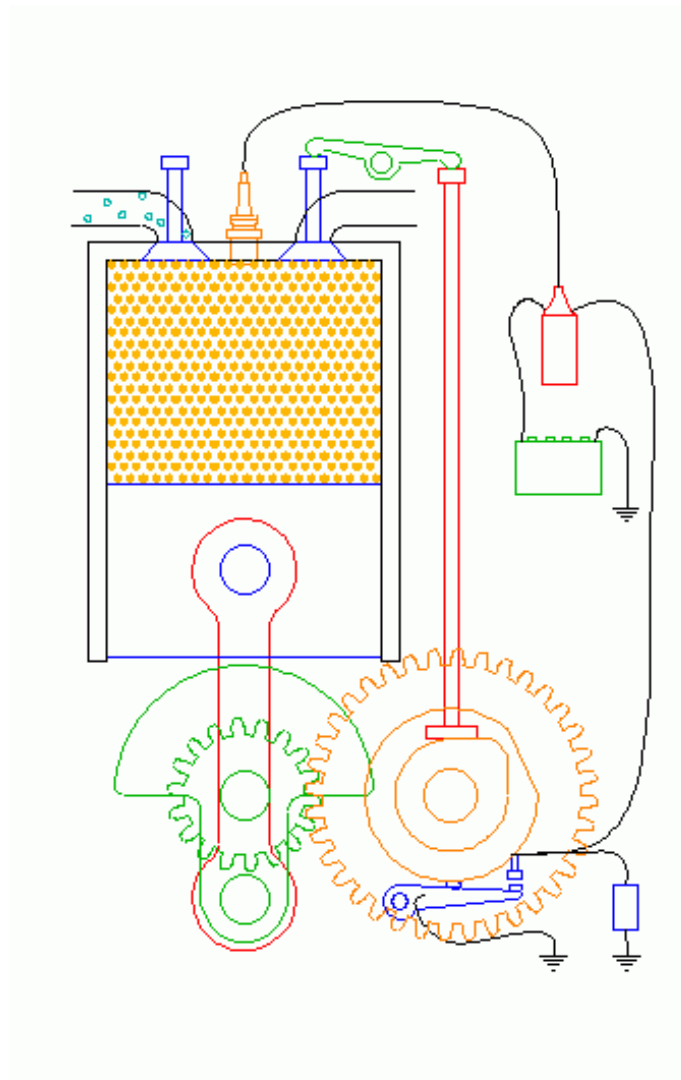
# Klipni motori SUI

- 4-taktni klipni motori

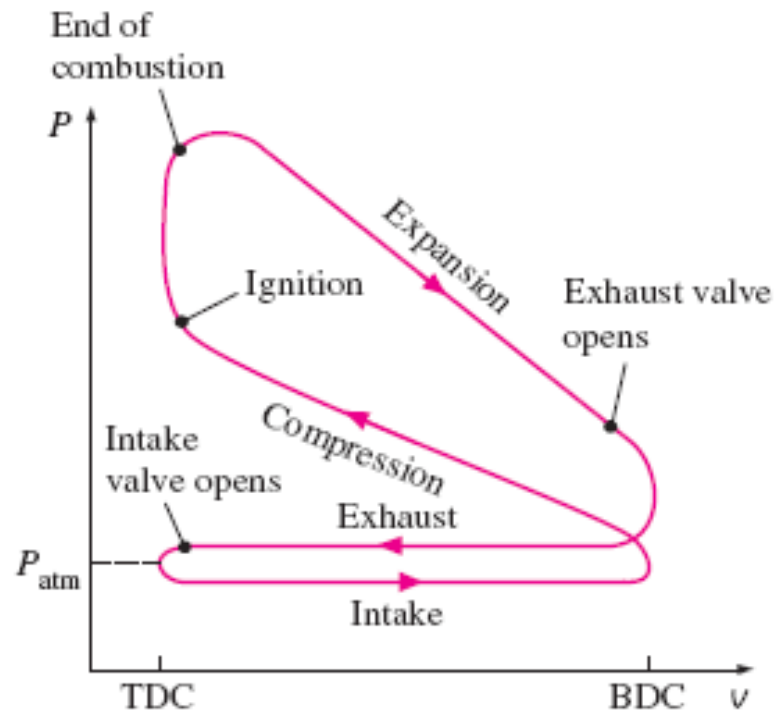




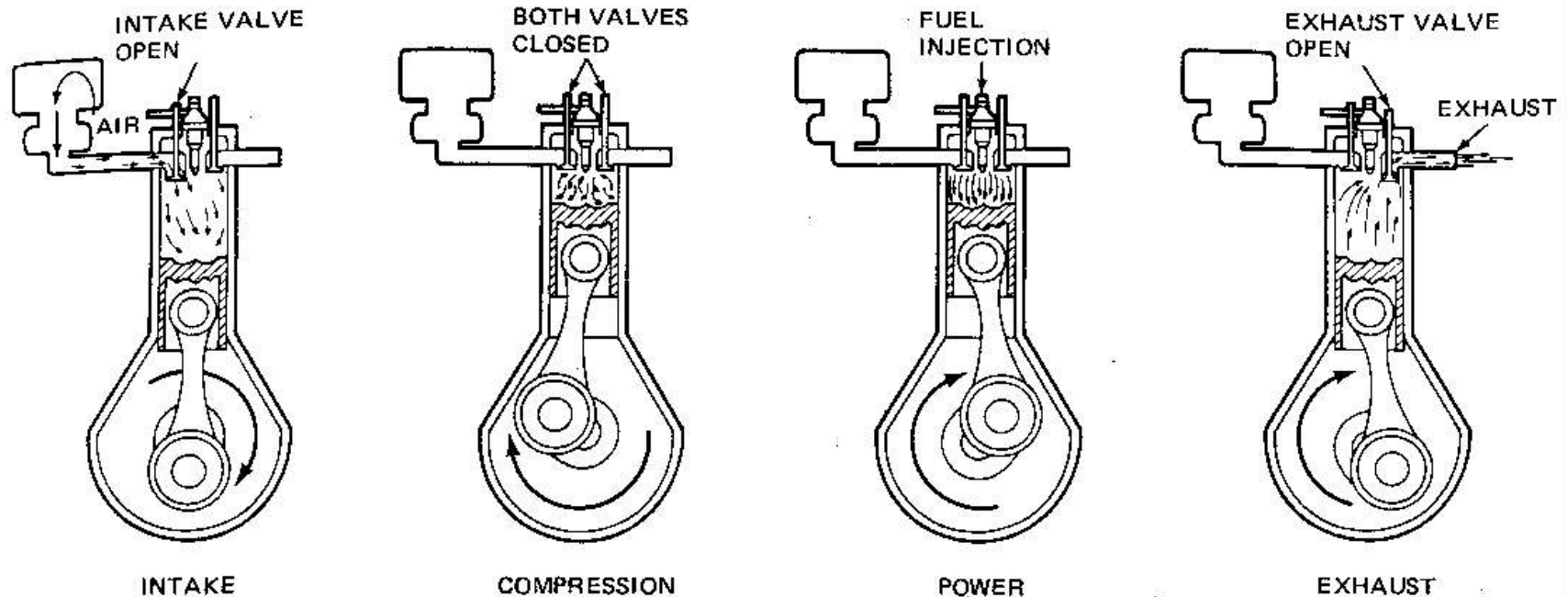
# 4-taktni Otto motor



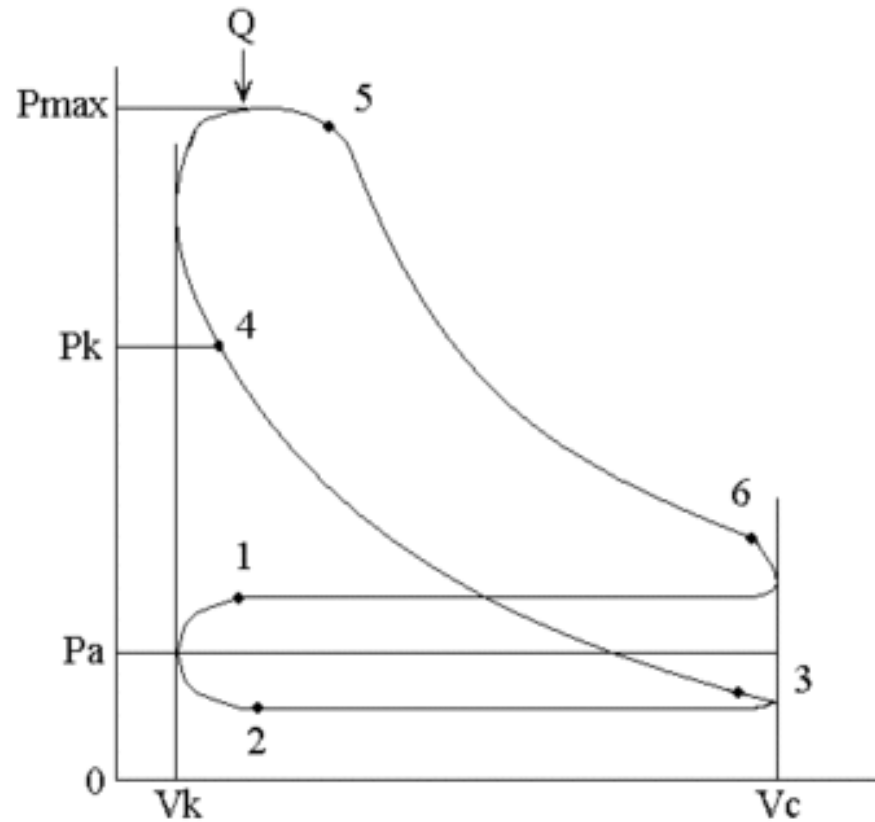
# Indikatorski dijagram rada 4-taktnog Otto motora



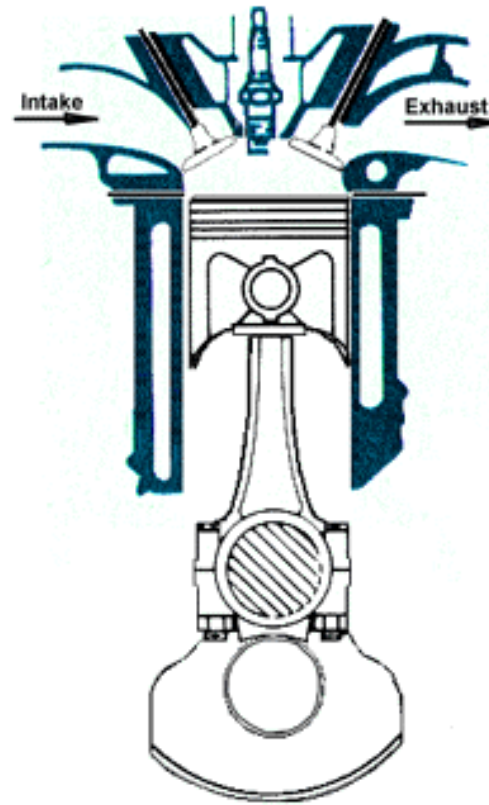
# Princip rada 4-taktnog diesel motora



# Indikatorski dijagram rada 4-taktnog diesel motora

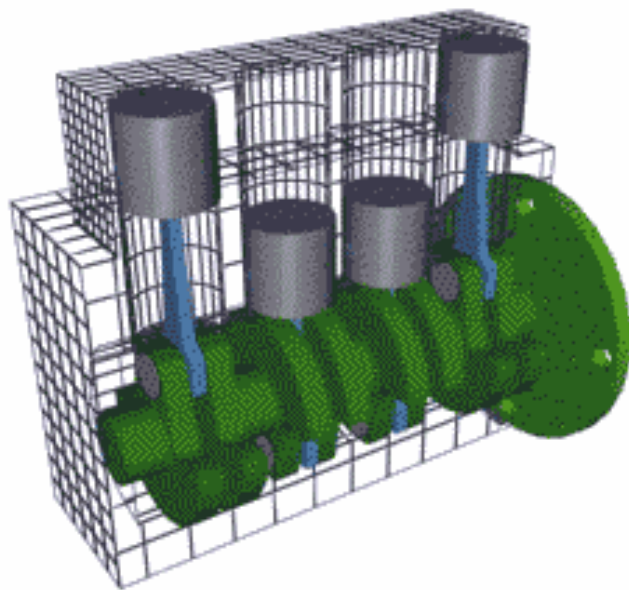


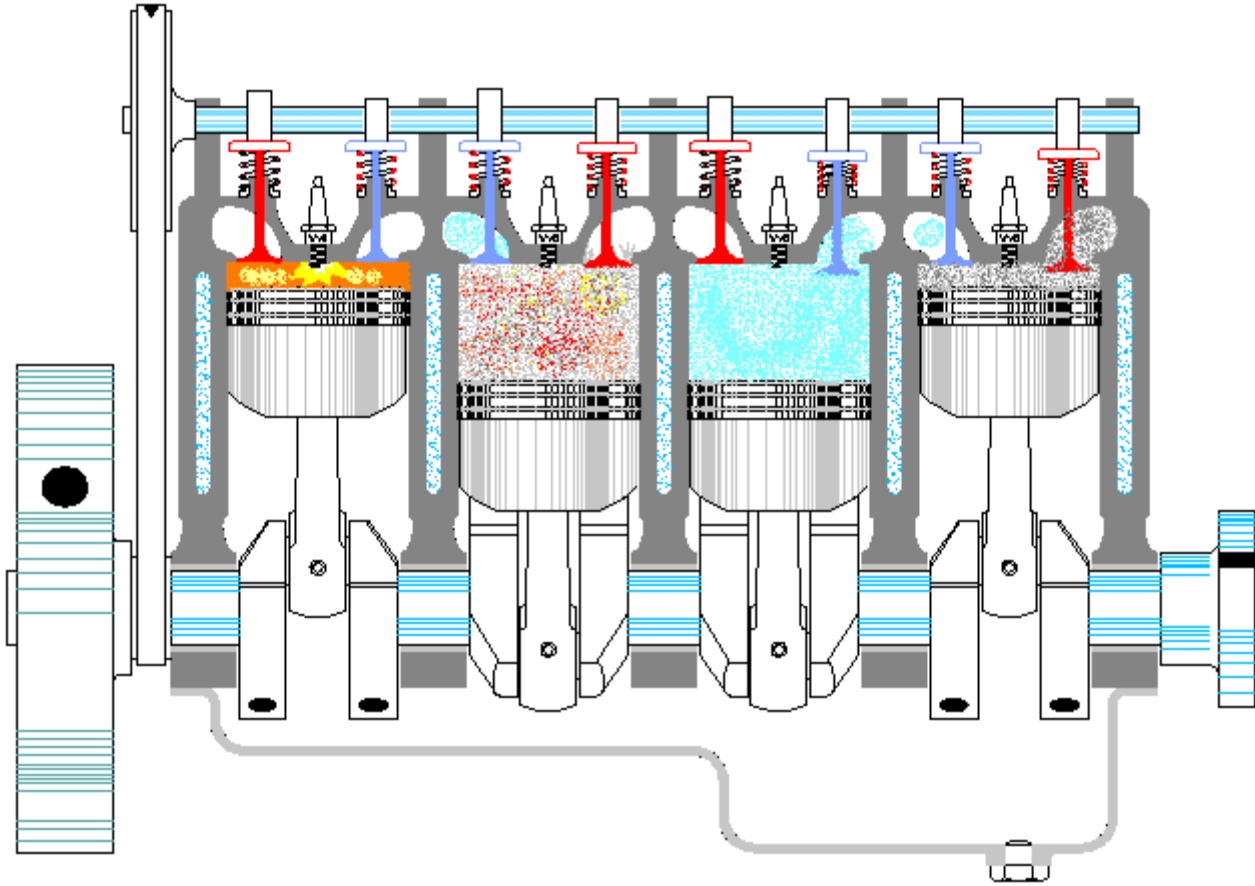
# Princip rada 4-taktnog motora - animacija

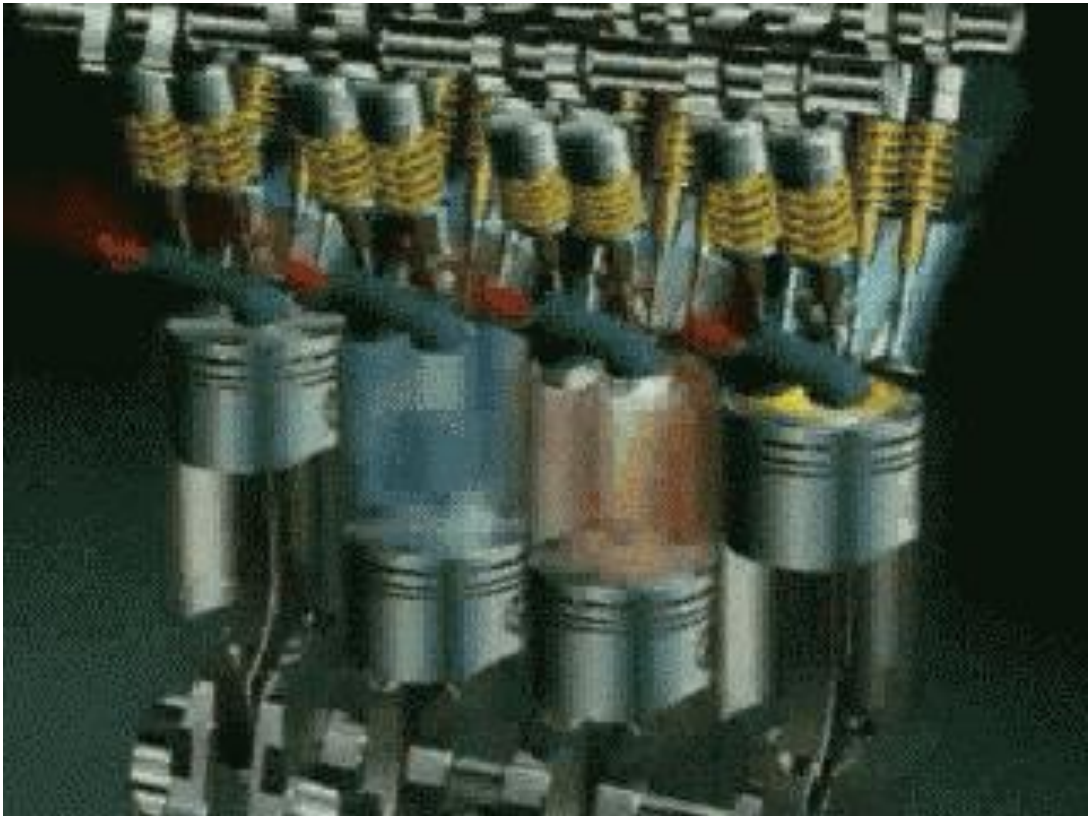


**INTAKE**

# Redni motor

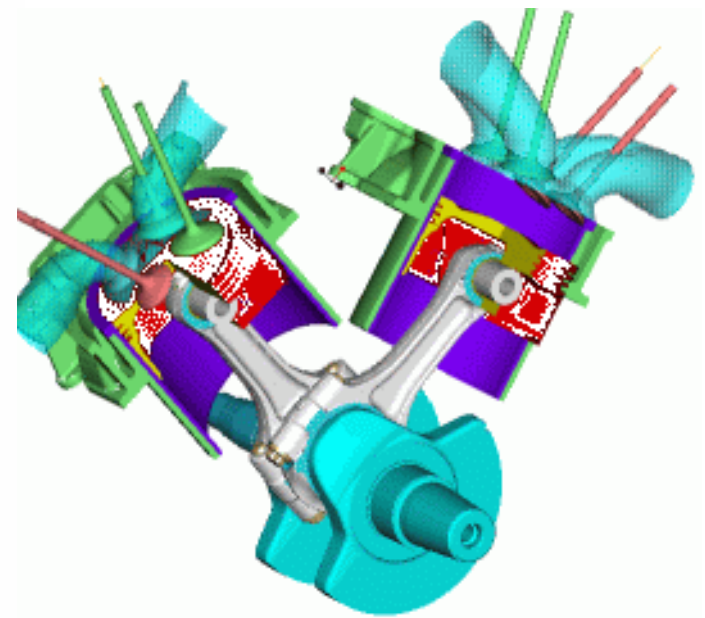
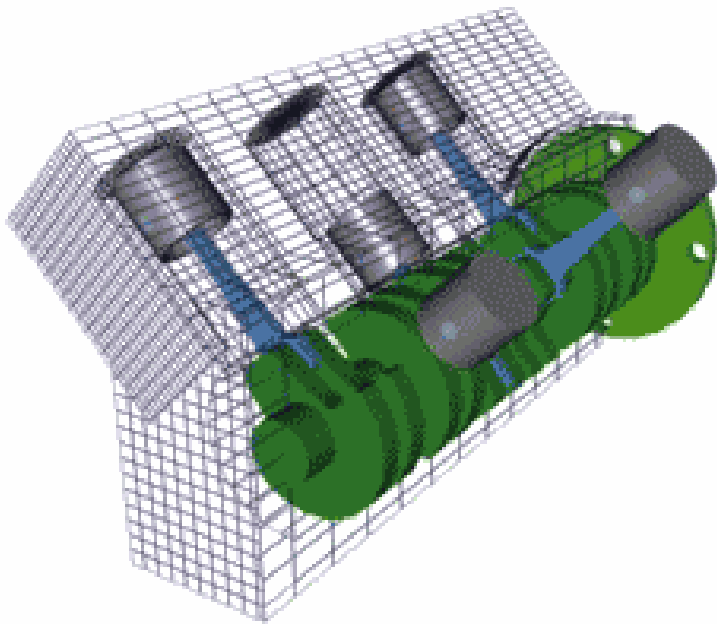




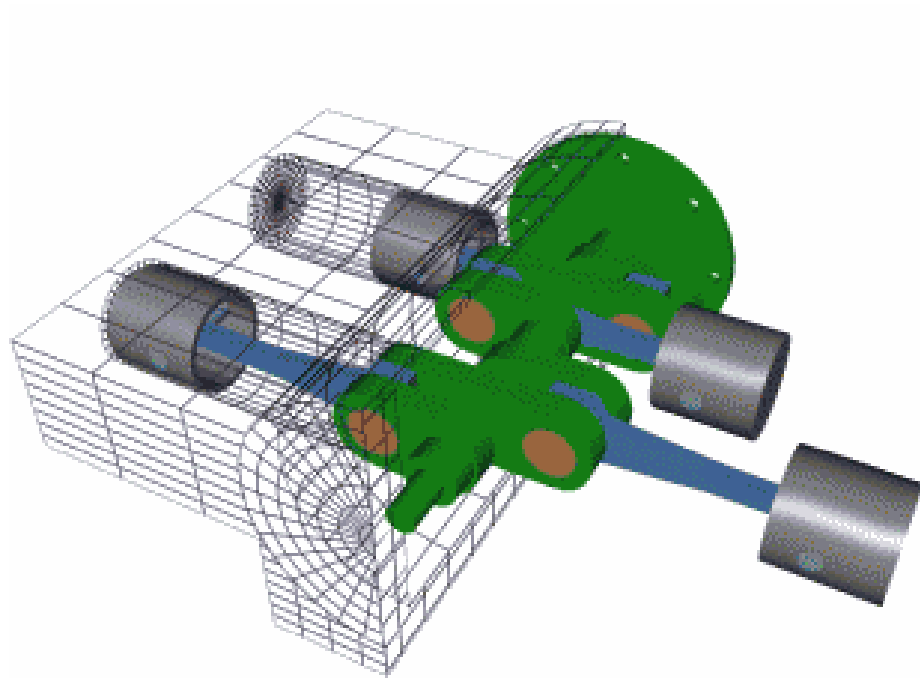




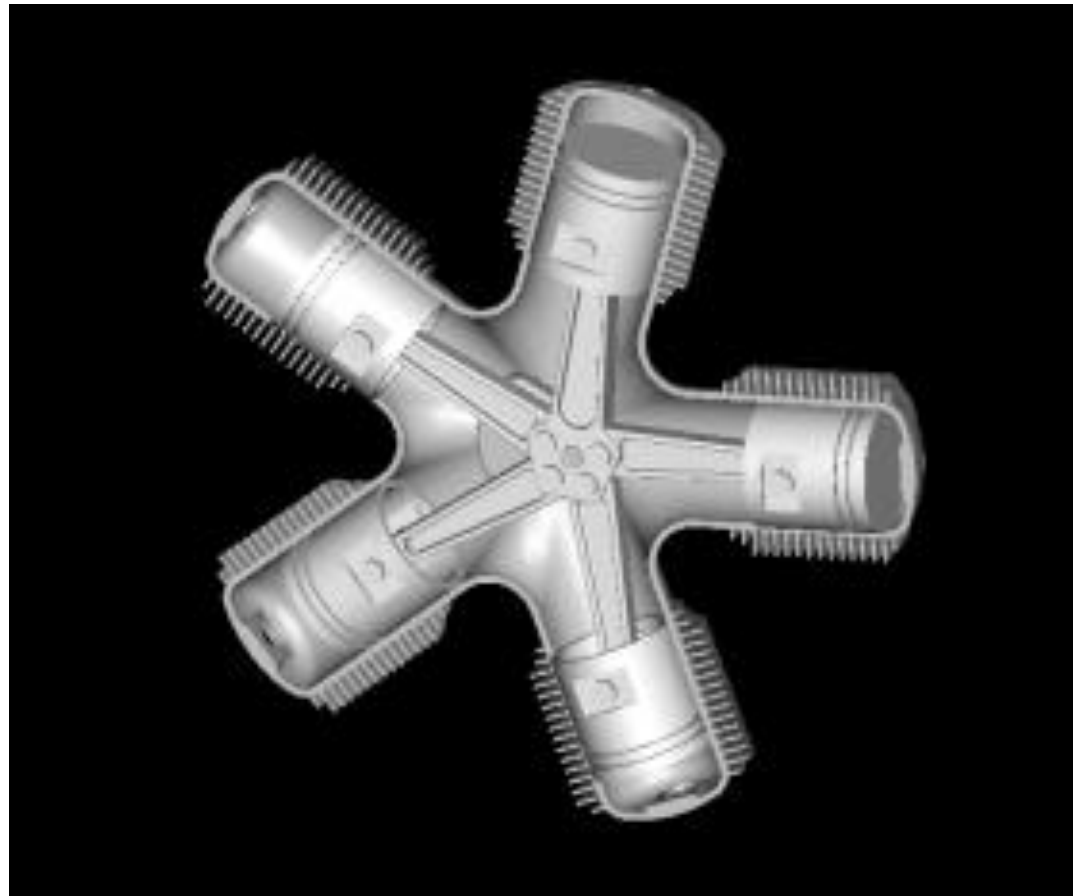
# V - motor



# Boxer motor

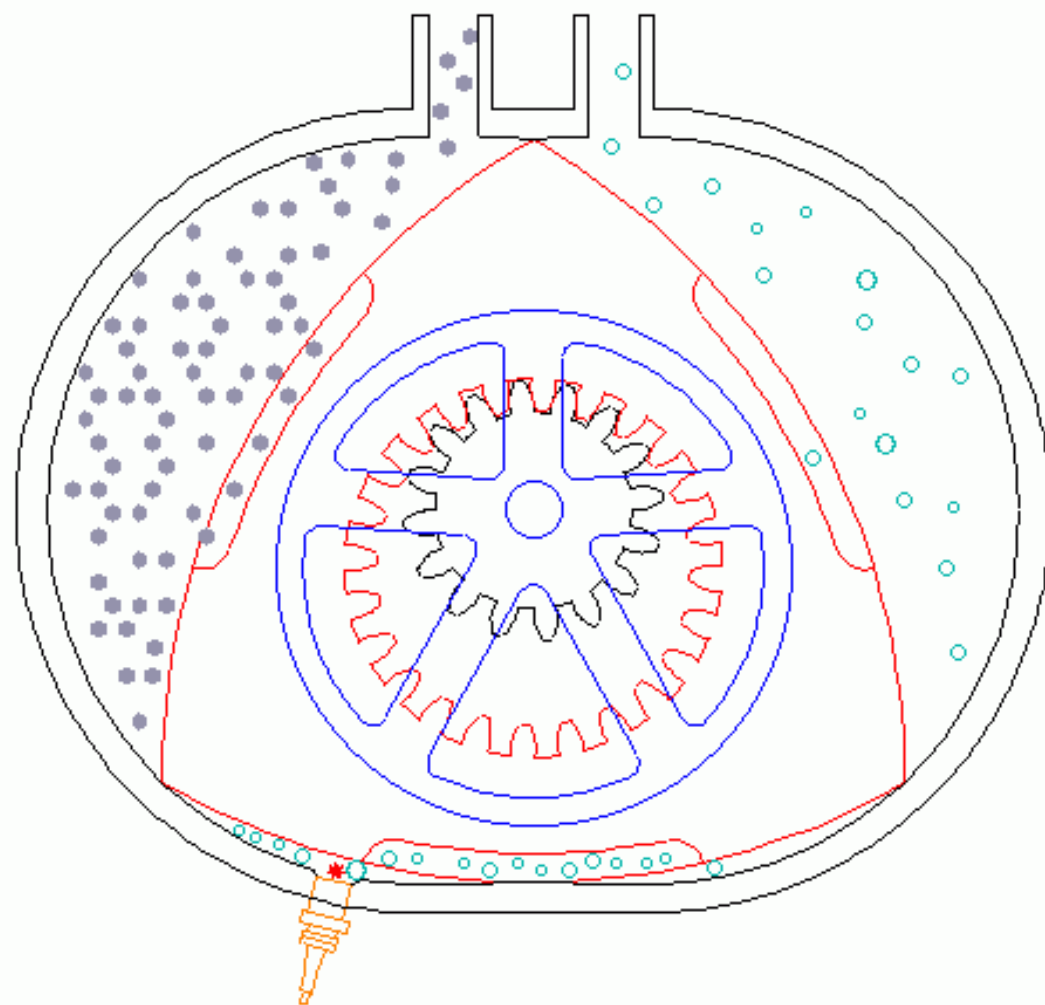


# Motor s radijalnim klipovima



# Wankelov motor

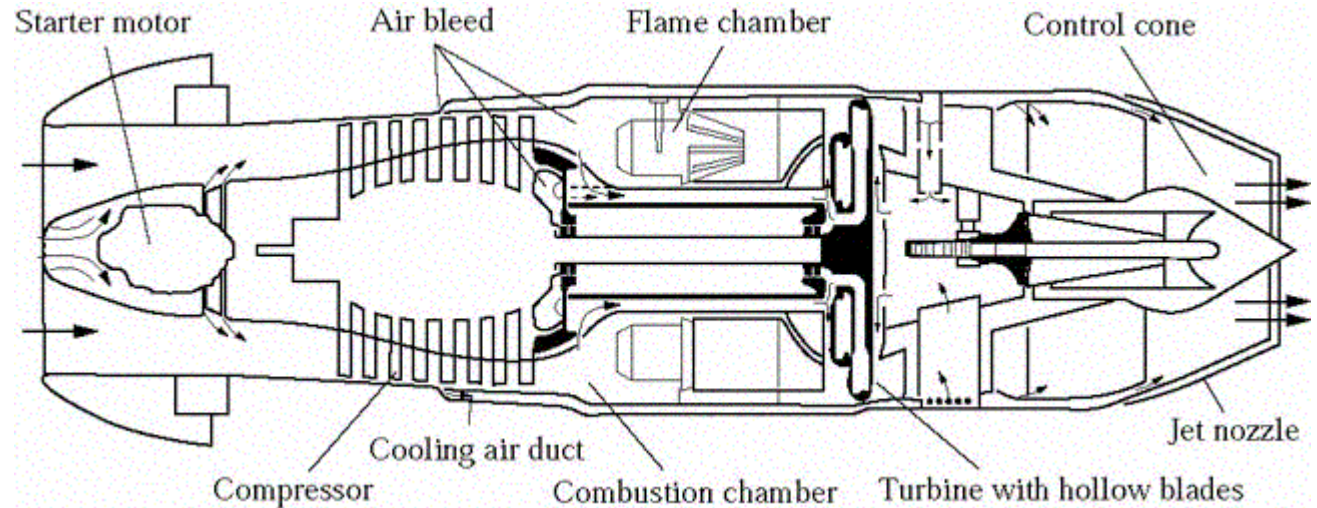
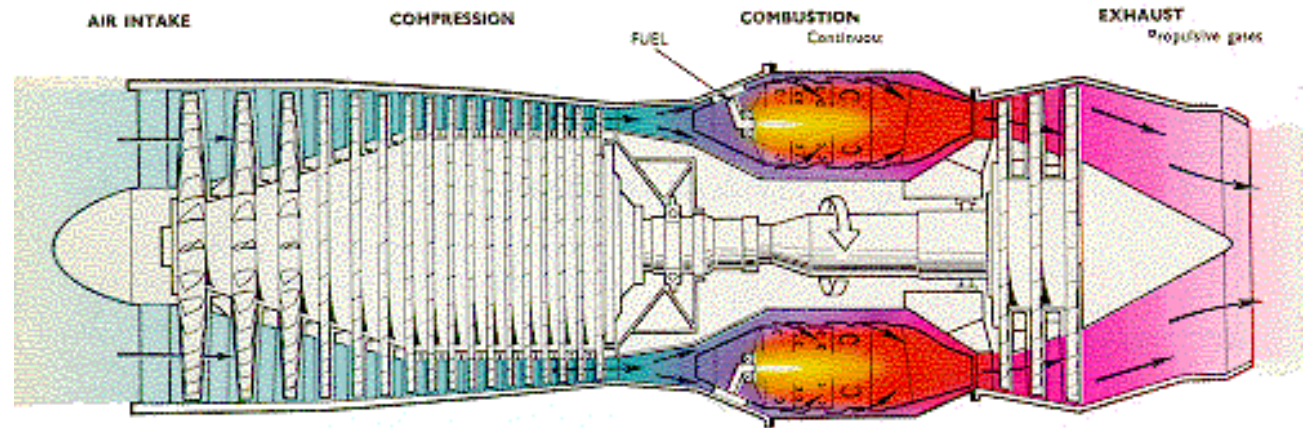




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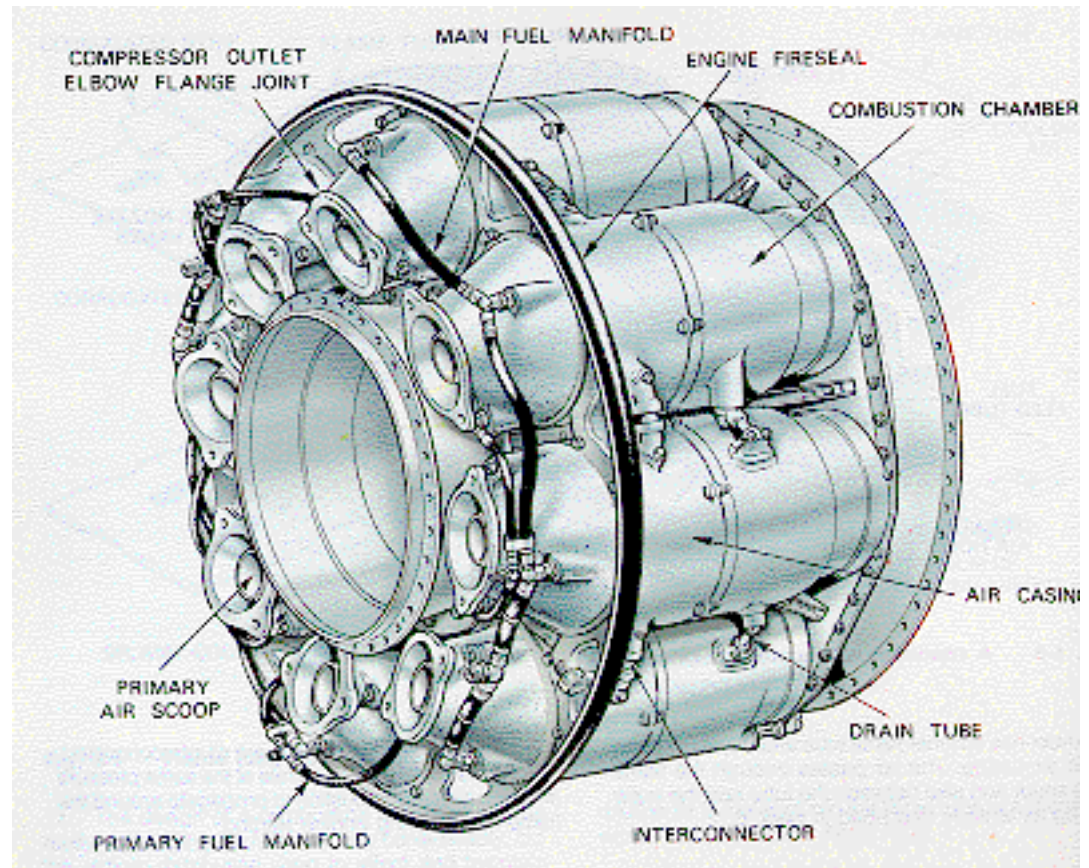
# Mlazni (reaktivni) motor

- S plinskom turbinom

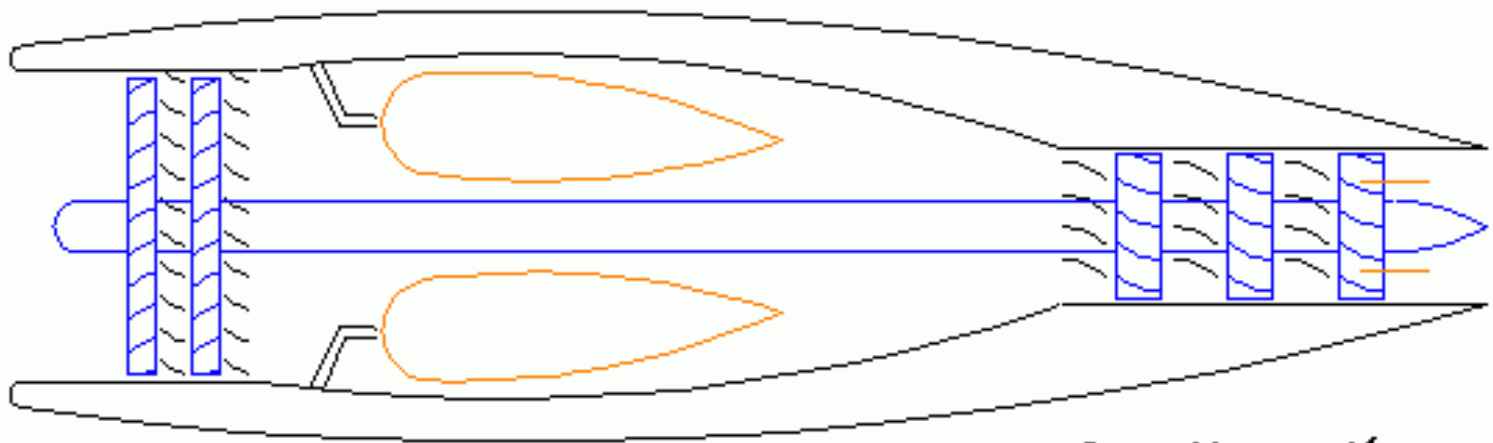


# Mlazni motor

- Višestruka komora izgaranja



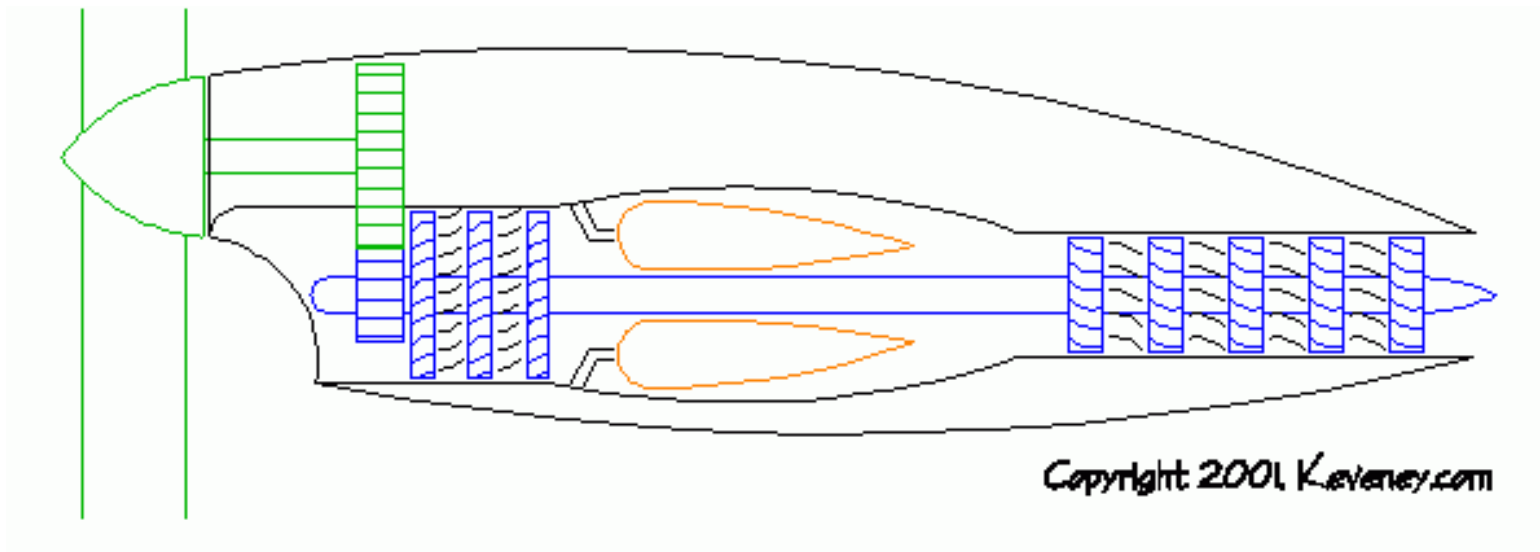
# Mlazni motor (turbo jet)



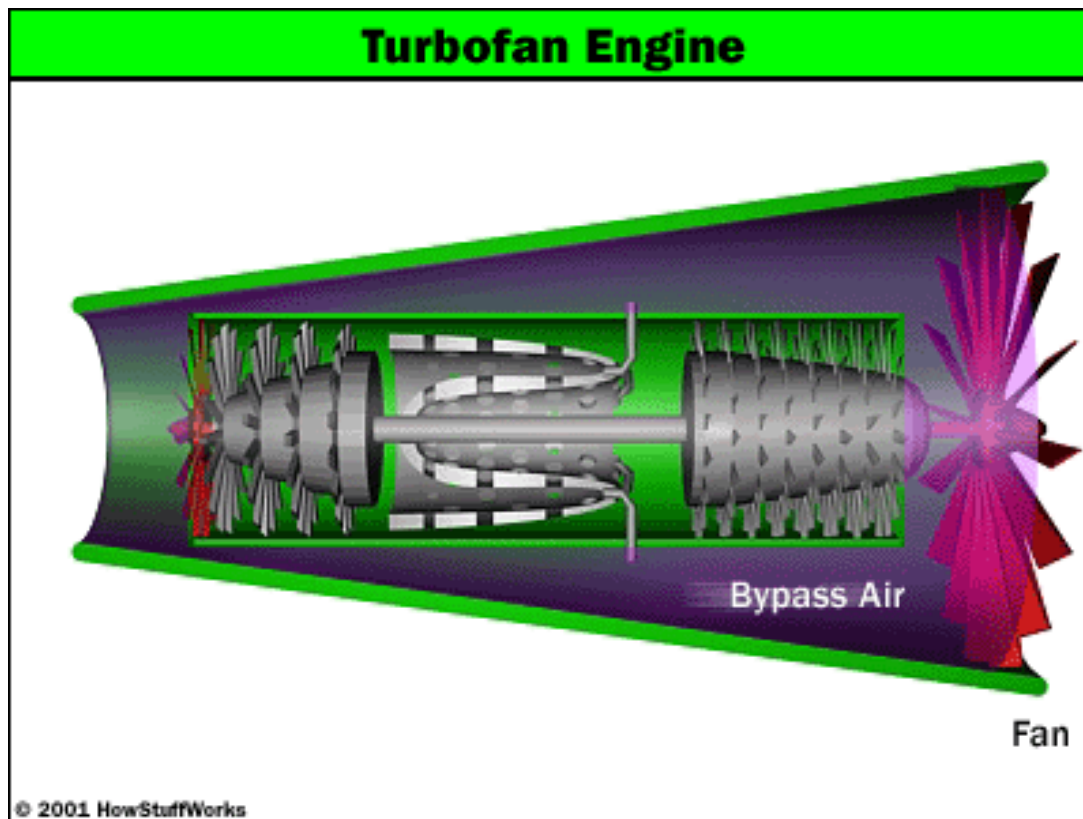
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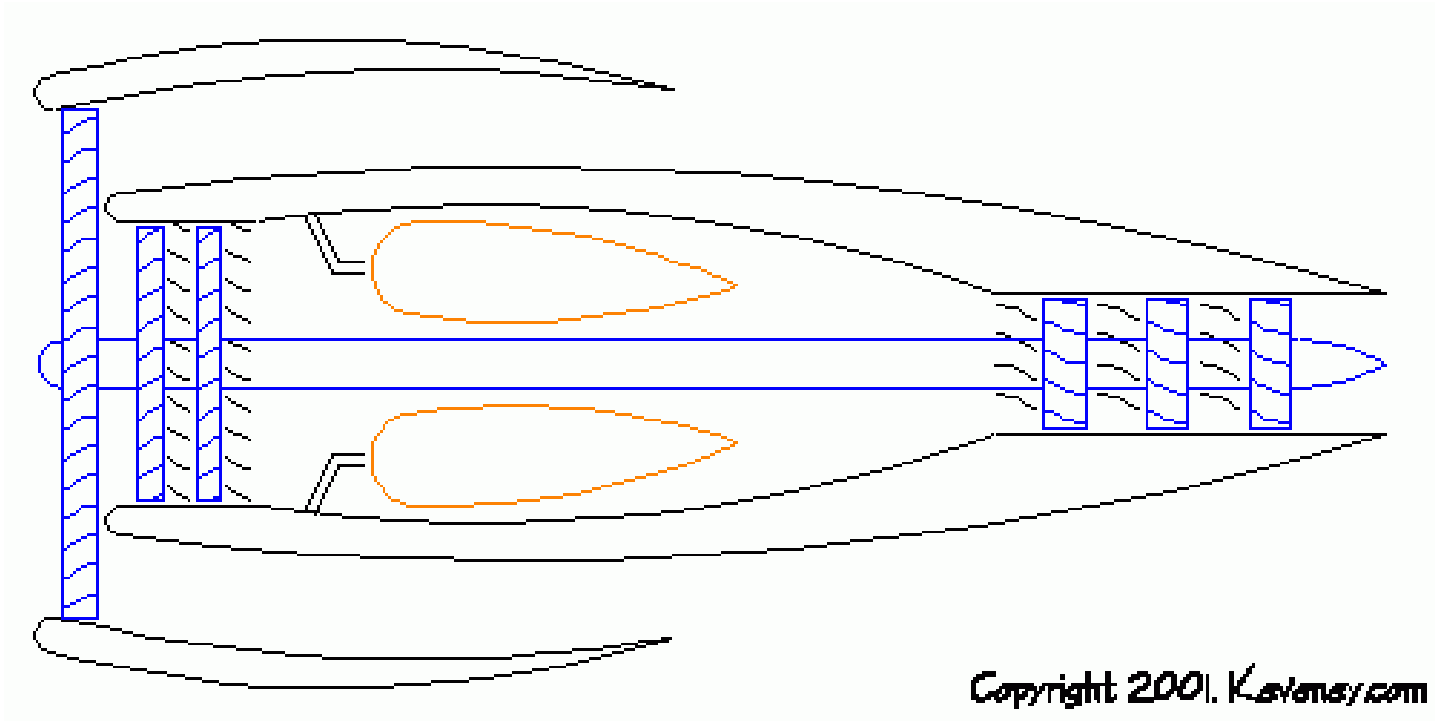
# Mlazni motor s elisom



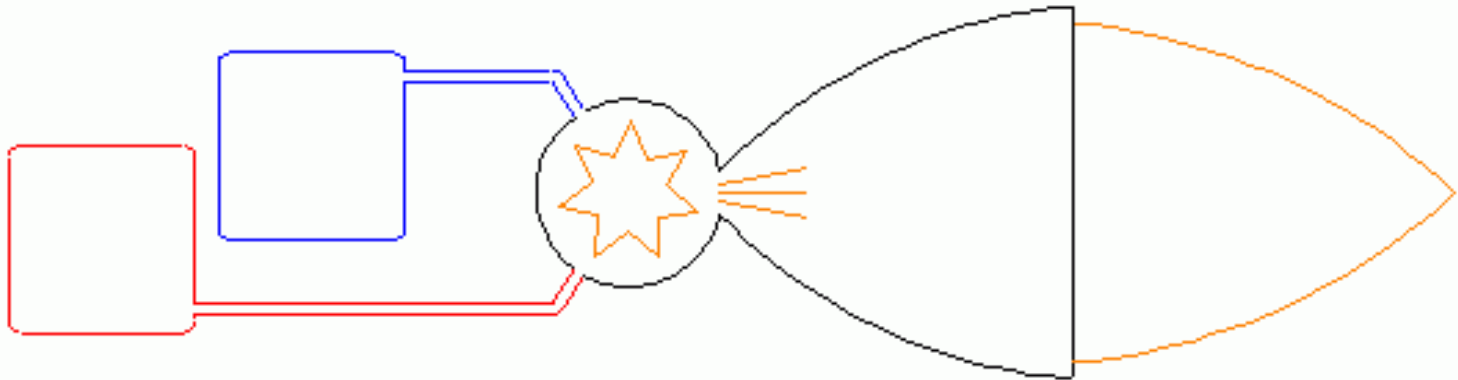
# Mlazni motor s ventilatorom



# Turbo mlazni motor s ventilatorom

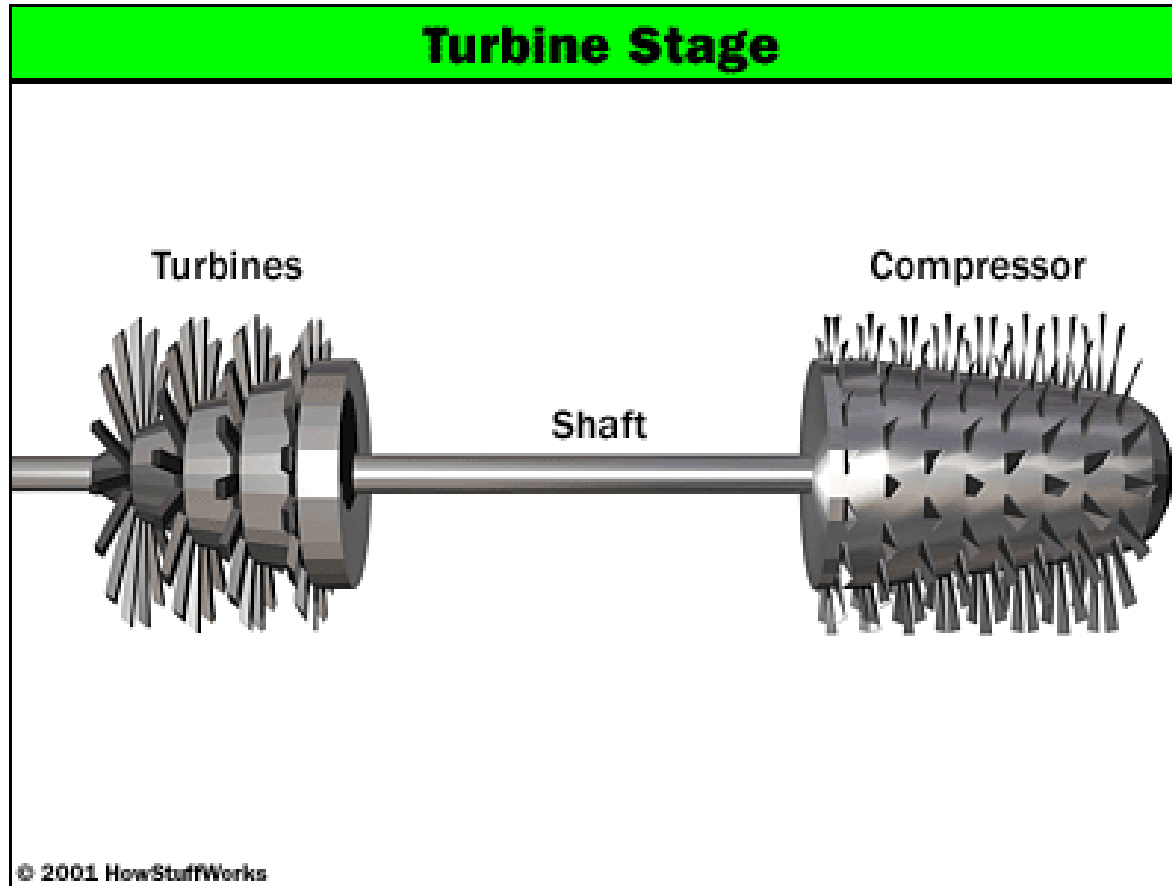


# Mlazni motor bez turbine (raketni motor)

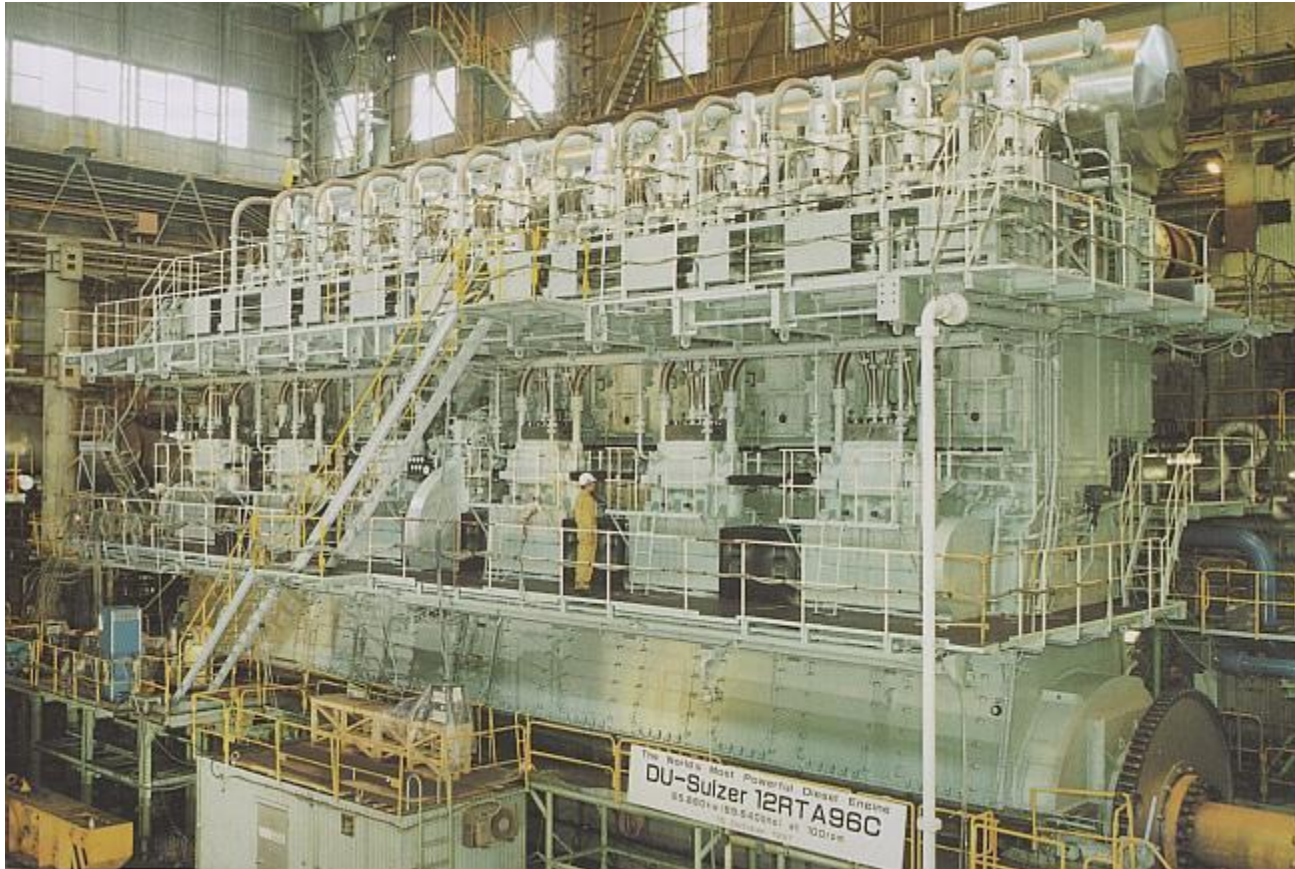


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# Turbina i kompresor mlaznog motora



# Brodski 2-taktni diesel motori 60-100 o/min



# Cilindarski blok

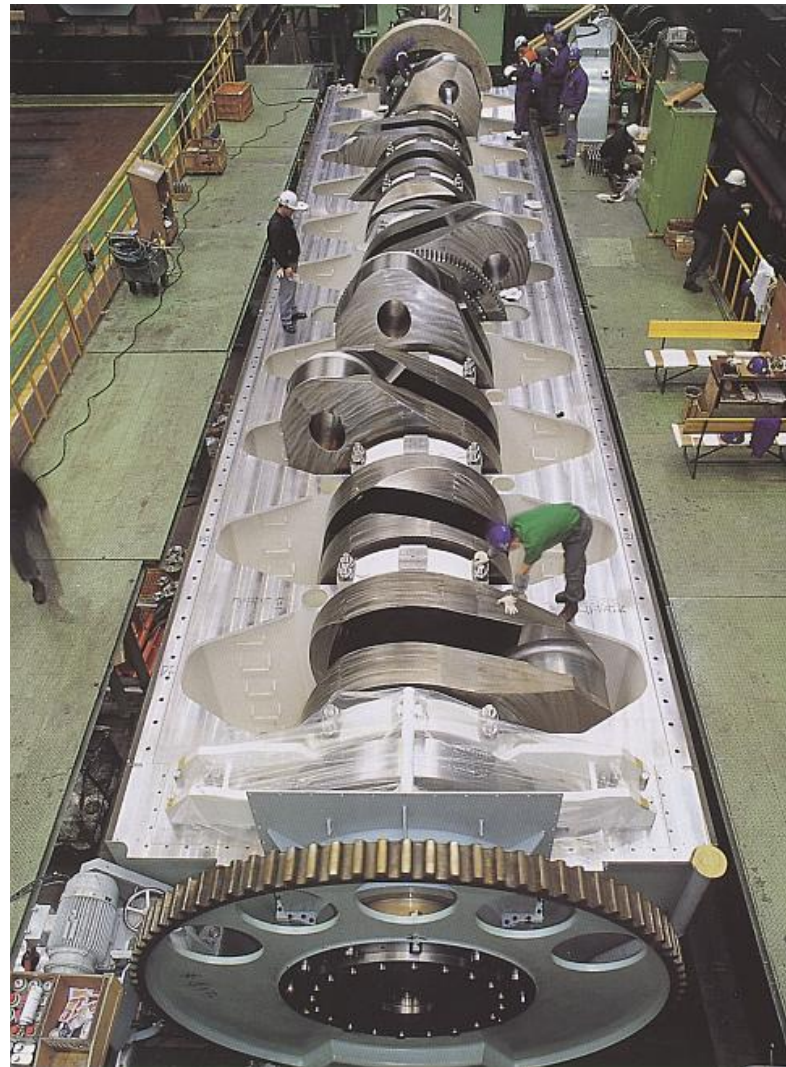


# Klip i klipnjača





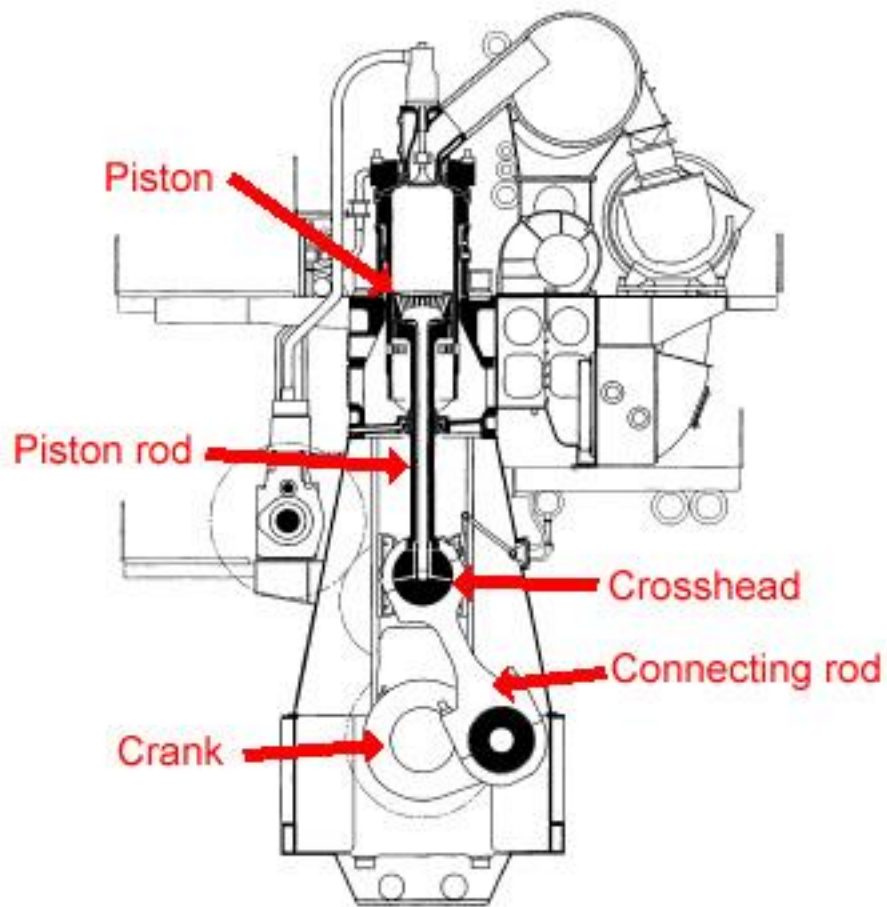
# Koljenasto vratilo



# Ležajevi koljenastog vratila



# Presjek 2-t diesel brodskog motora 108.920 KS kod 102 o/min. 14 cilindara



# Konstrukcija motora SUI

## **Nepokretni dijelovi**

- cilindarski blok
- cilindarska glava
- korito motora (karter)

## **Pokretni dijelovi**

- motorni (klipni) mehanizam
- razvodni mehanizam

## **Pomoćni uređaji**

- uređaj za napajanje gorivom
- uređaj za podmazivanje
- uređaj za hlađenje
- uređaj za paljenje
- uređaj za pokretanje
- uređaj za usis i ispuh

# Nepokretni dijelovi motora

- Cilindarski blok



# John Deere-blok, glava, kompletan motor

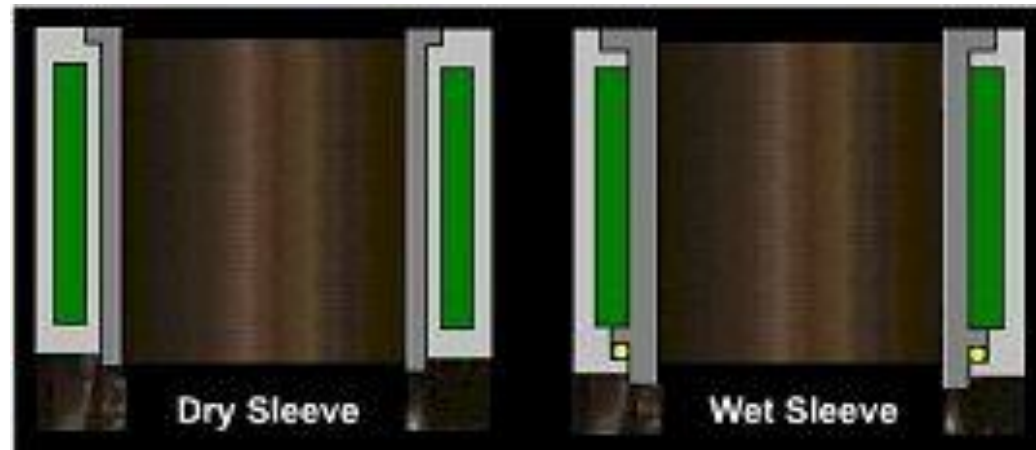


- Suhe cilindarske košuljice



# CILINDARSKE KOŠULJICE

- Suhe košuljice  
(lijevo)
- Mokre košuljice  
(desno)





- Cilindarska košuljica



- Cilindarska glava



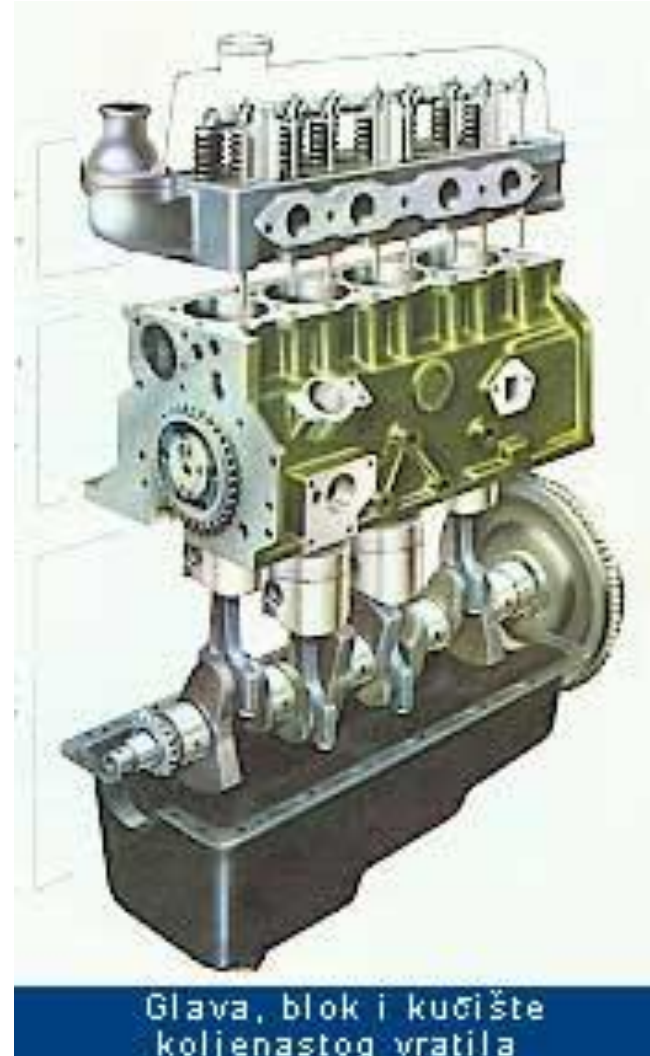


# Cilindarska glava - presjek



# Glava, blok i korito motora

- Korito motora (karter)



# Pokretni dijelovi motora

- Klipni (motorni) mehanizam



# Klip i klipnjača



# John Deere – klip i klipni prstenovi

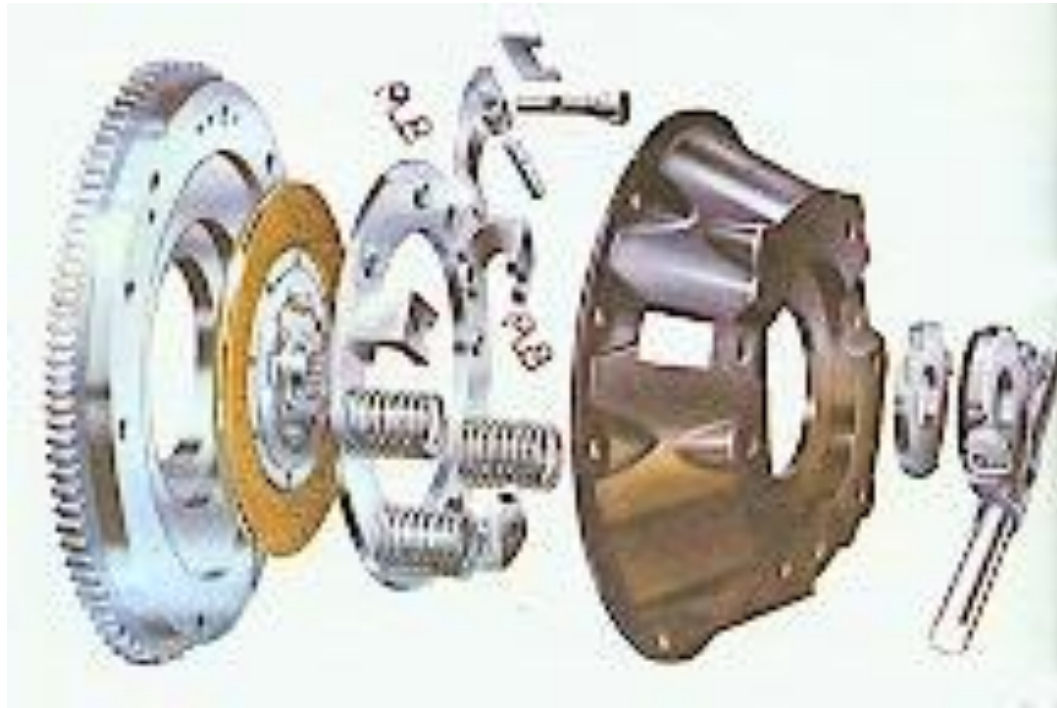




# Koljenasto vratilo

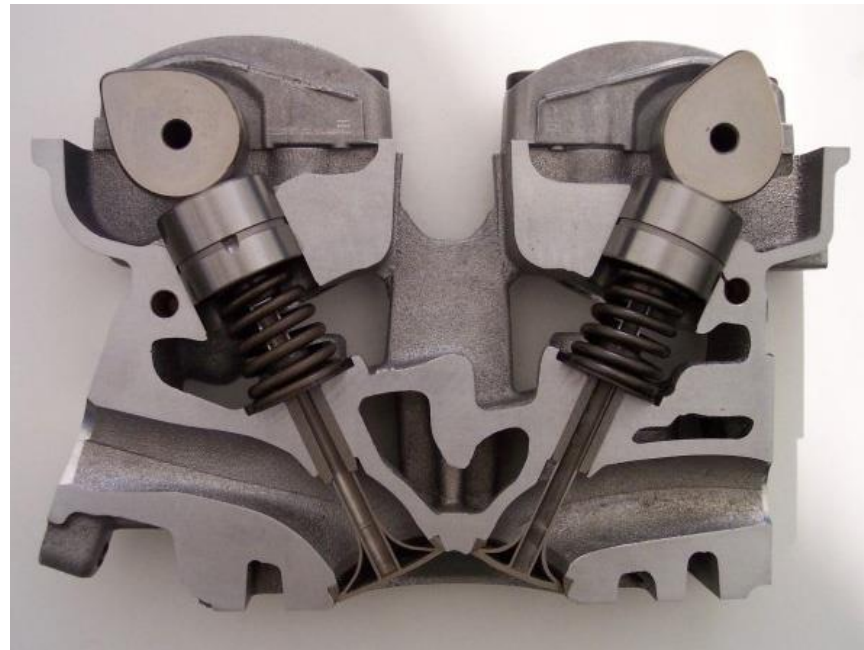


# Zamašnjak i spojka



# Razvodni mehanizam

- Ventilski razvodni mehanizam



# Ventili, sjedišta ventila i vođice



# Bregasto vratilo



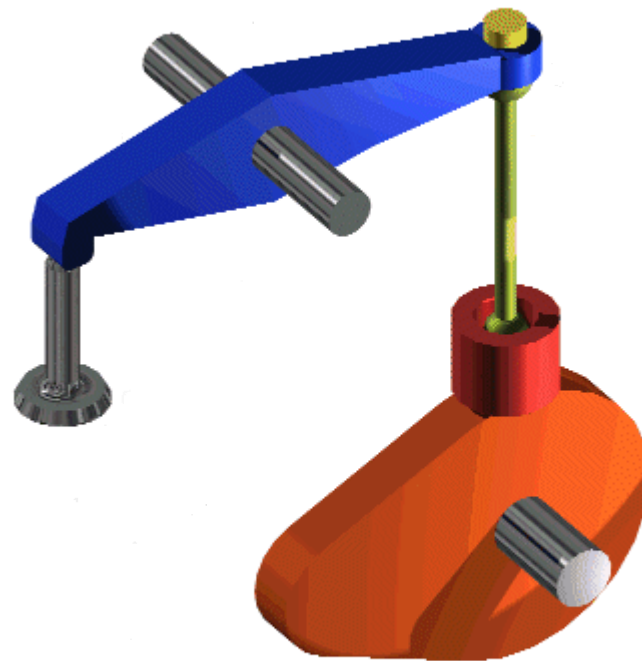
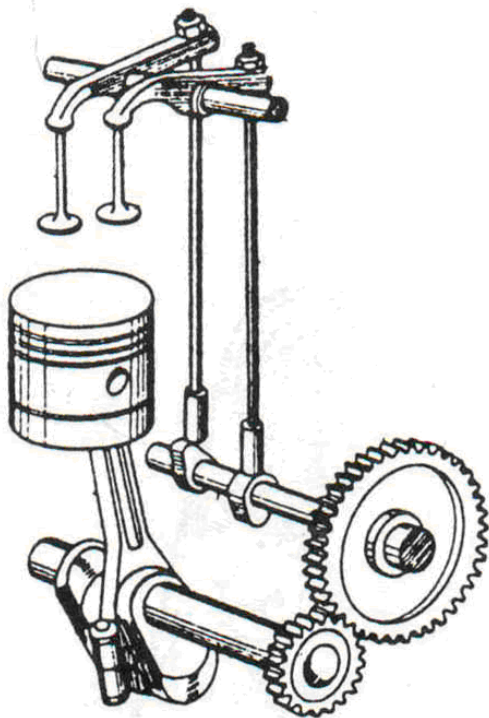
# DOHC-dva bregasta vratila u glavi – pogon lancem



# OHC – bregasto vratilo u glavi – pogon zupčastim remenom



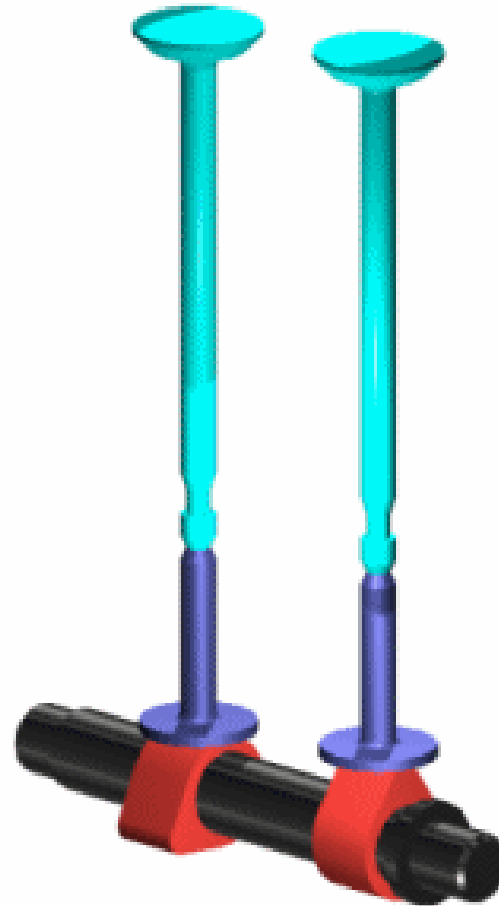
# Bregasto vratilo u bloku-podizači- klackalice – pogon zupčanicima



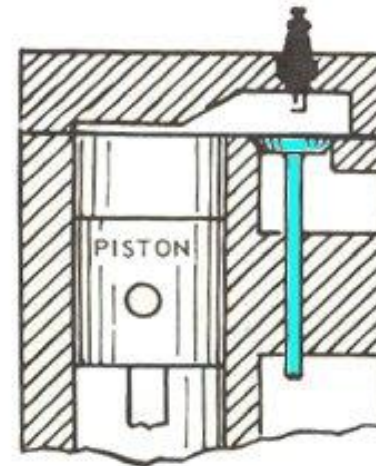
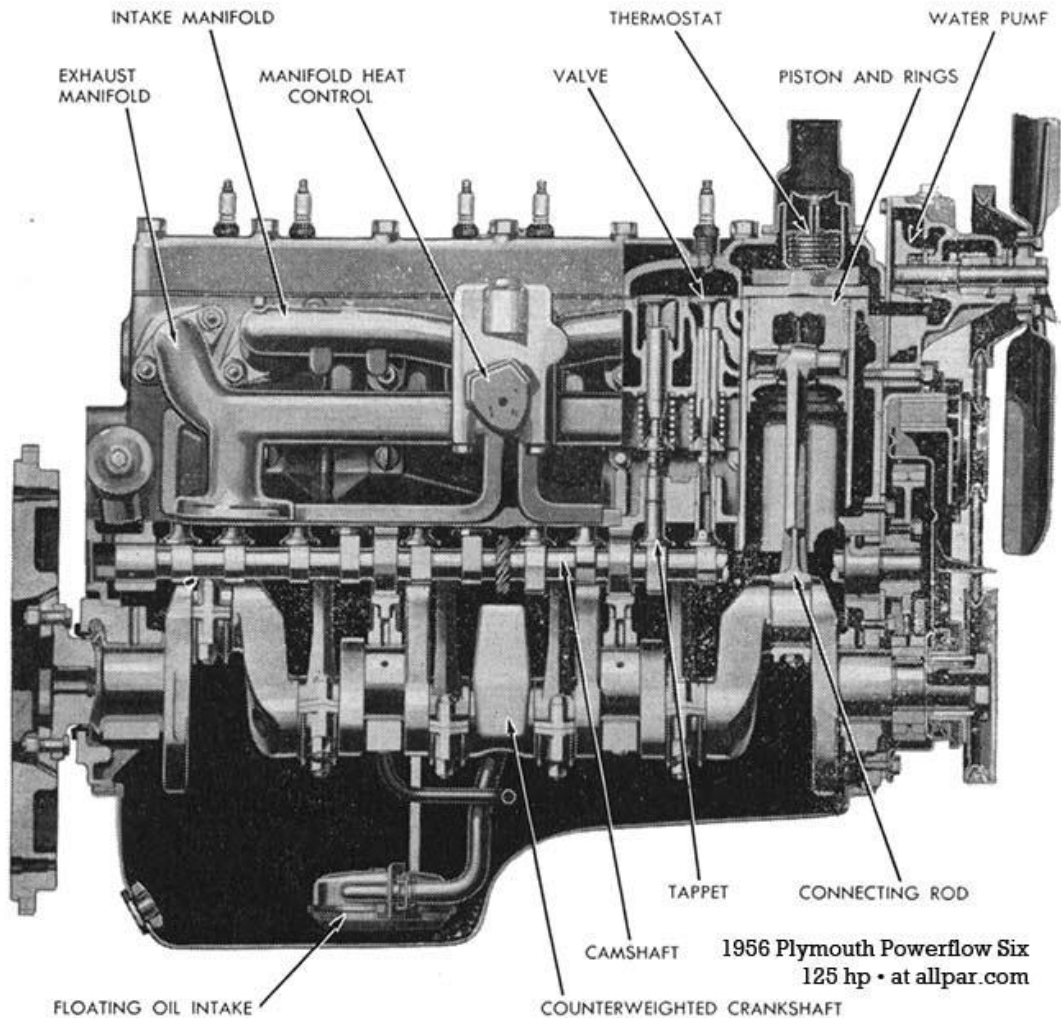


# Razvodni mehanizam sa stojećim ventilima

- Ventili su u bloku,  
kao i bregasto vratilo
- Bregasto vratilo  
preko podizača  
podiže ventile



# Motor sa stojećim ventilima



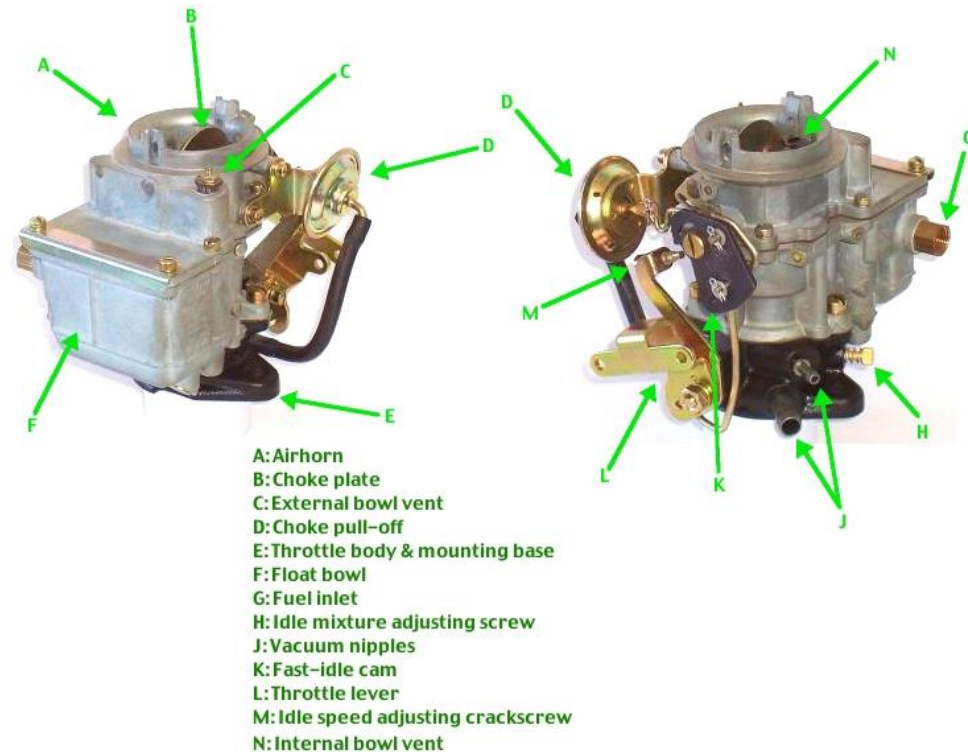
Valves

Cylinder

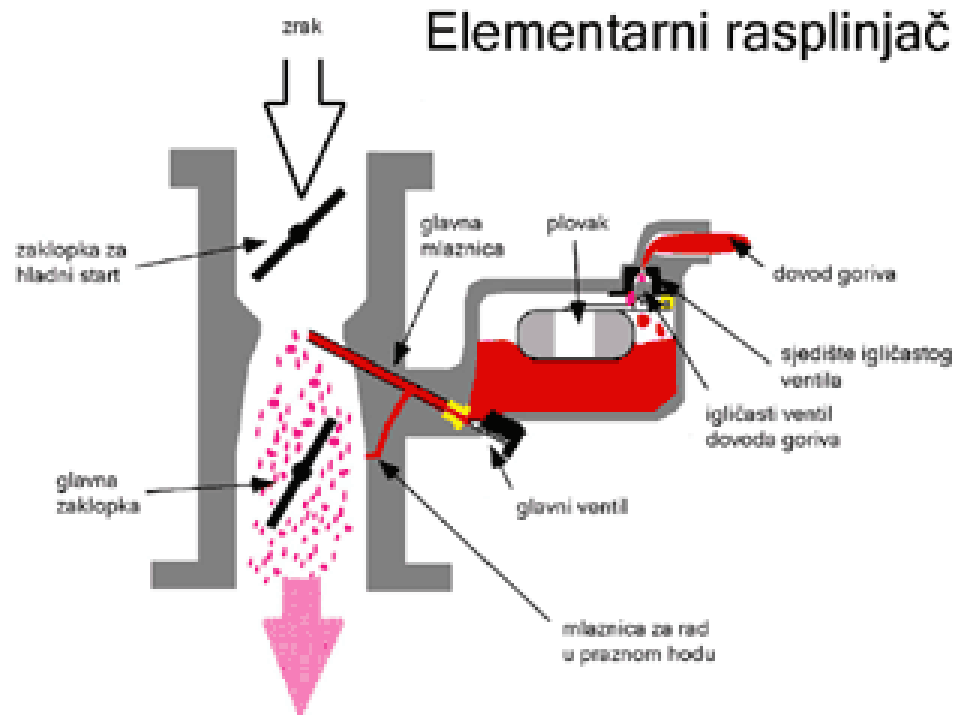
Form an inverted letter L

# Pomoćni uređaji motora

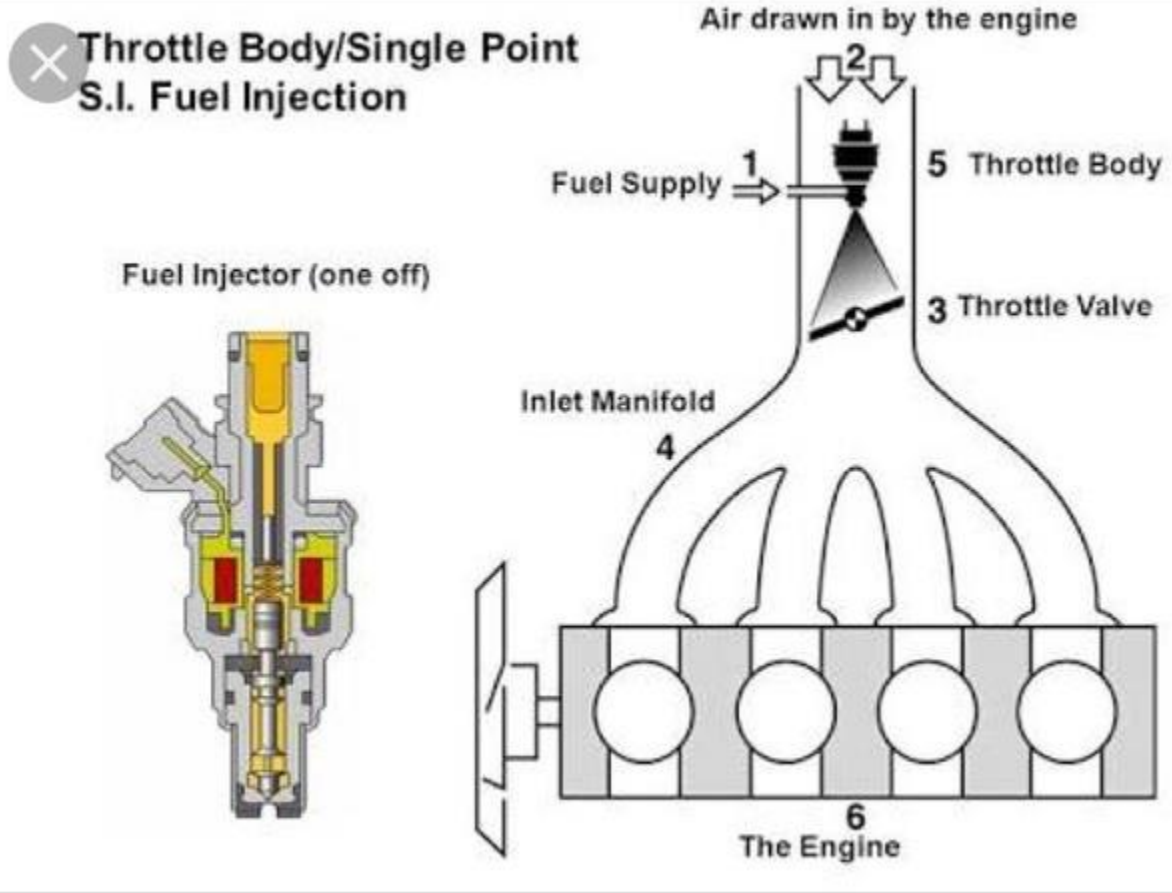
- Uređaj za napajanje gorivom otto motora
  - Spremnik goriva (rezervoar)
  - Niskotlačna crpka za gorivo
  - Rasplinjač (karburator) ili sustav ubrizgavanja



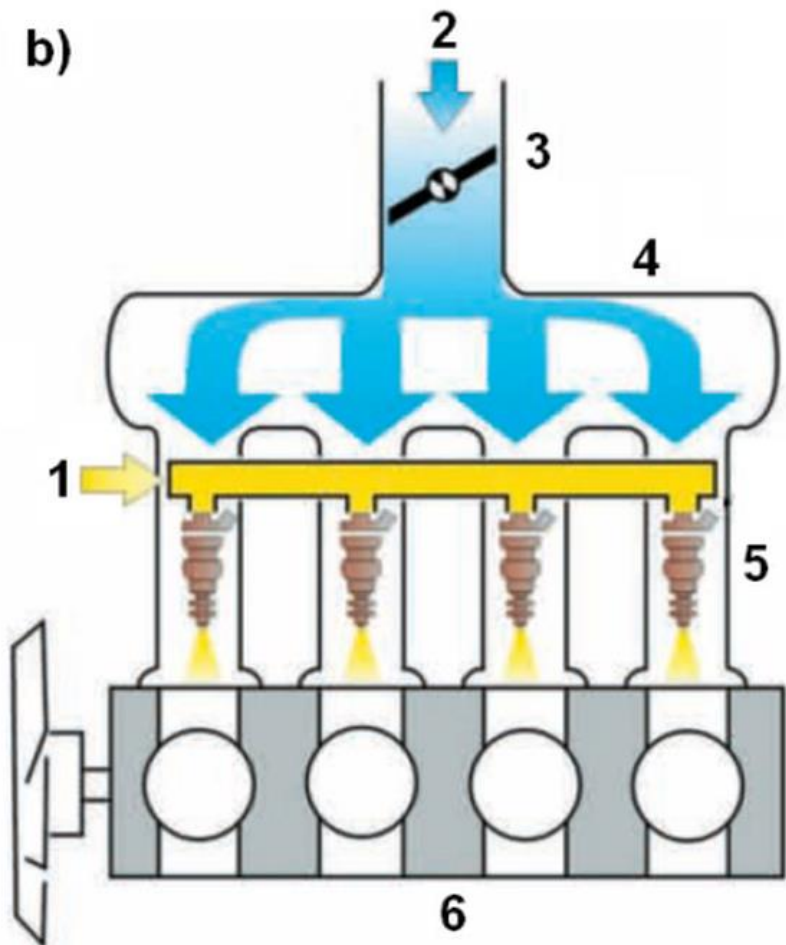
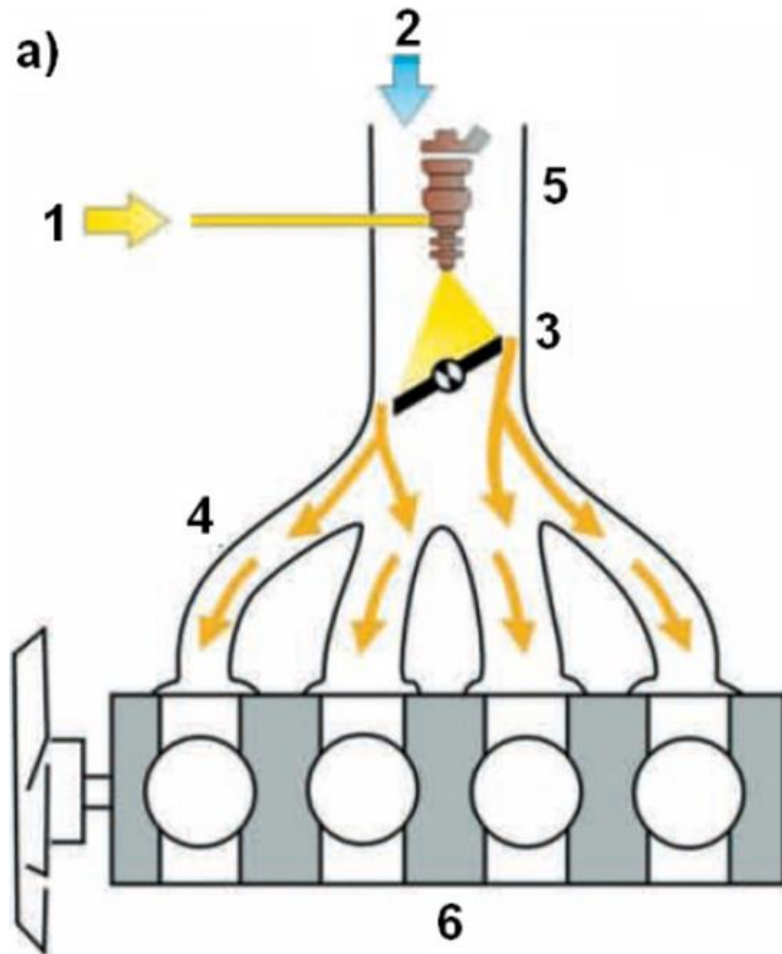
# Elementarni rasplinjač



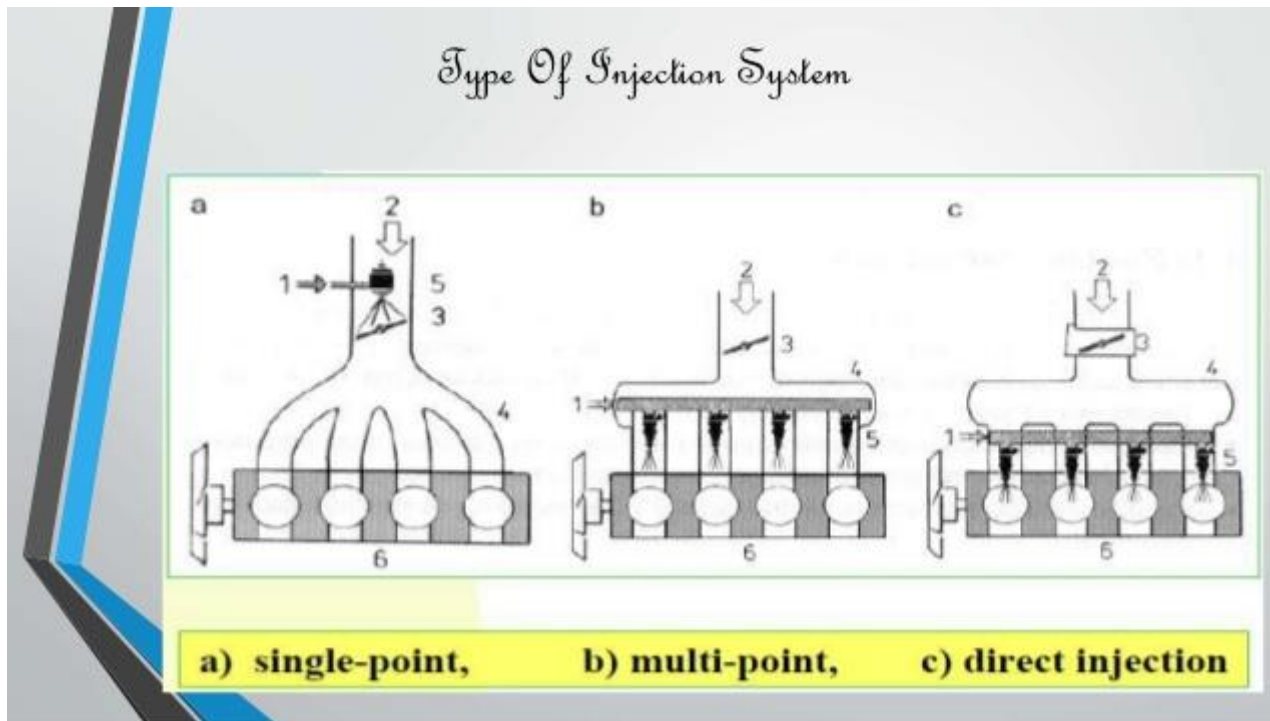
# Single-point ubrizgavanje u usisnoj cijevi



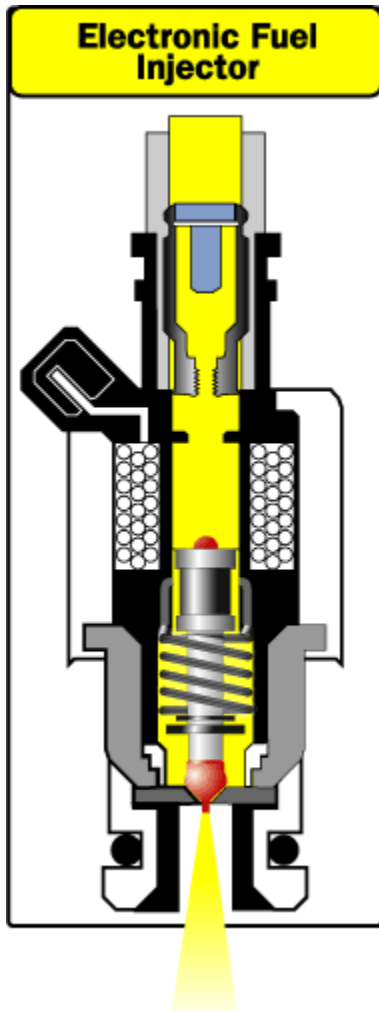
# Single-point, multi-point ubrizgavanje



# Single-point, multi-point i direktno ubrizgavanje

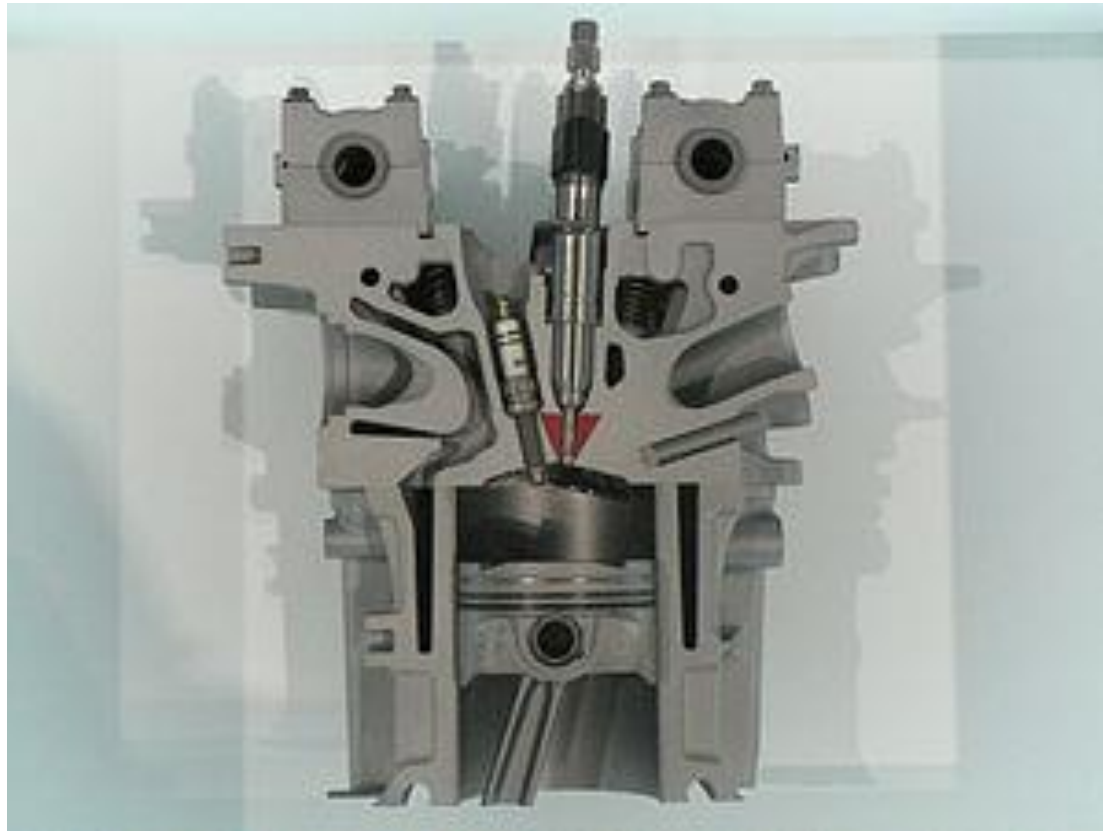


# Brizgaljka goriva otto motora





# GDI motor (gasoline direct injection)

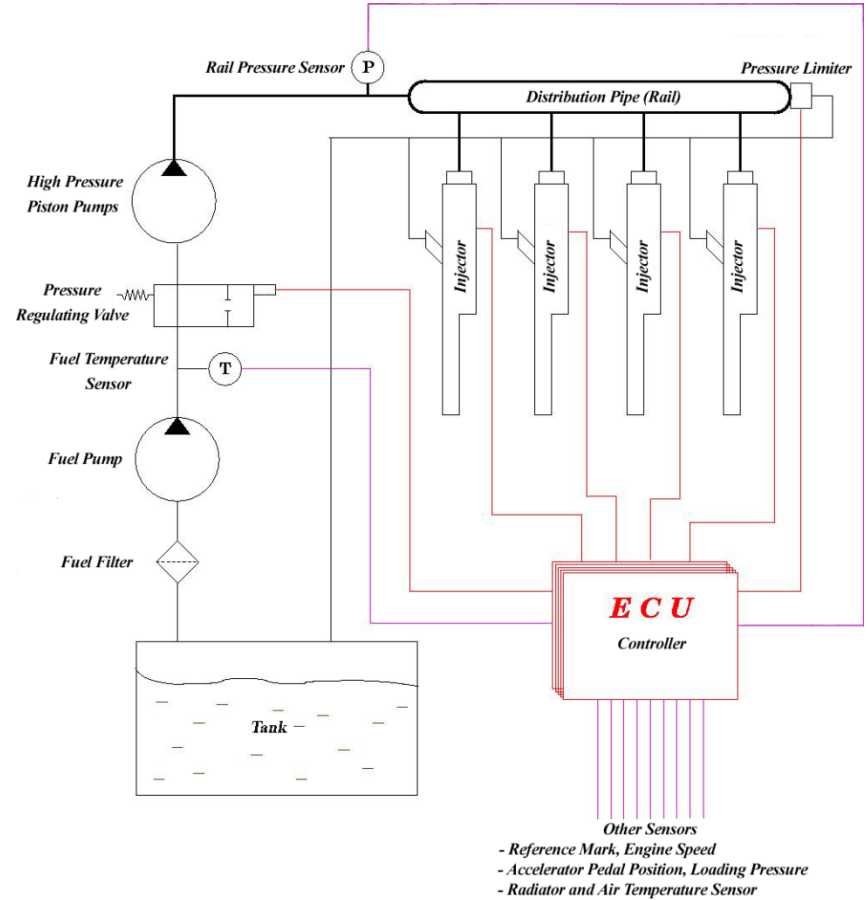


# Vrtložna komora u klipu Otto motora s direktnim ubrizgavanjem



# Uređaj za napajanje gorivom diesel motora

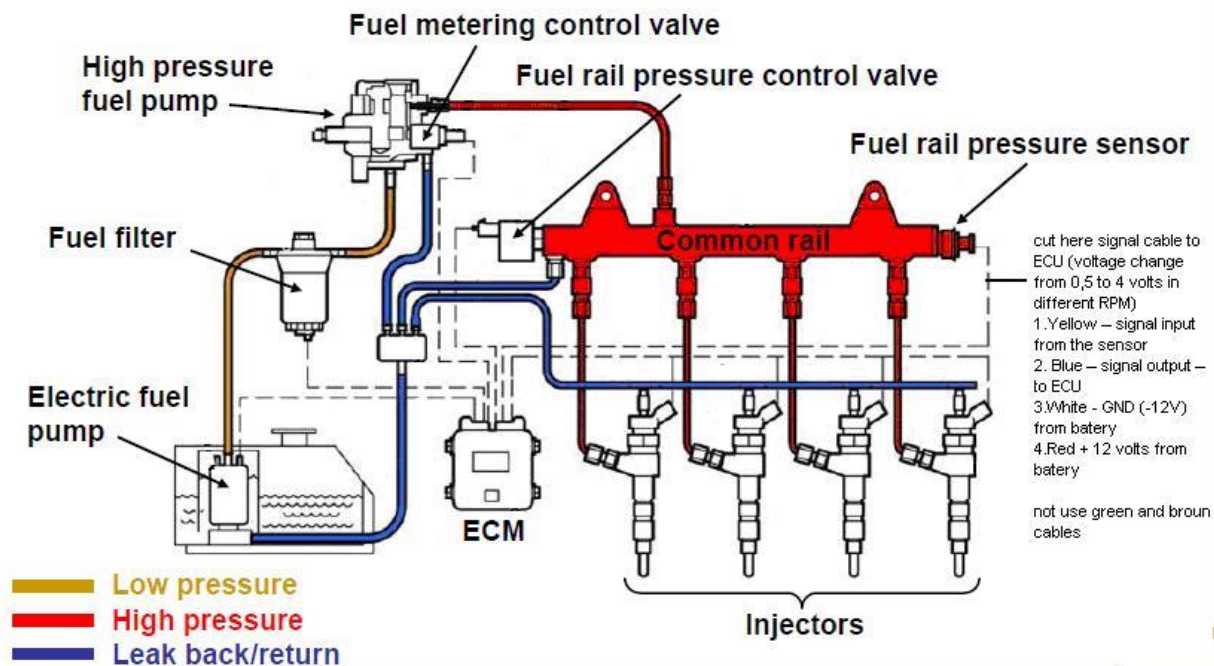
- Spremnik goriva (rezervoar)
- Taložnik (taložna čašica)
- Niskotlačna crpka za gorivo
- Prečistači goriva (grubi i fini)
- Visokotlačna crpka za gorivo
- Brizgaljke



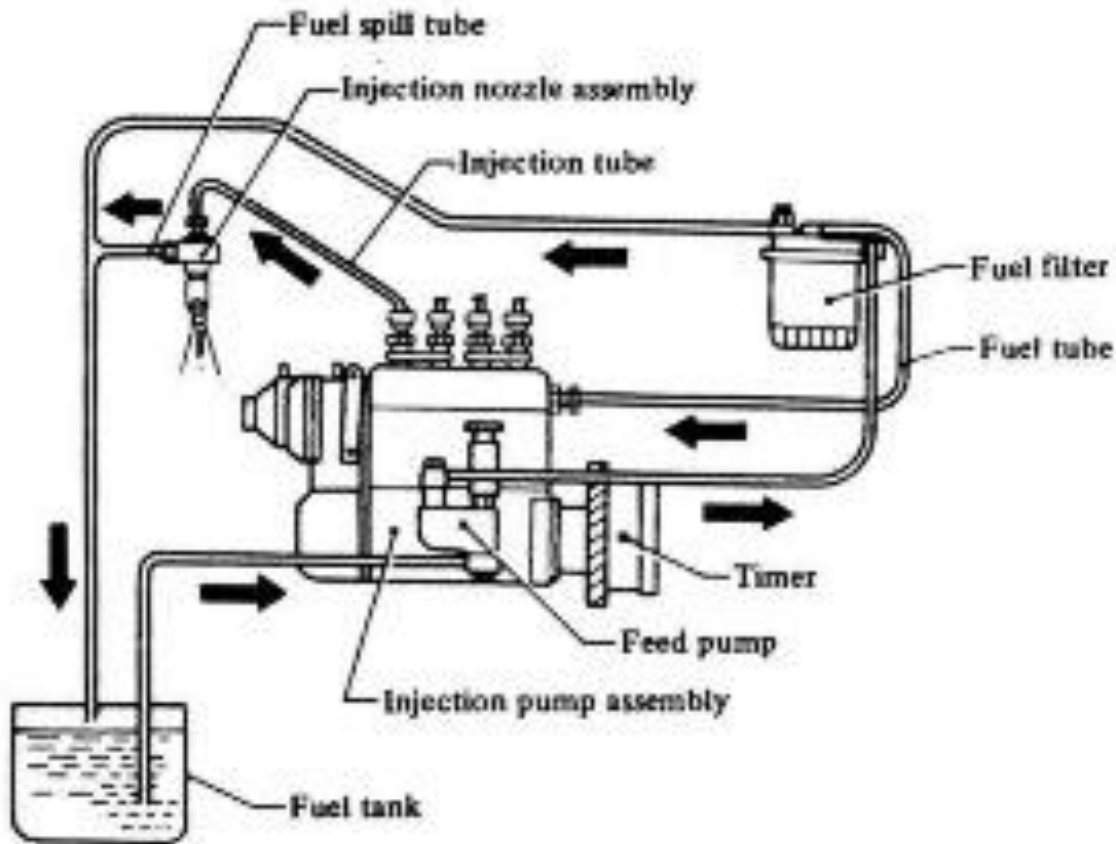
# Common rail sustav ubrizgavanja goriva

## Common Rail Diesel Fuel Systems

Components overview (example: Bosch EDC 16)



# Uređaj s rednom (linijskom) visokotlačnom crpkom



# Niskotlačna crpka za gorivo

- Klipna ili membranska

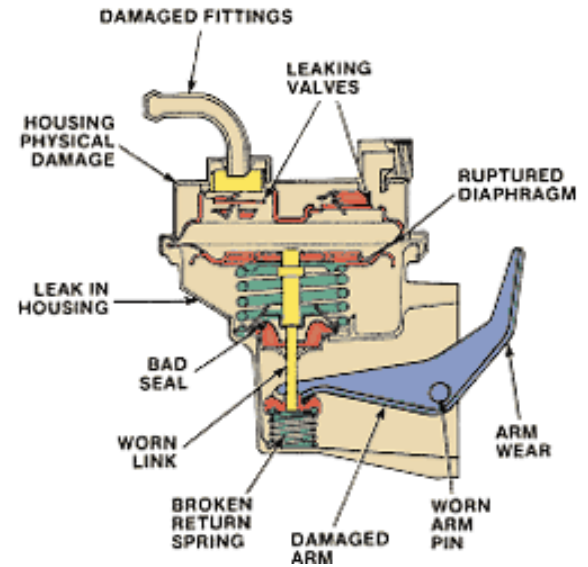
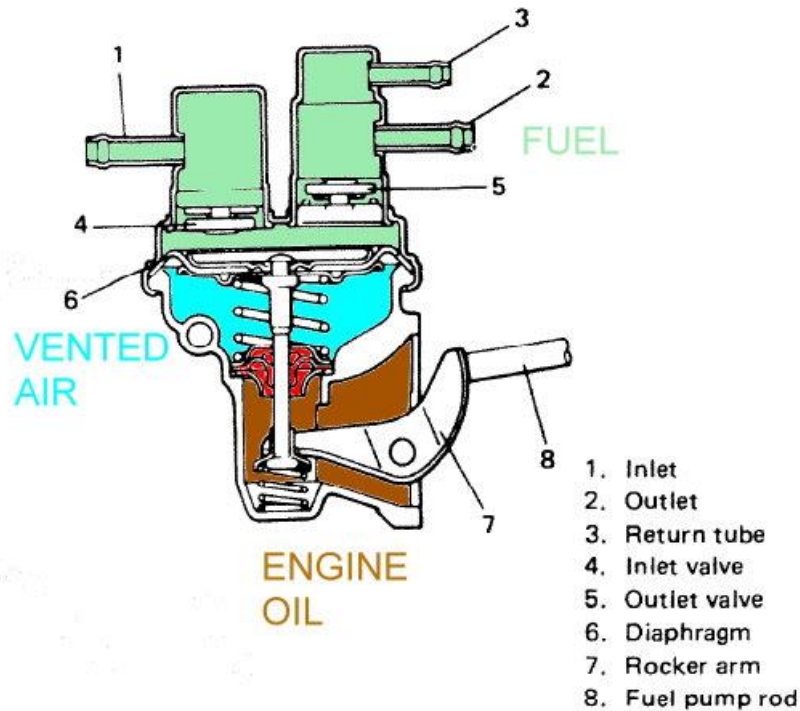
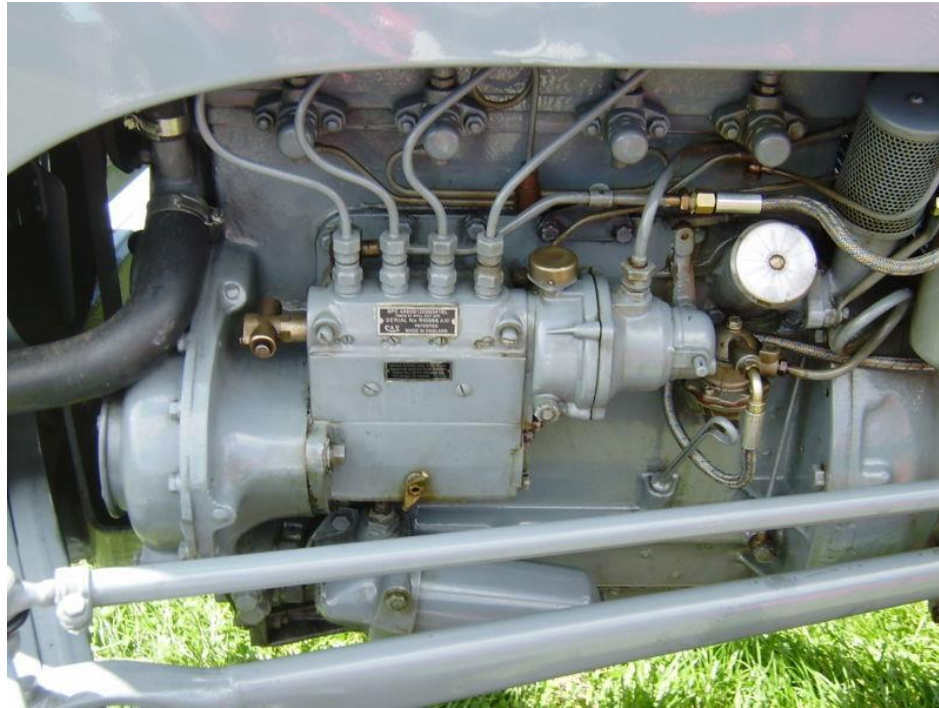
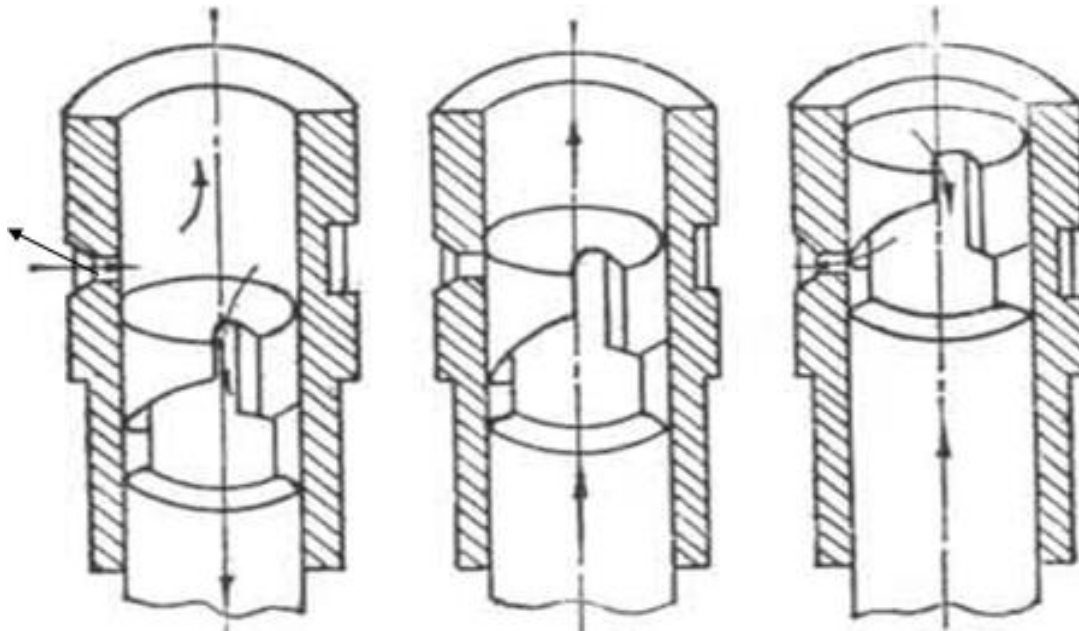


Fig. 4-2-7

# Redna visokotlačna crpka za gorivo s pneumatskim regulatorom

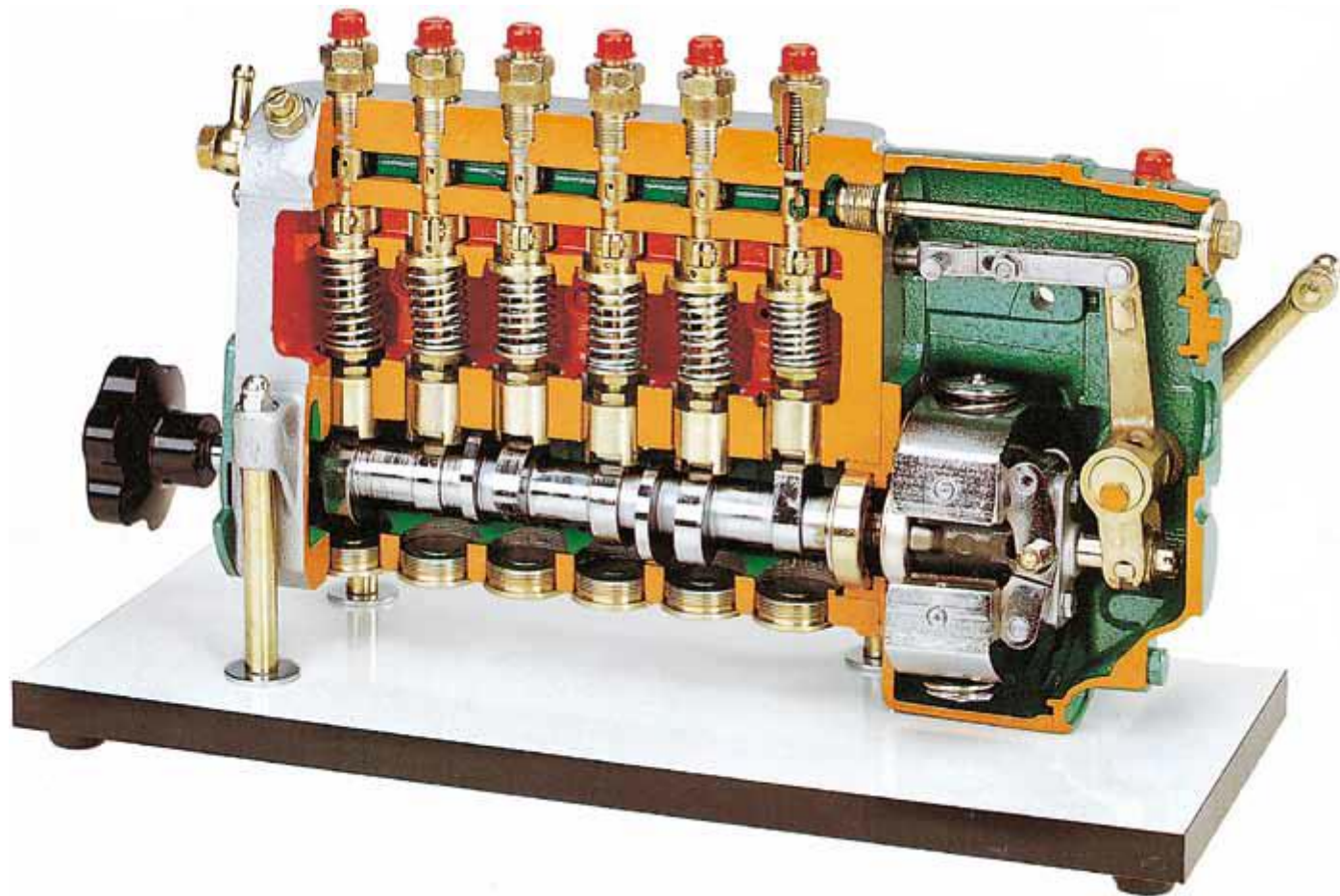


# Regulacija broja okretaja motora zakretanjem klipova u elementima crpke

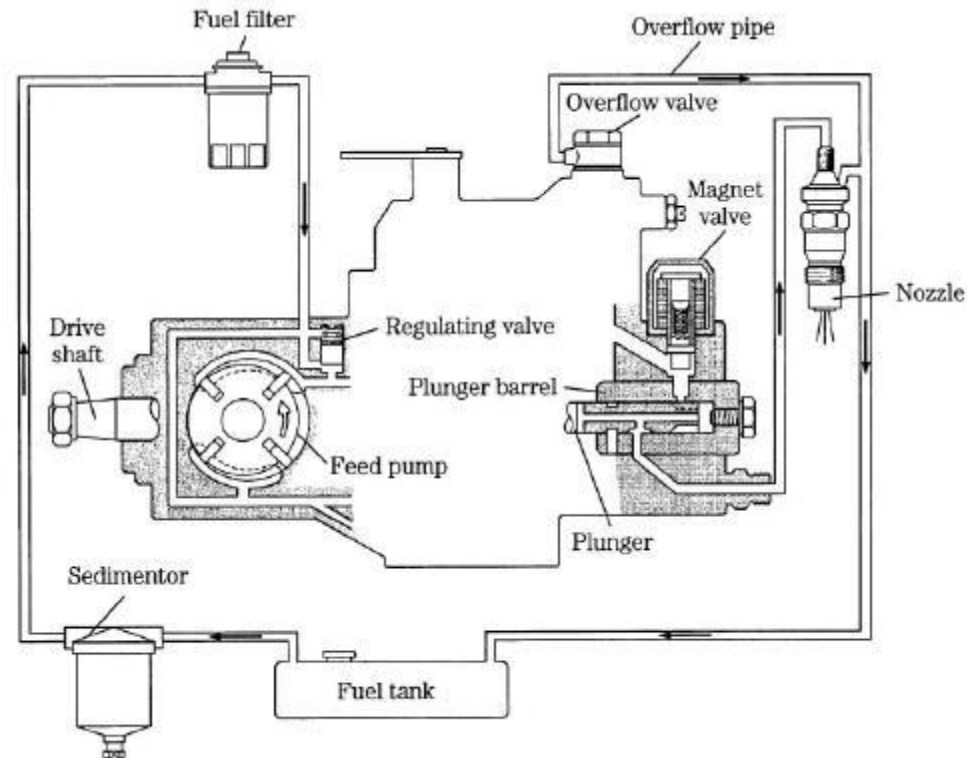




# Centrifugalni regulator redne visokotlačne crpke za gorivo

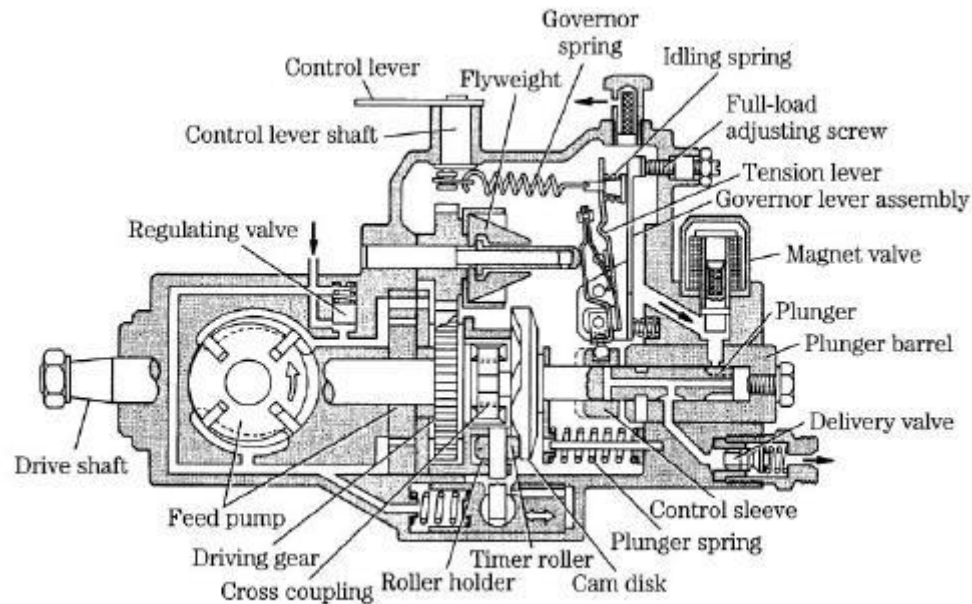


# Rotacijska visokotlačna crpka za gorivo



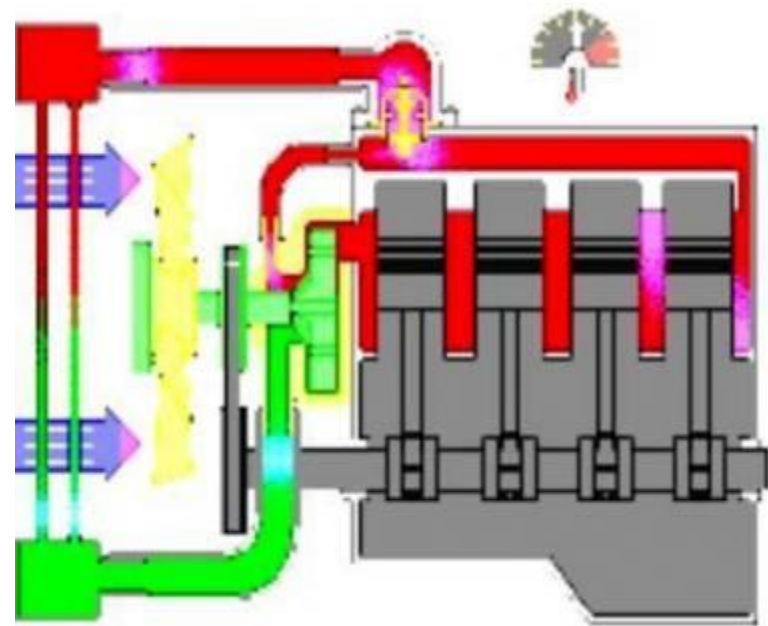
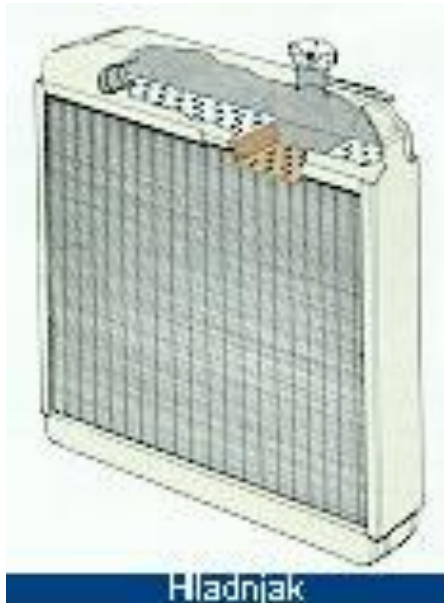
5-9 Typical small-engine distributor-type system. *Yanmar Diesel*

# Rotacijska VT crpka za gorivo

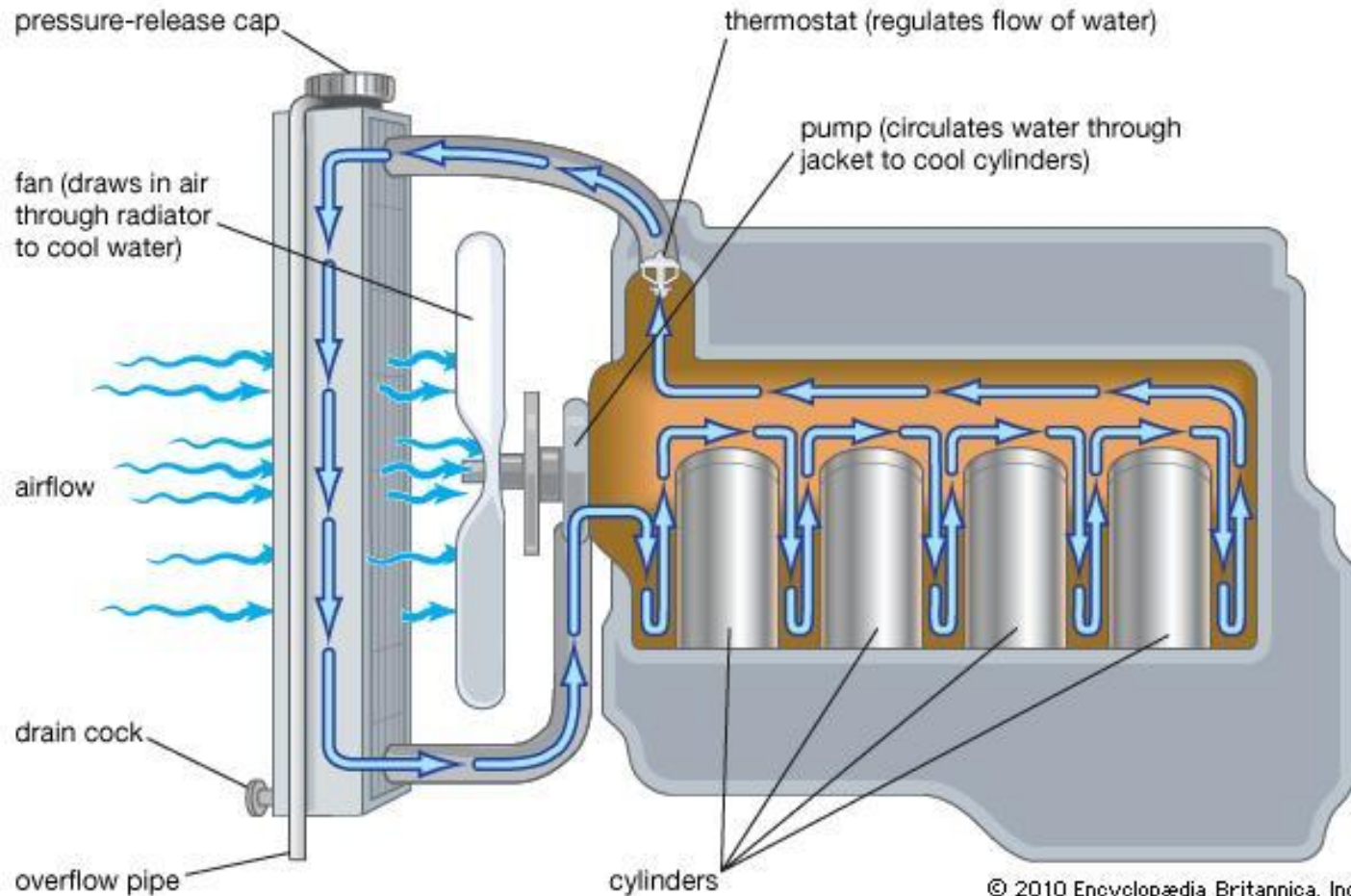


5-10 Bosch VE Series injection pump.

# Uređaj za hlađenje motora



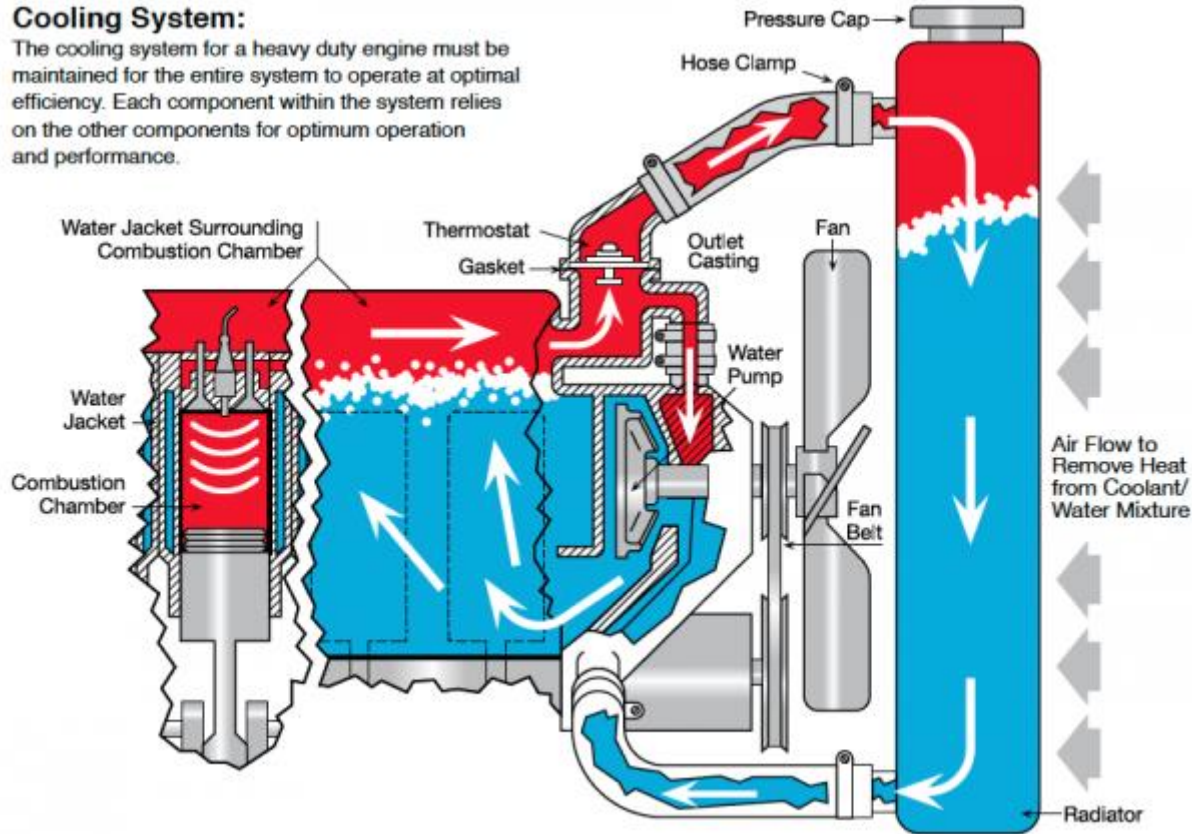
# Cirkulacija rashladne tekućine velikim tokom



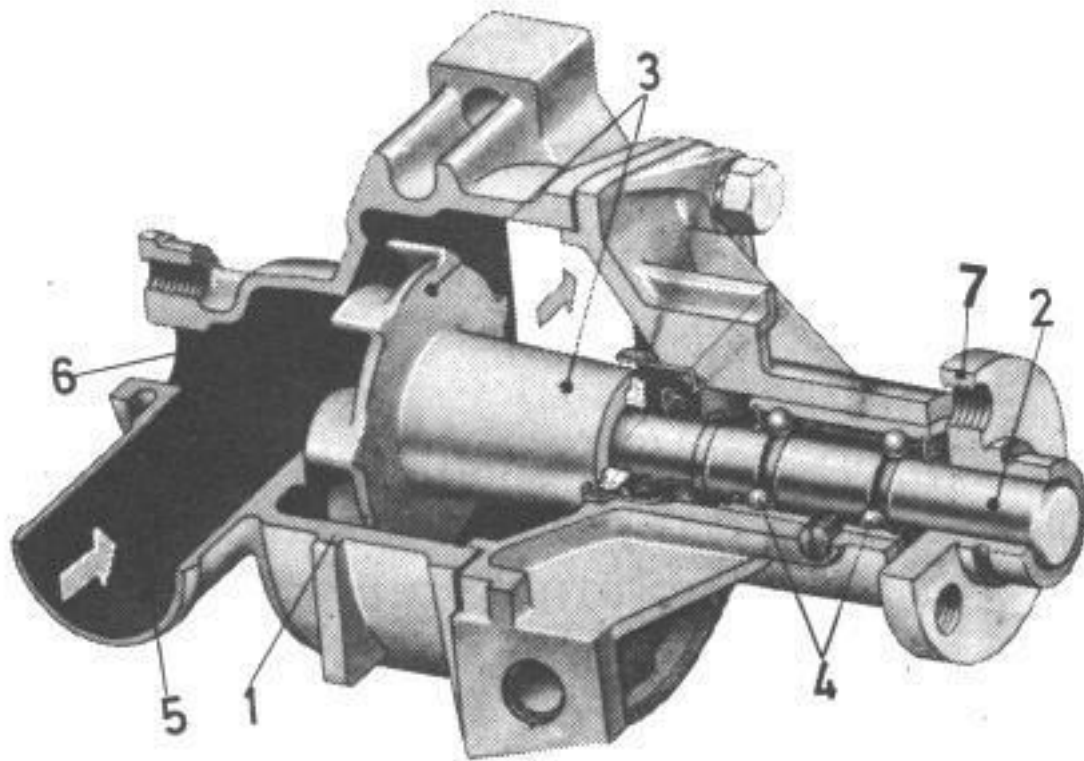
# VELIKI I MALI TOK RASHLADNE TEKUĆINE

## Cooling System:

The cooling system for a heavy duty engine must be maintained for the entire system to operate at optimal efficiency. Each component within the system relies on the other components for optimum operation and performance.



# Crpka za rashladnu tekućinu („vodena pumpa”)



# TERMOSTAT





# HLADNJAK I ČEP S DVOSTRUKIM VENTILOM



# VENTILATOR I SENZOR ZA TEMPERATURU



# Sredstva protiv smrzavanja - antifriz



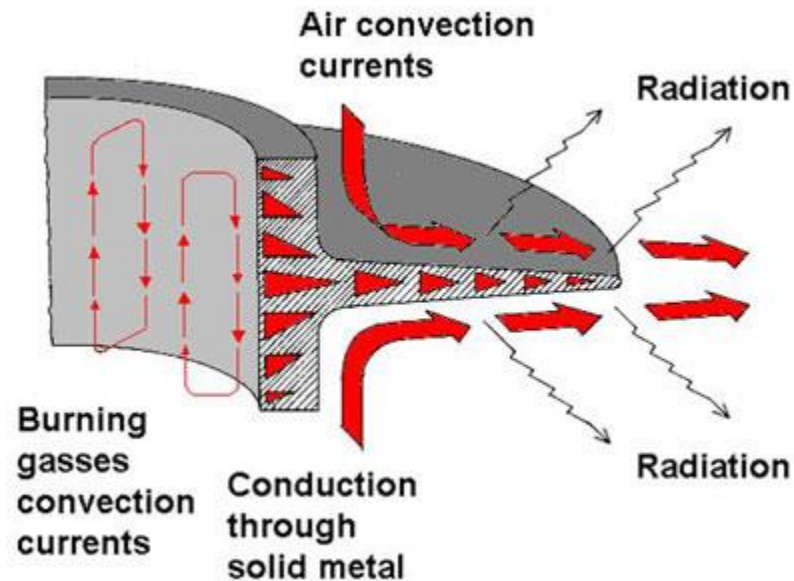
# Zračno hlađenje motora



# Cilindar i cilindarska glava s rebrima



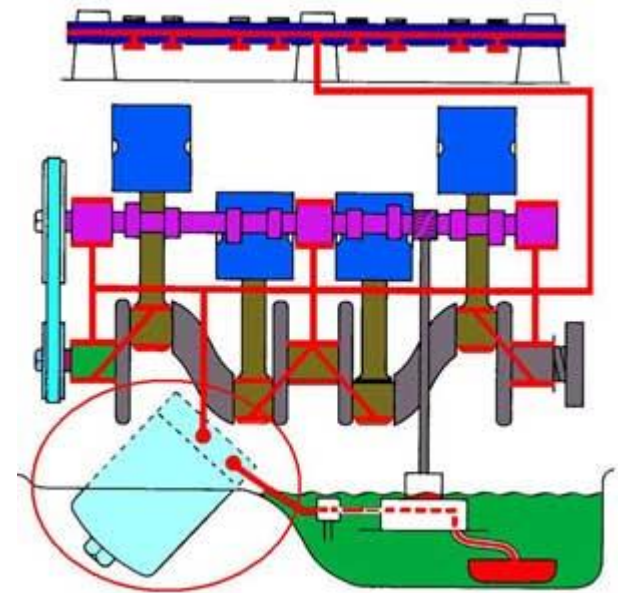
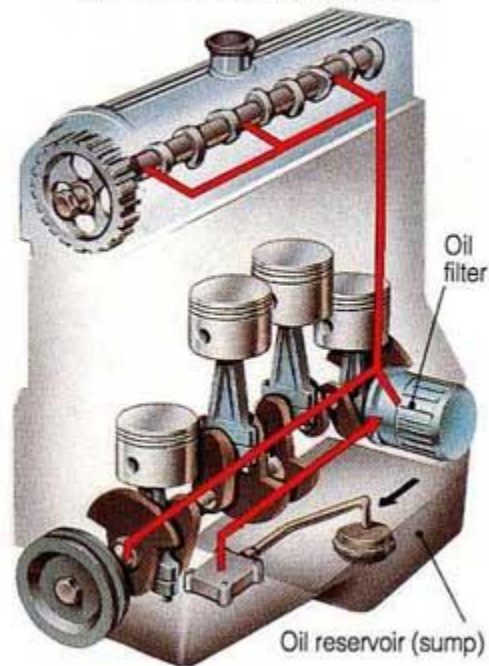
# Zračno hlađenje – prijelaz topline konvekcijom, kondukcijom i zračenjem



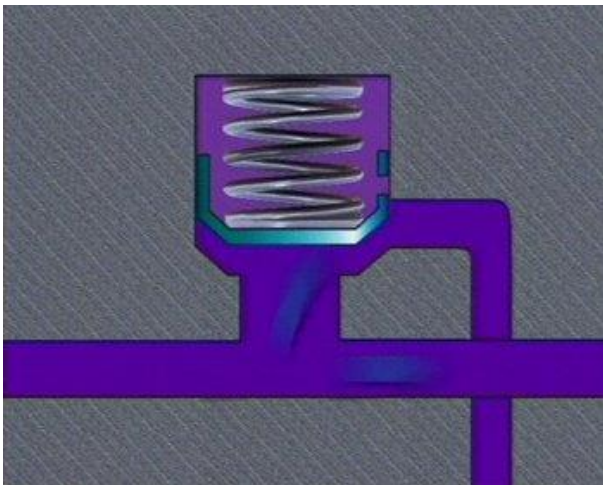
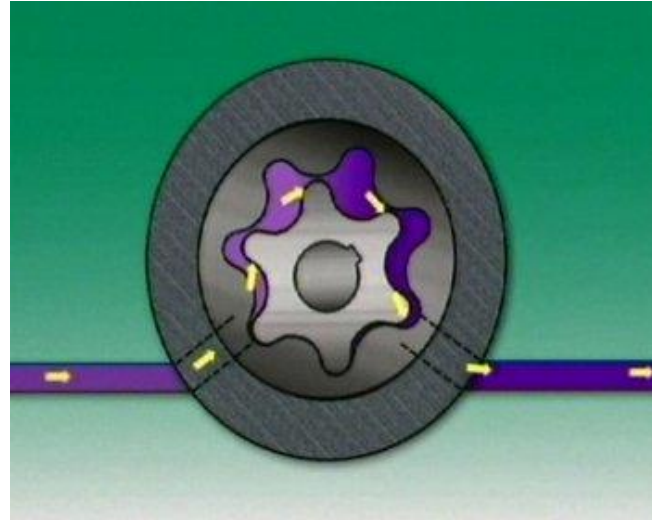


# Shema podmazivanja motora

The lubrication system

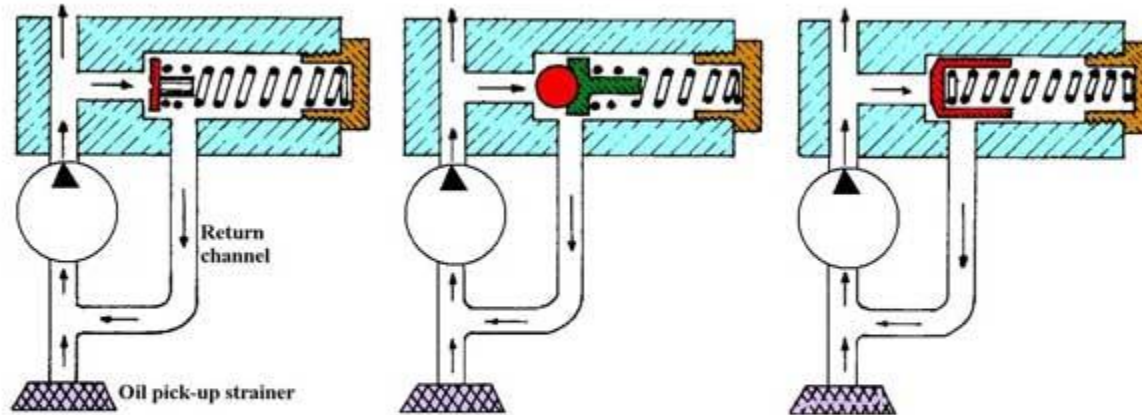






# Prelivni sigurnosni ventil

To oil filter and main oil gallery



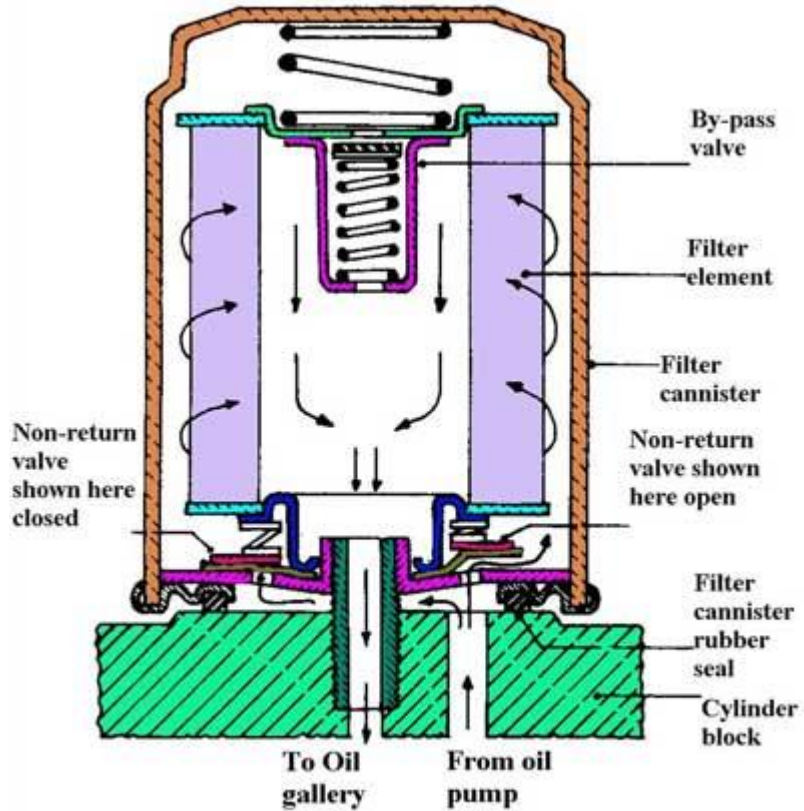
Disc Type

Ball Type

Plunger Type

Assorted types of pressure relief valves

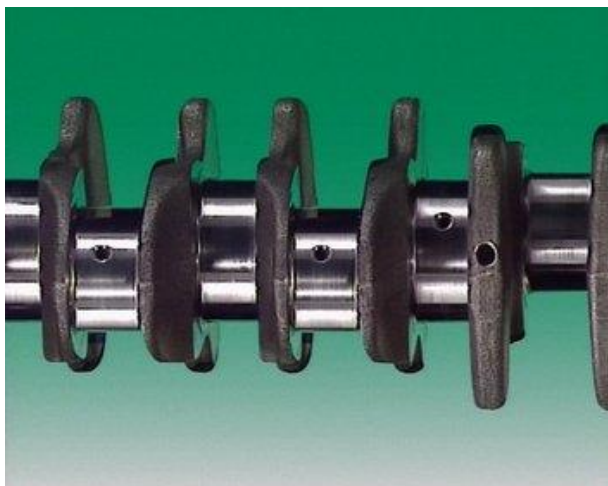
# Uljni prečistač



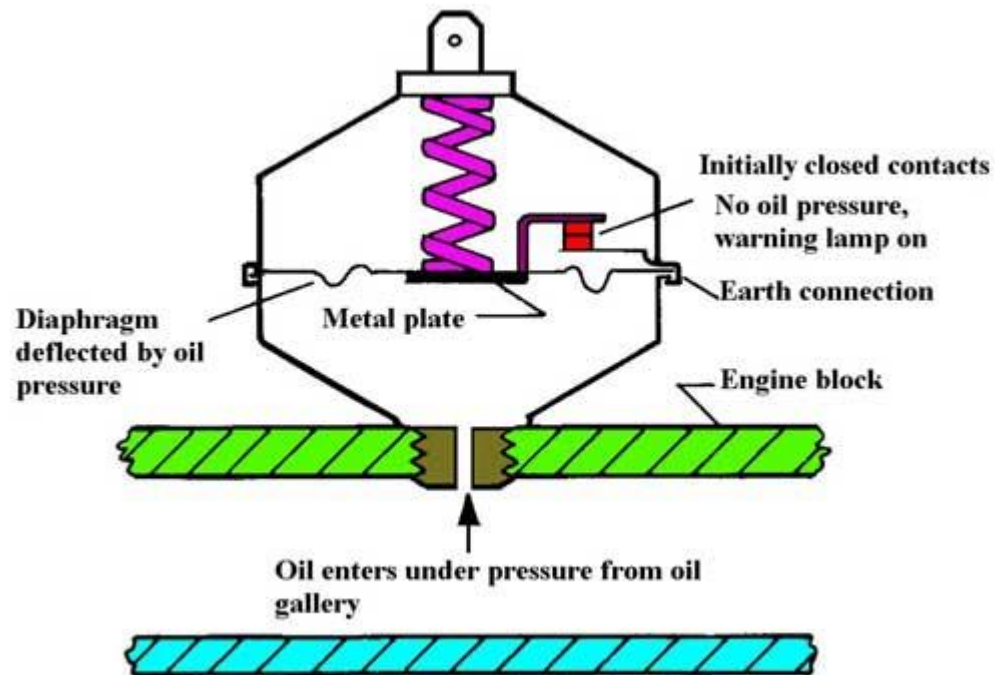
Full flow replacement oil filter unit



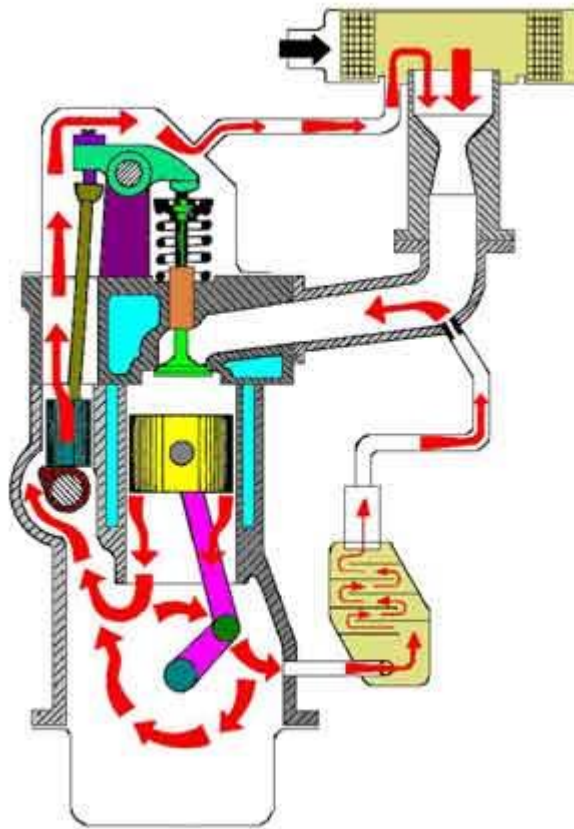
# Šupljine za ulje u koljenastom vratilu i mjerna šipka za kontrolu razine ulja u karteru



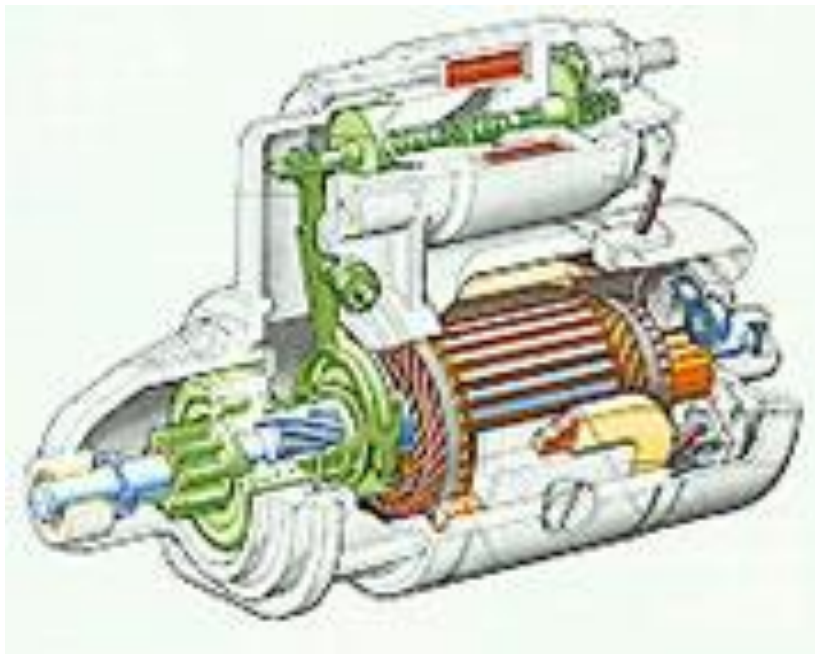
# Tlačni prekidač indikatora ulja



# Oduška kartera

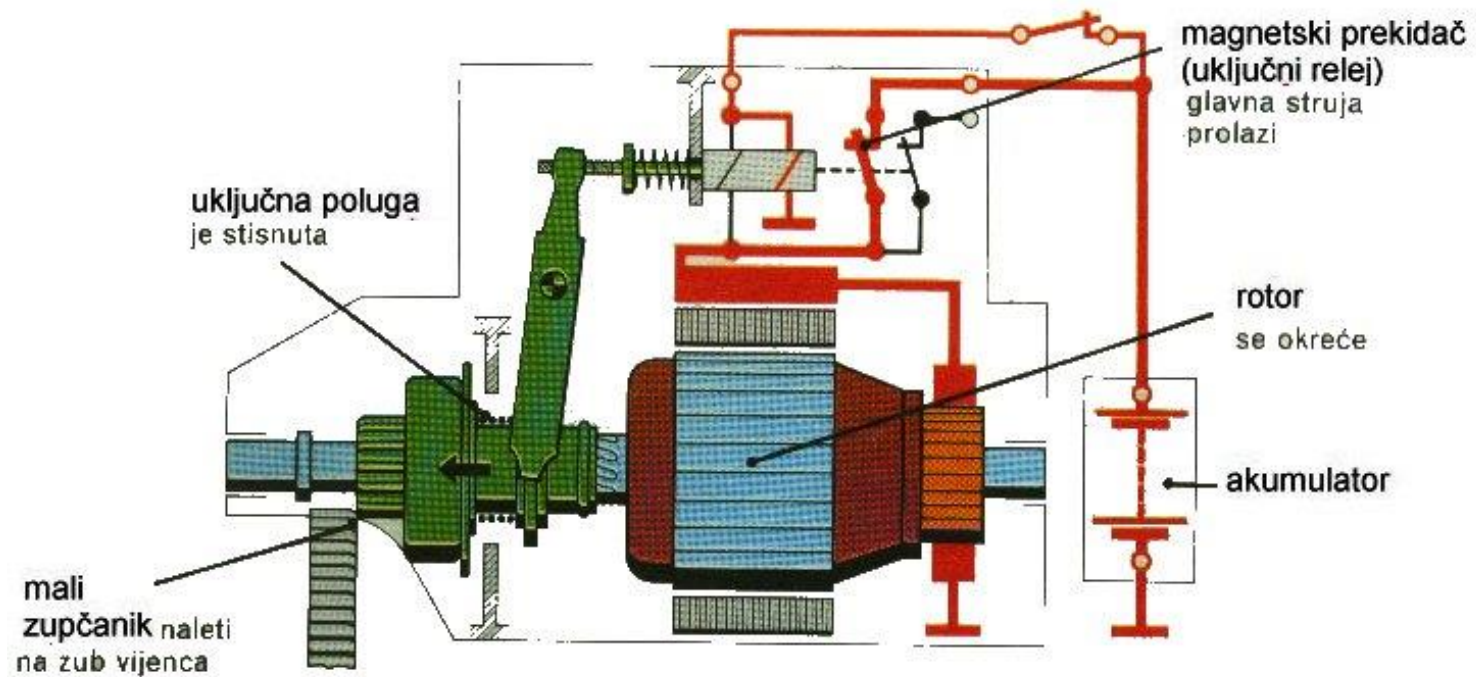


# Uređaj za pokretanje motora elektro-pokretač s el.mag. uključivačem



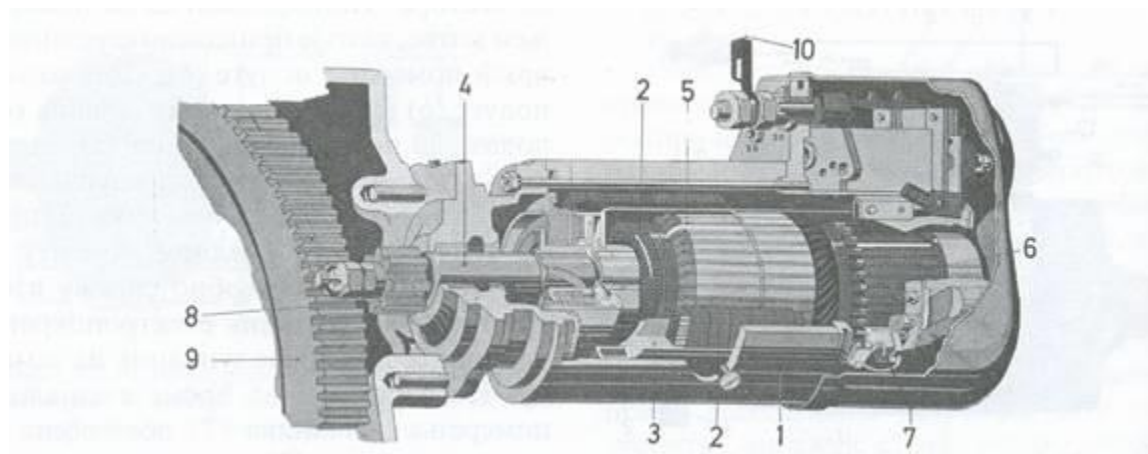
# Shema pokretanja elektropokretača

## ELEKTRIČNO POKRETANJE

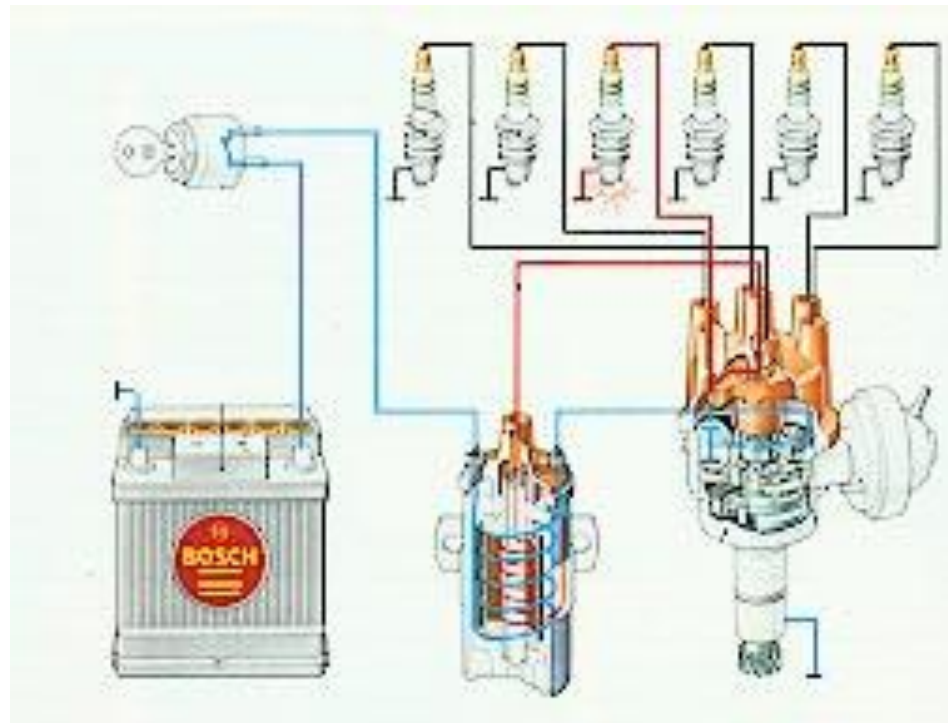




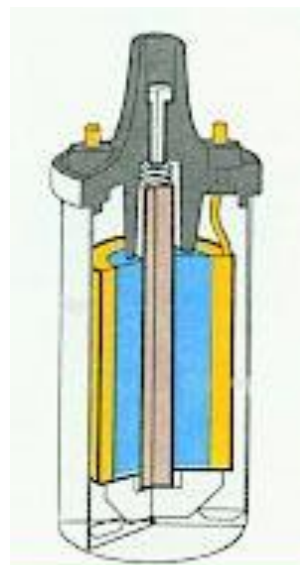
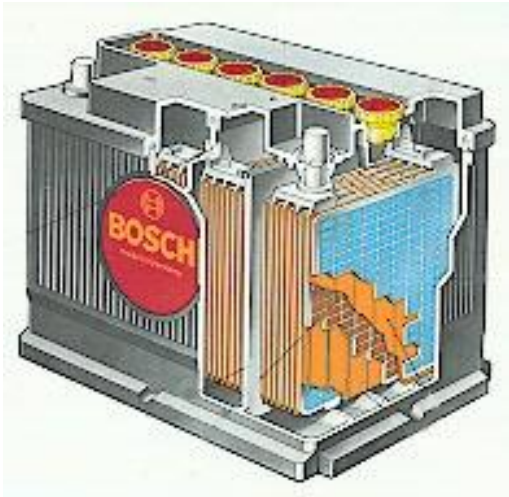
# Elektropokretač s pomičnim rotorom



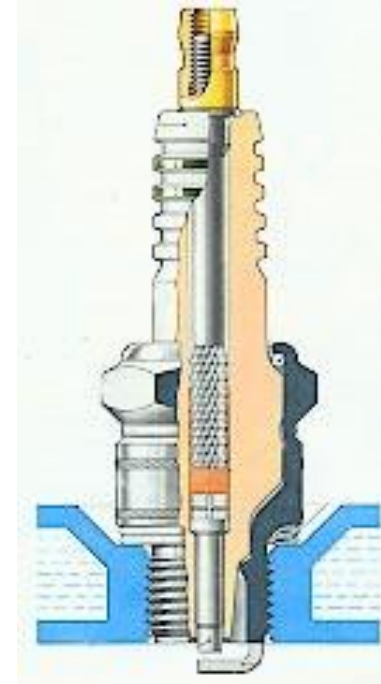
# Uređaj za paljenje otto motora baterijsko paljenje



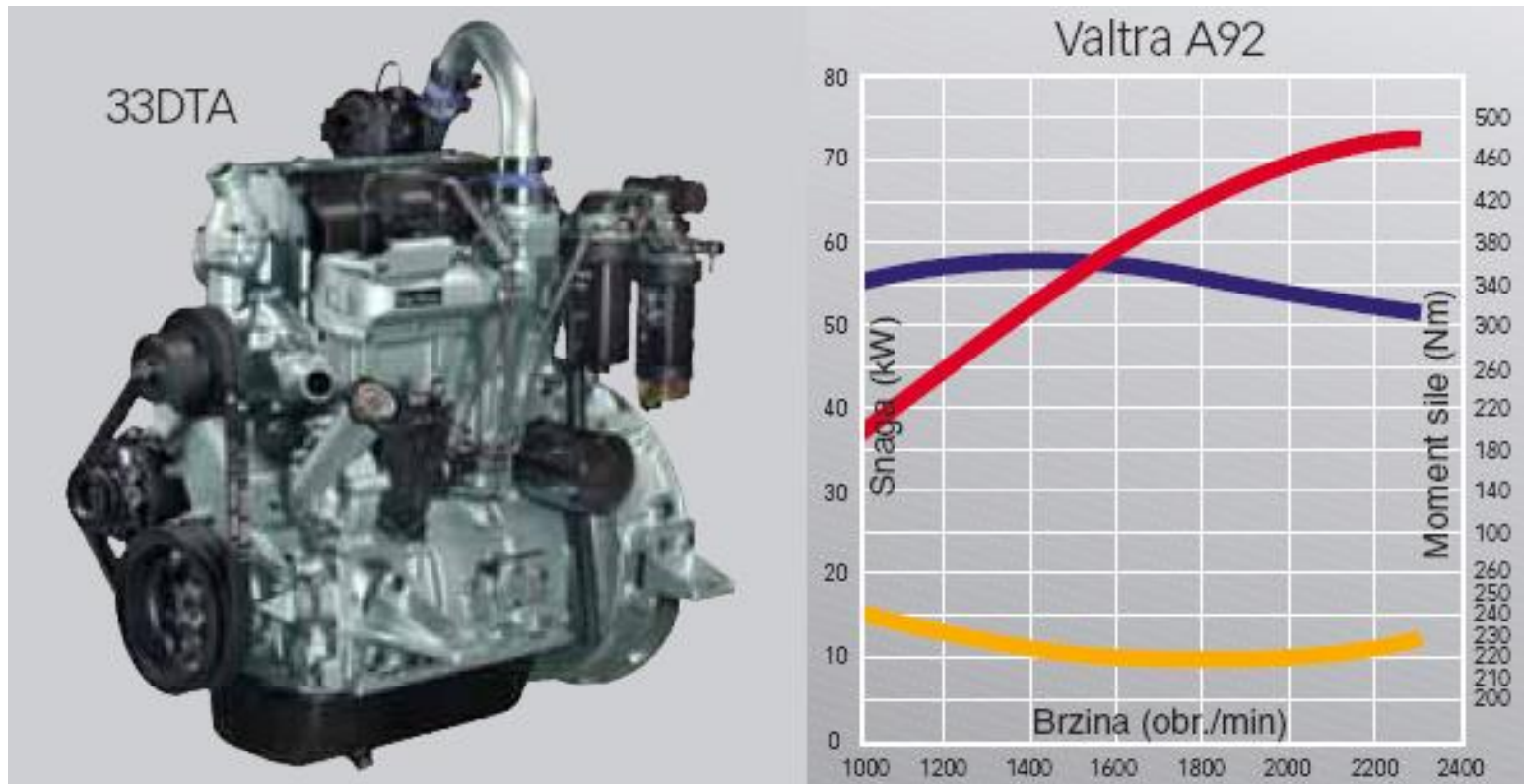
# Akumulator, indukcijski svitak, razvodnik paljenja, svjećica



Indukcijski svitak



# Tehničke karakteristike motora traktora Valtra A 92

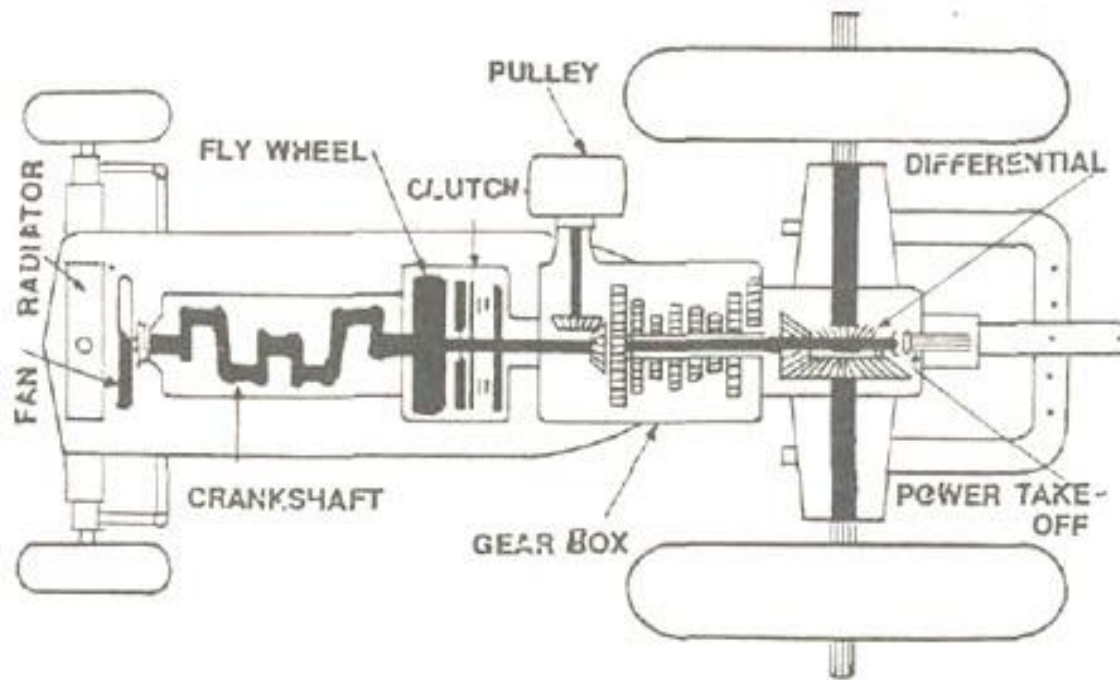


# POLJOPRIVREDNI TRAKTOR

## TRANSMISIJSKI UREĐAJI

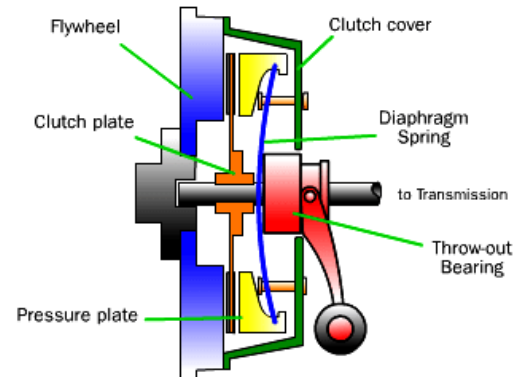
- Spojka
- Mjenjač
- Reduktor
- Konusno-tanjurasti prijenosnik
- Diferencijal
- Završni prijenos

# Transmisijski uređaji traktora

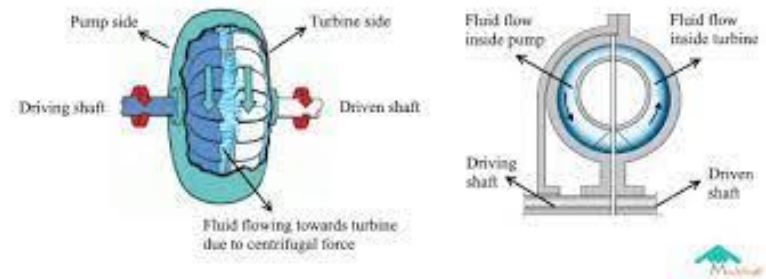


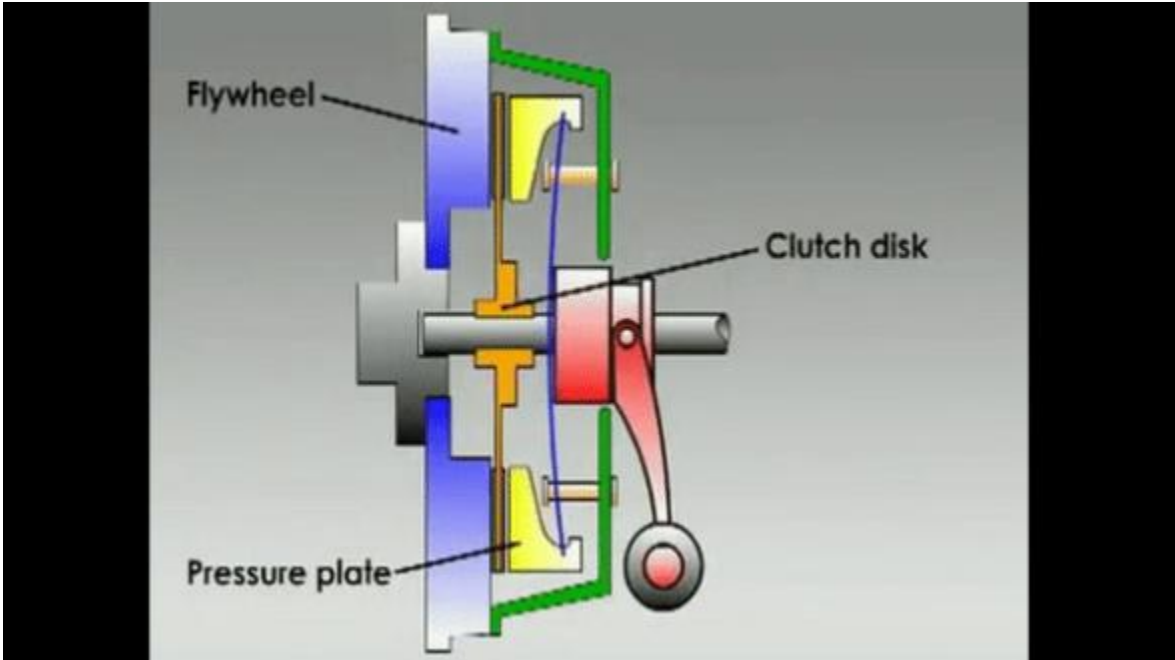
# SPOJKA (KVAČILO, KUPLUNG)

- Mehanička tarna



- Hidraulička (hidrodinamička, turbo-kupplung)

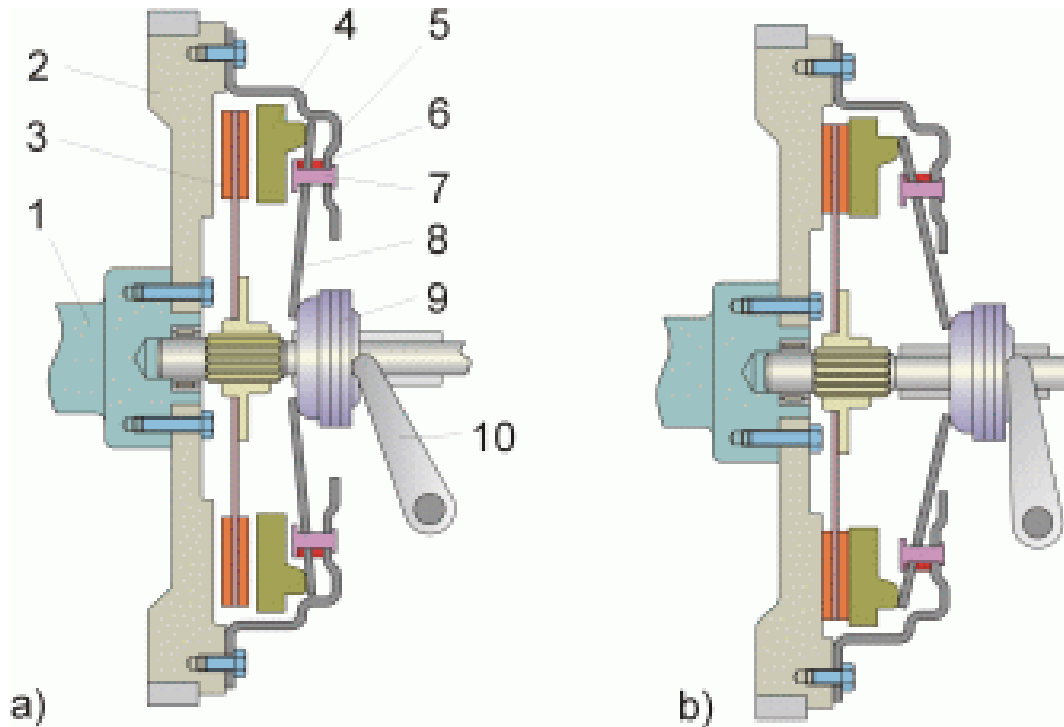






# Mehanička tarba spojka

## 1-struka tanjurasta spojka



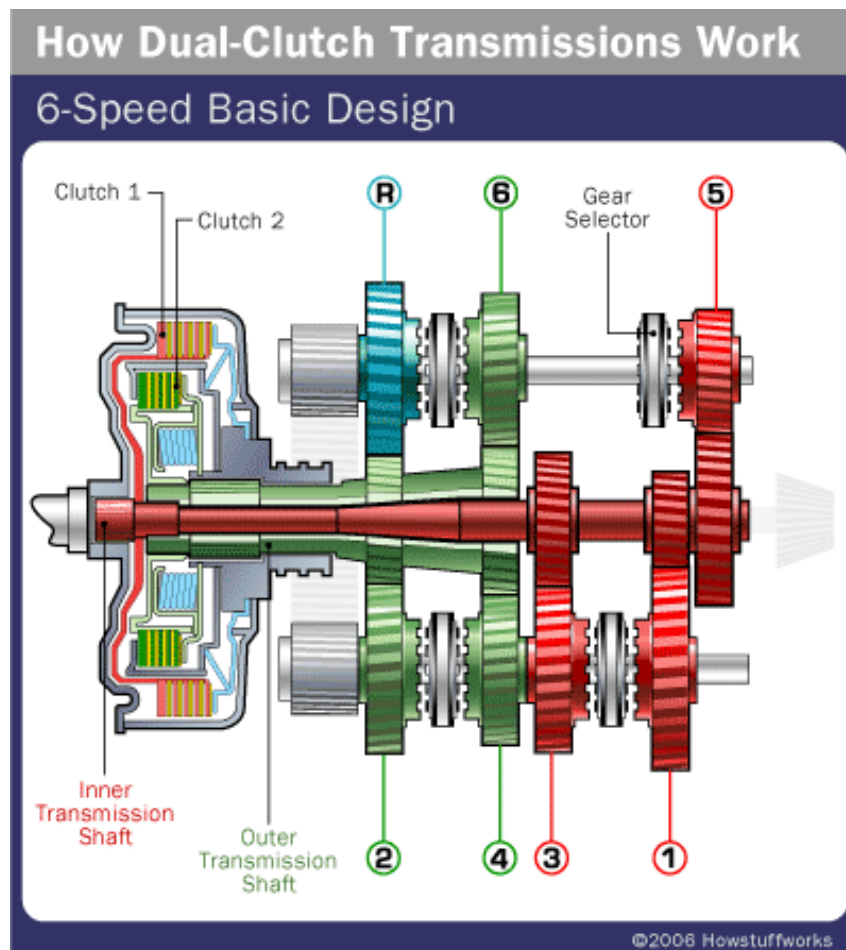
# 1-struka tanjurasta spojka



# Potisni ležaj spojke s hidrauličnim vodom

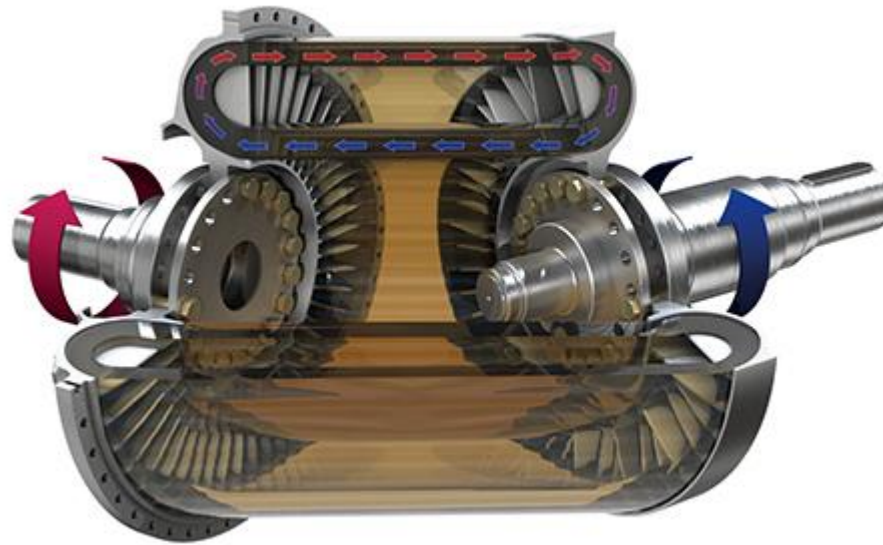


# Dvostruka tanjurasta spojka



# Hidrodinamička spojka

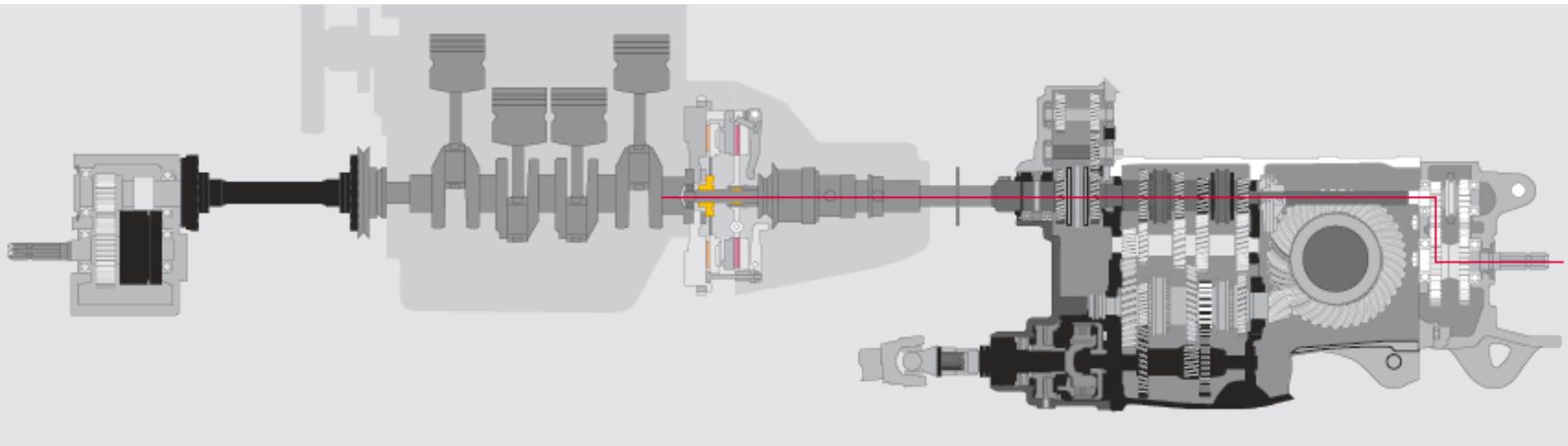
- Sklop turbine i pumpe – cirkulacija ulja s lopatica pumpe čiji rotor okreće koljenasto vratilo na lopatice turbine prenosi okretni moment na spojničko vratilo



# Fendt turbo kuplung



# Transmisija traktora Valtra

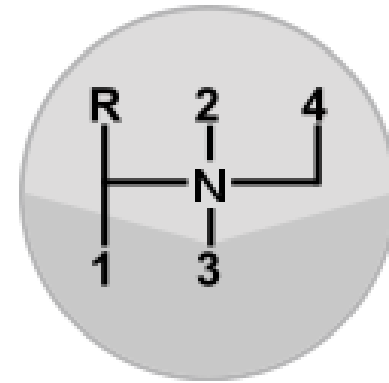
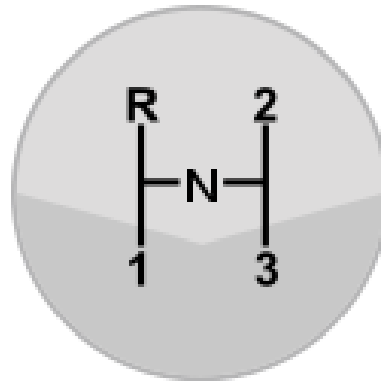
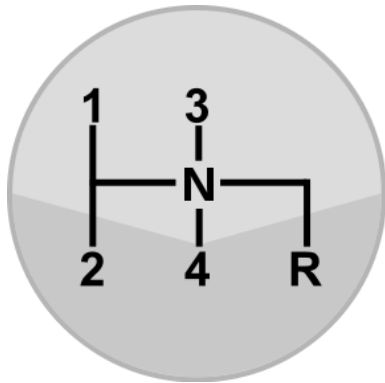


# Stupnjevani mjenjač

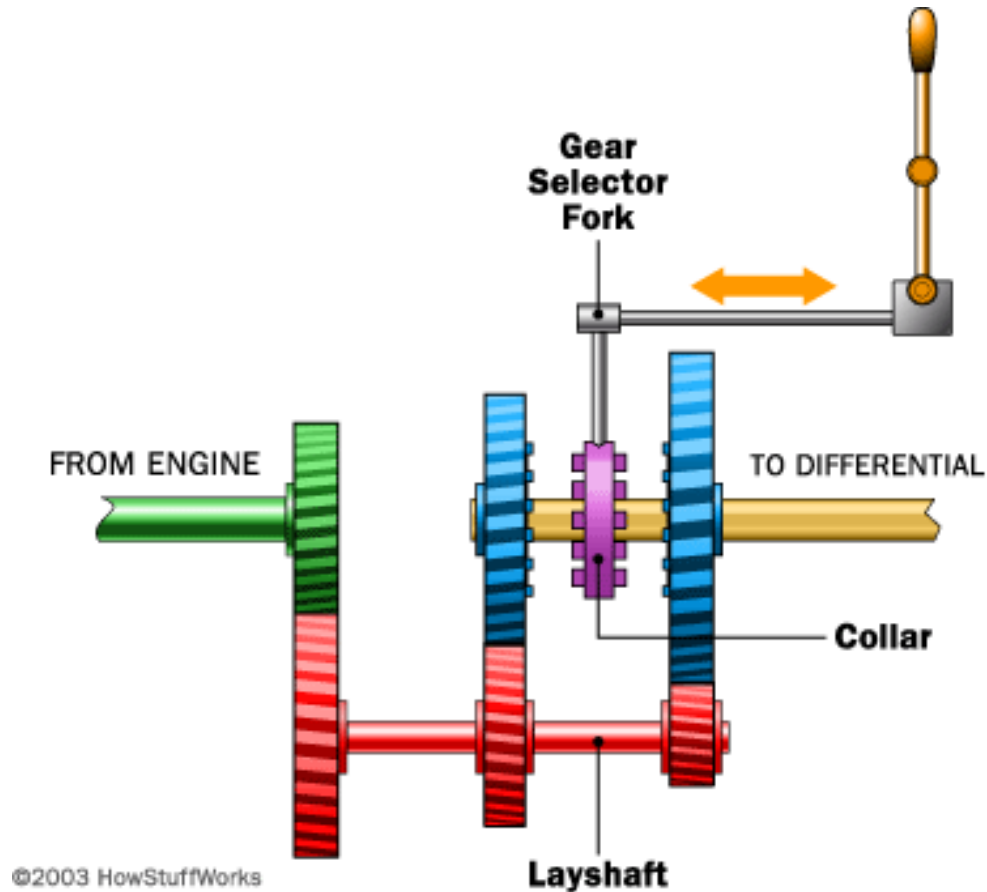




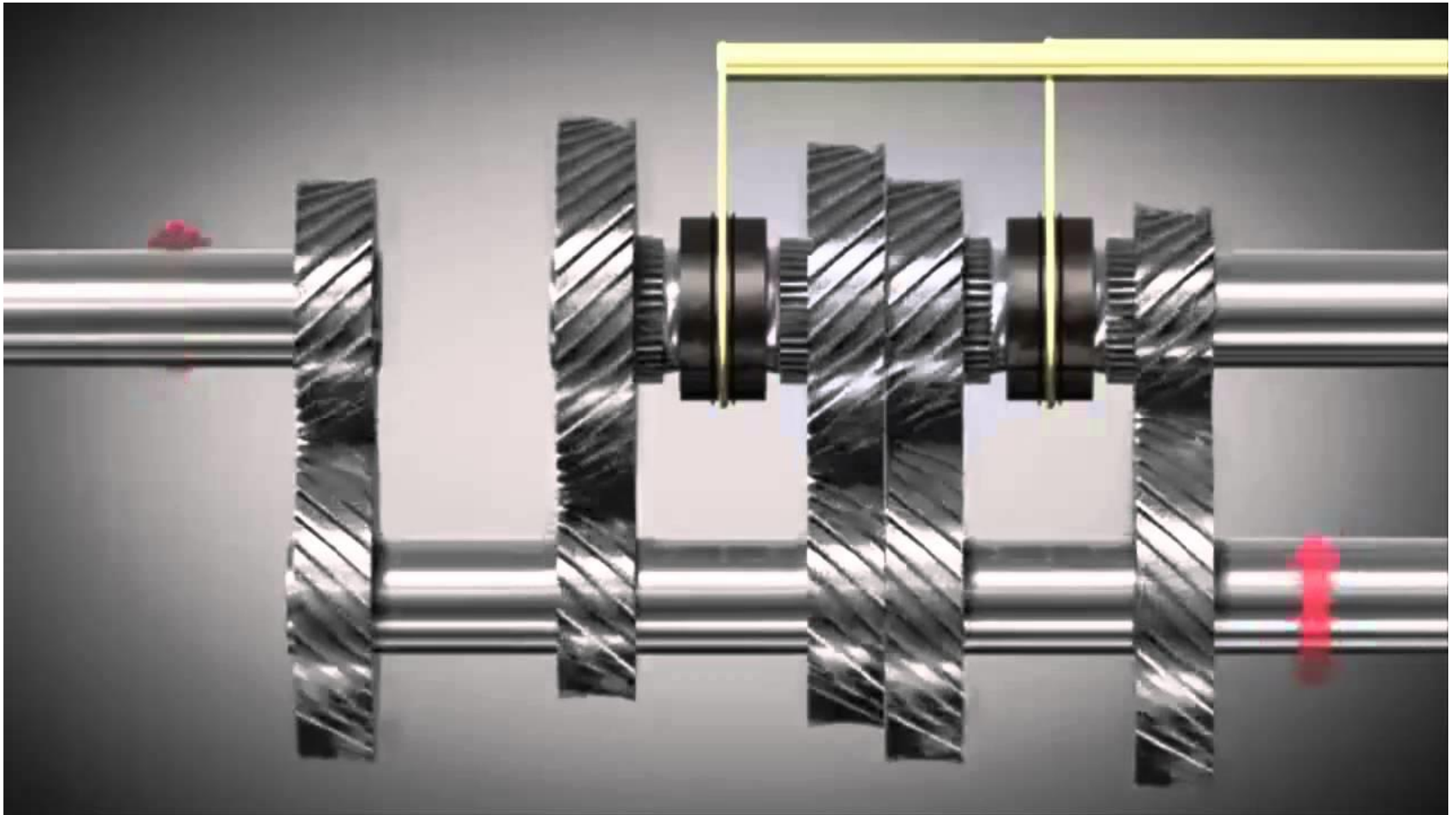
# Sheme mijenjanja brzina



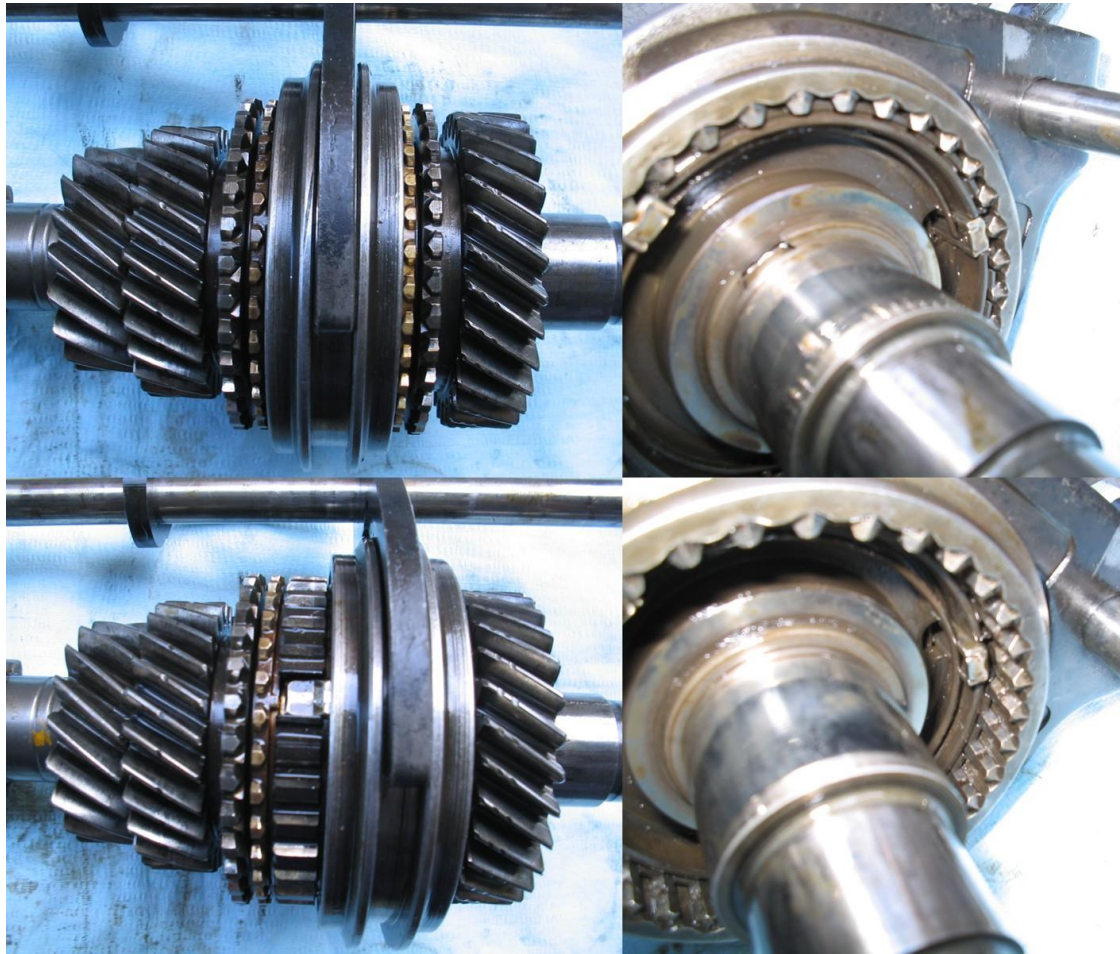
# Mjenjač sa stalno uzubljenim zupčanicima



# Sinhronizirani mjenjač s 4 stupnja prijenosa



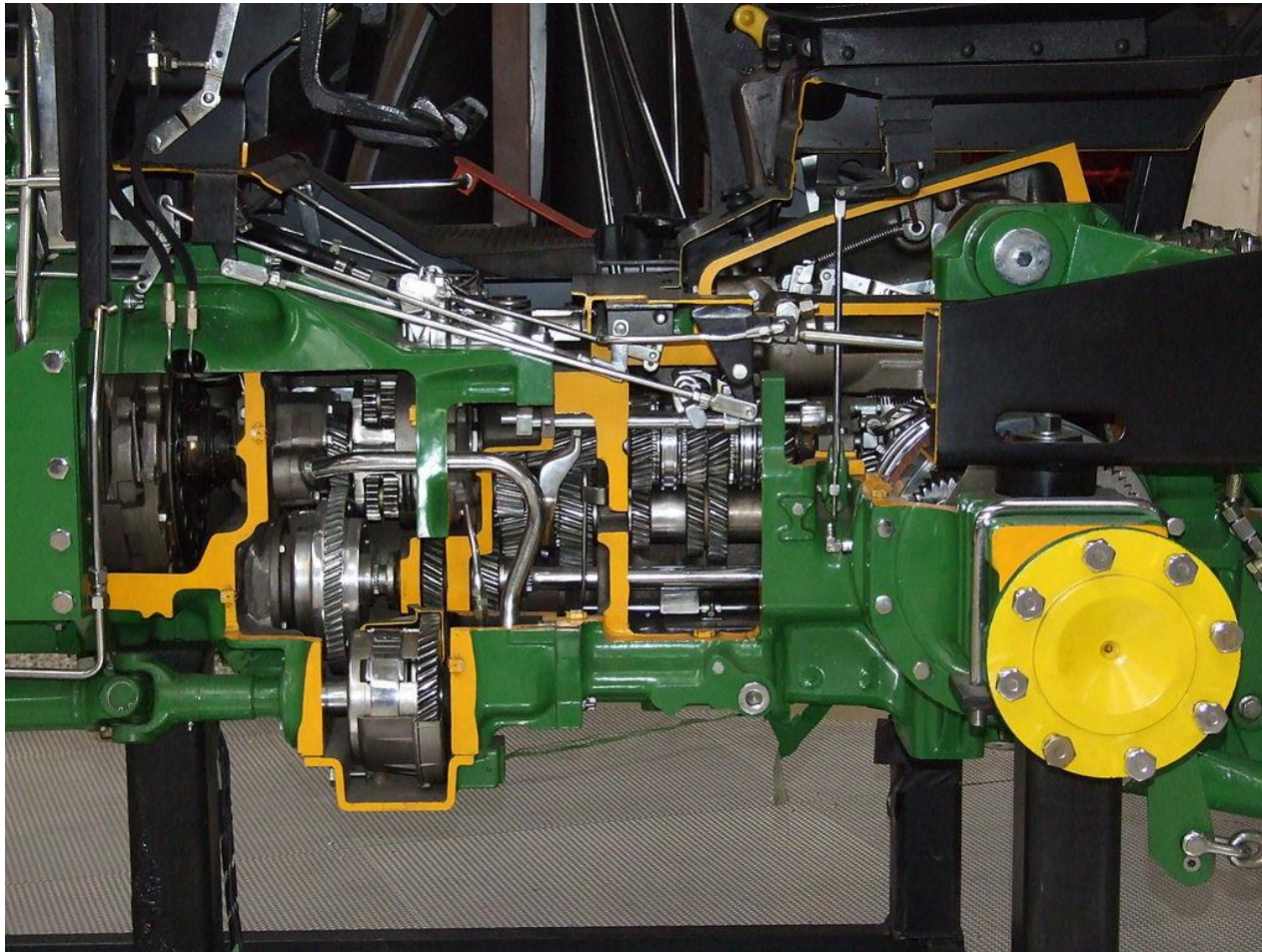
# Prsteni za uključenje slobodnog zupčanika



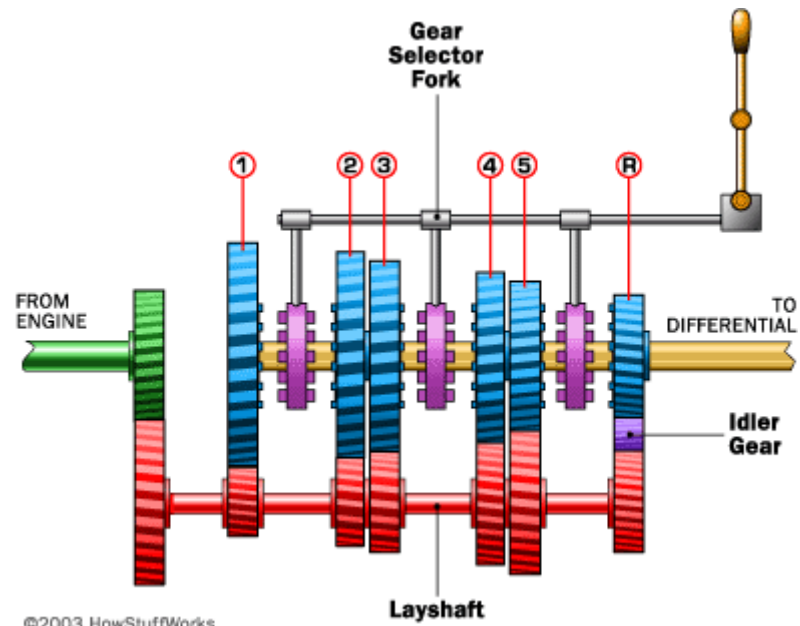
# Sinhroni mjenjača



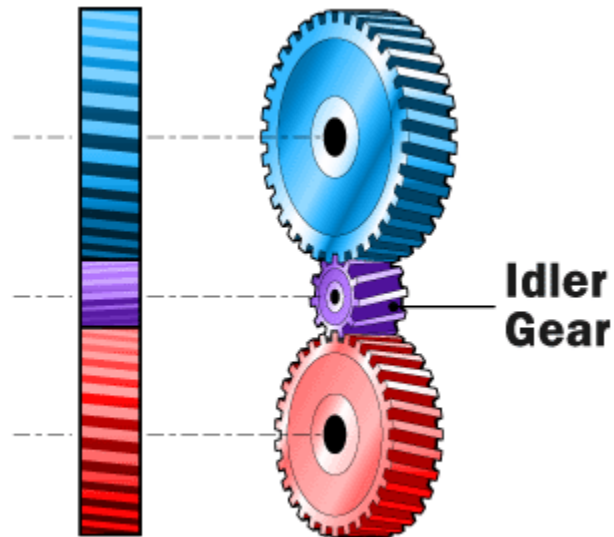
# Transmisija traktora JD 3350



# 5-brzinski mjenjač



# Međuzupčanik za kretanje u nazad





# Reduktor

## **Uloga:**

Redukcija osnovnih (direktnih) stupnjeva brzina („zec – kornjača”)

## **Izvedbe:**

Planetarni reduktor (na slici)

Reduktor s čeonim zupčanicima



# Konusno-tanjurasti prijenosnik i diferencijal

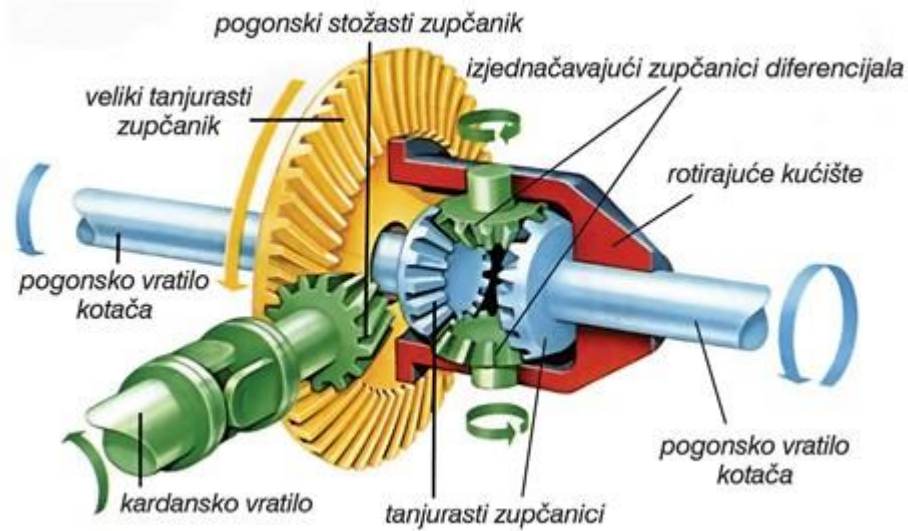
## ***Uloga:***

KTP: promjena smjera pogona pod  $90^\circ$  i redukcija broja okretaja

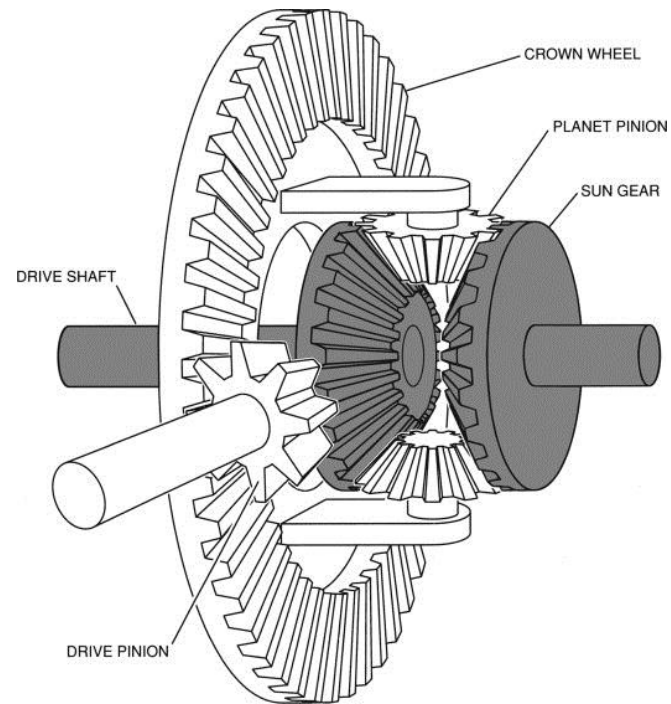
DIF: Omogućava razliku obodnih brzina vanjskog i unutrašnjeg kotača u zavoju



# Diferencijal - konstrukcija



# Diferencijal



# Uređaj za kočenje

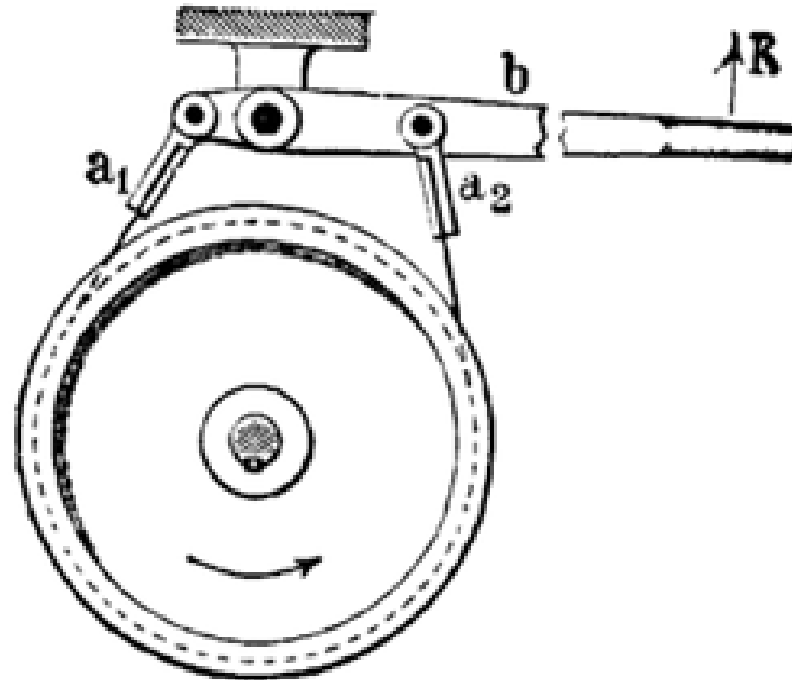
## Kočnice s bubnjem



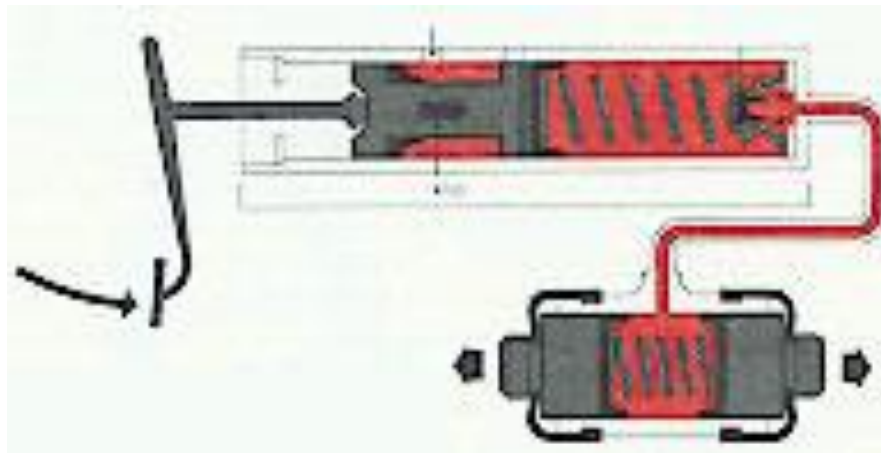
# Disk kočnice



# Pojasna kočnica



# Hidraulično aktiviranje kočnice glavni kočioni cilindar i radni cilindar





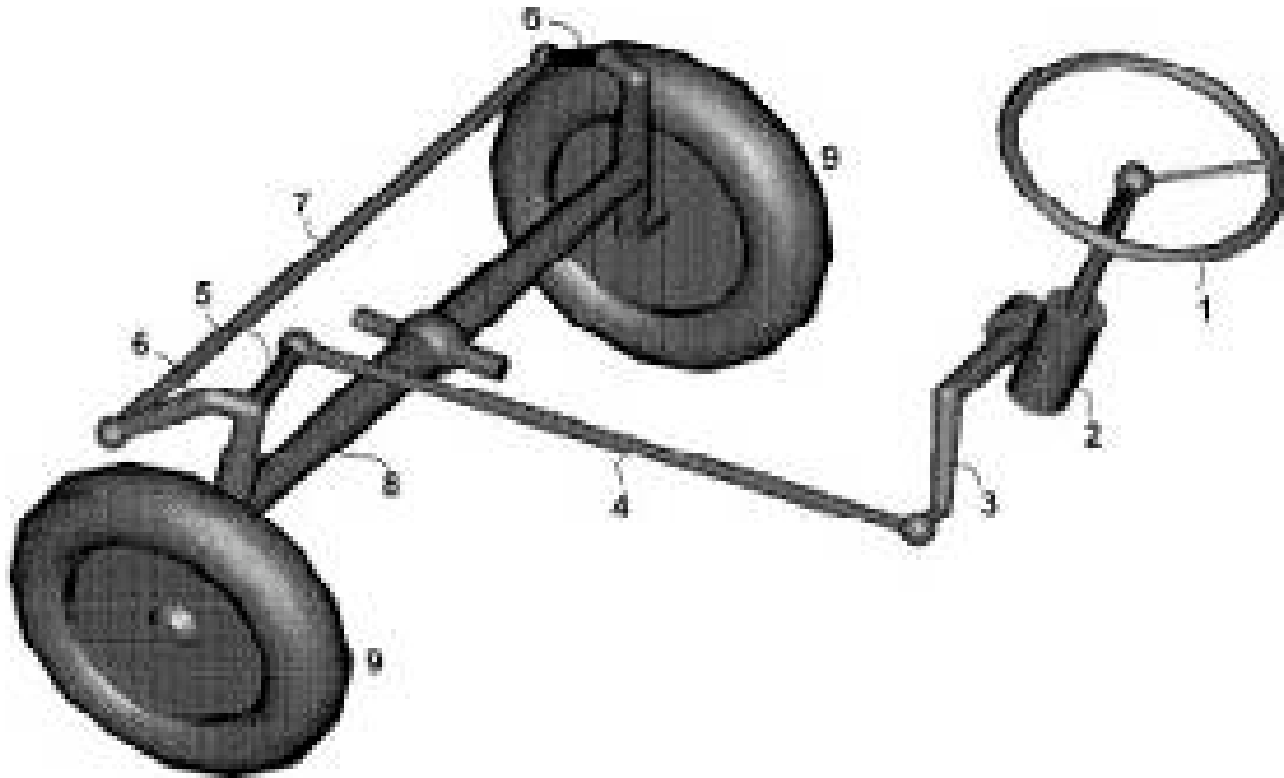
# Ručna (parkirna) kočnica



# Uređaj za upravljanje traktorom

- Mehaničko
  - S jednom uzdužnom sponom
  - S dvije uzdužne spone
    - Hidrauličko – preko upravljačkog cilindra
    - Preko centralnog zgloba – zglobni traktori

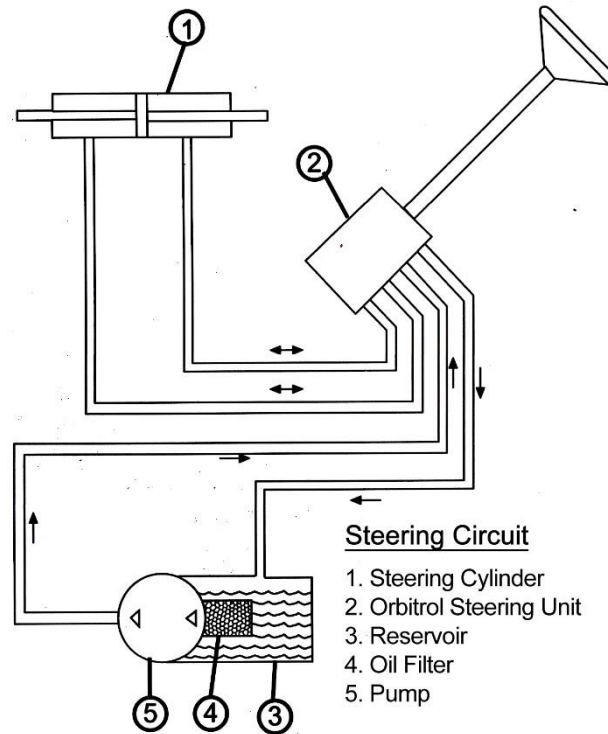
# Upravljanje s jednom uzdužnom sponom



# Mehanizam upravljača s konusnim i segmentnim zupčanicom



# Hidrostatski upravljački mehanizam



# Hidrostatski upravljač



# Hidraulično upravljanje traktorom

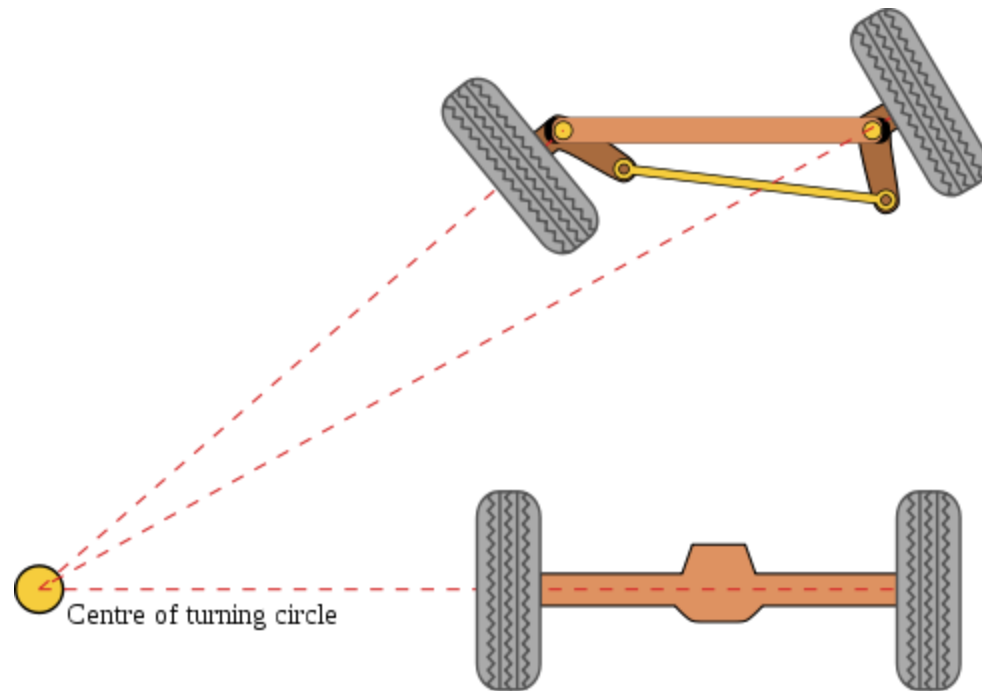


# Upravljanje preko centralnog zgloba





# Radijus okretanja kotača



# Uređaj za vožnju

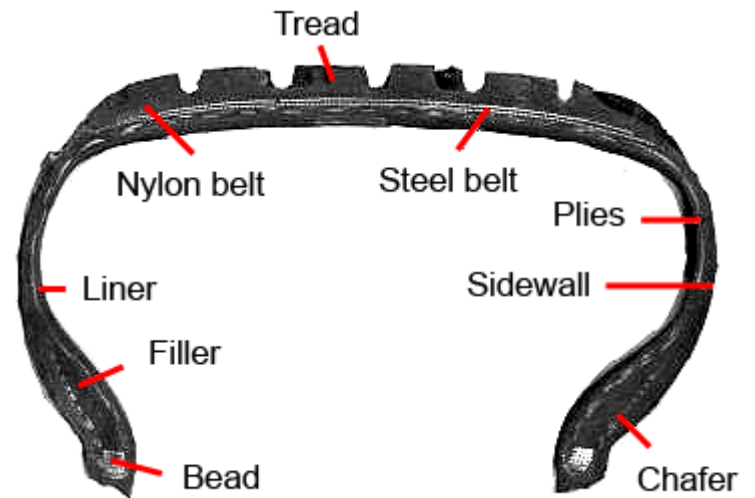
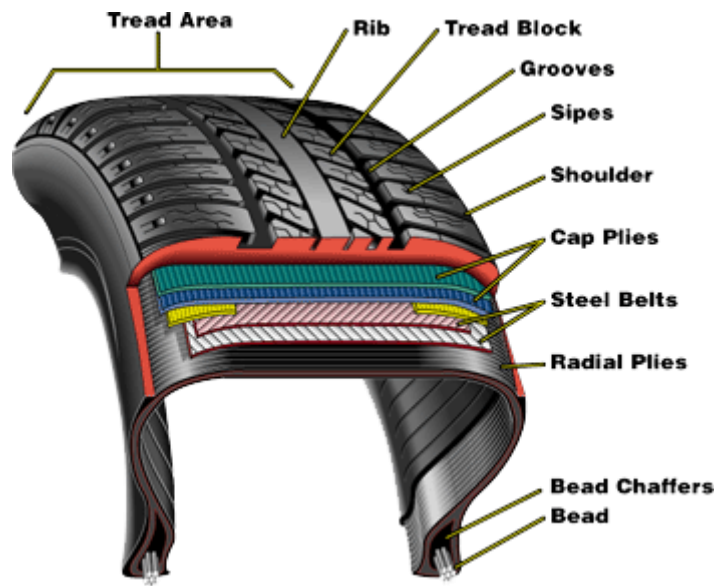
- Traktori s pneumaticima
- Traktori gusjeničari
- Traktori s polugusjenicom

# Traktor s pneumaticima

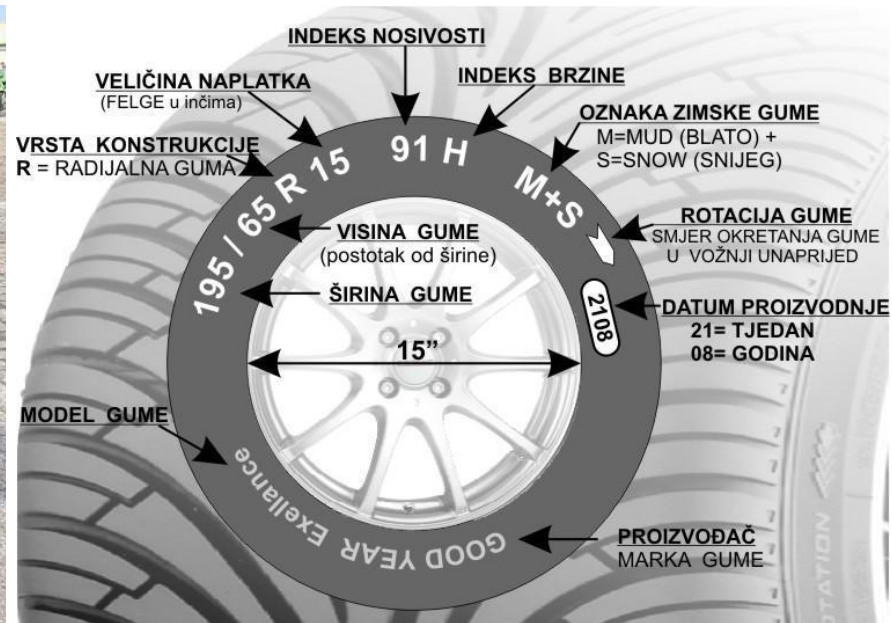


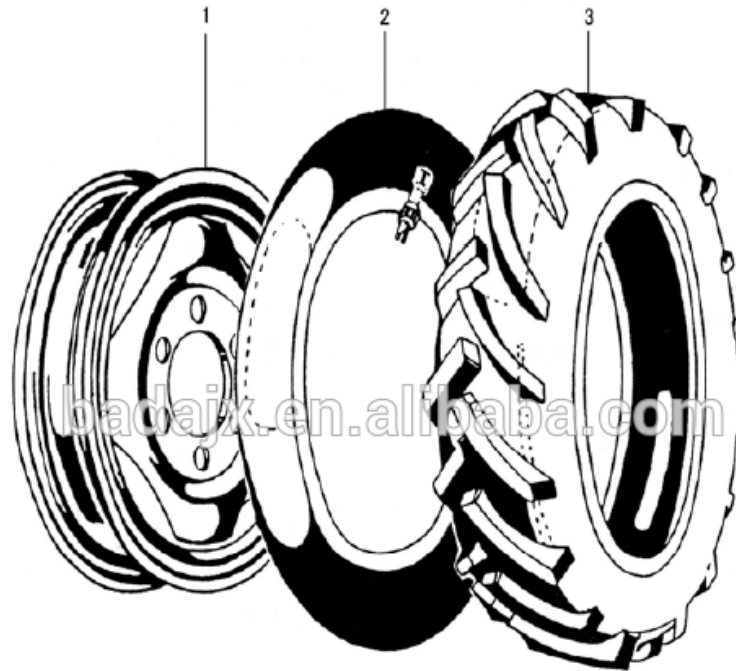
- Pneumatik
  - Naplatak
  - Disk
  - Vanjska guma
  - Unutrašnja guma (zračnica)
  - Ventil

# Vanjska guma - presjek



# Pneumatik, oznake





**Front Driving Wheel (Four wheel drive)**

# Disk i naplatak





# Kotači traktora

- Stražnji pogonski



- Prednji upravljački



# Udvojeni kotači traktora



# Rešetkasti kotači



# Traktor gusjeničar



# Mehanizam s gusjenicom



# Traktori s gumenom gusjenicom



# Traktor s 2 i 4 gusjenice

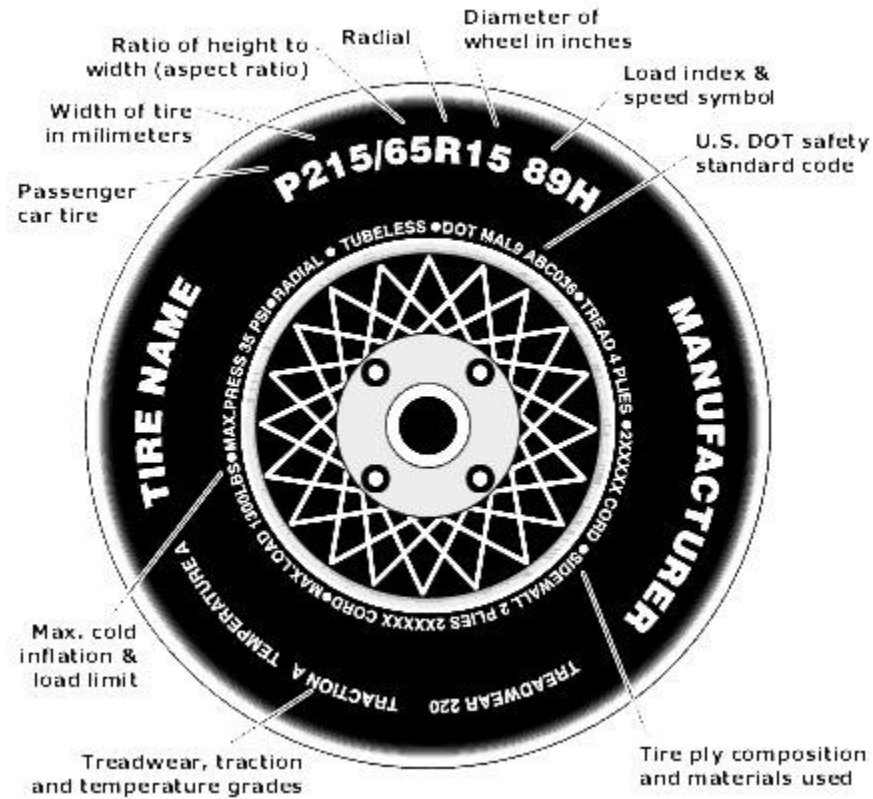


# Traktor s 4 gusjenice



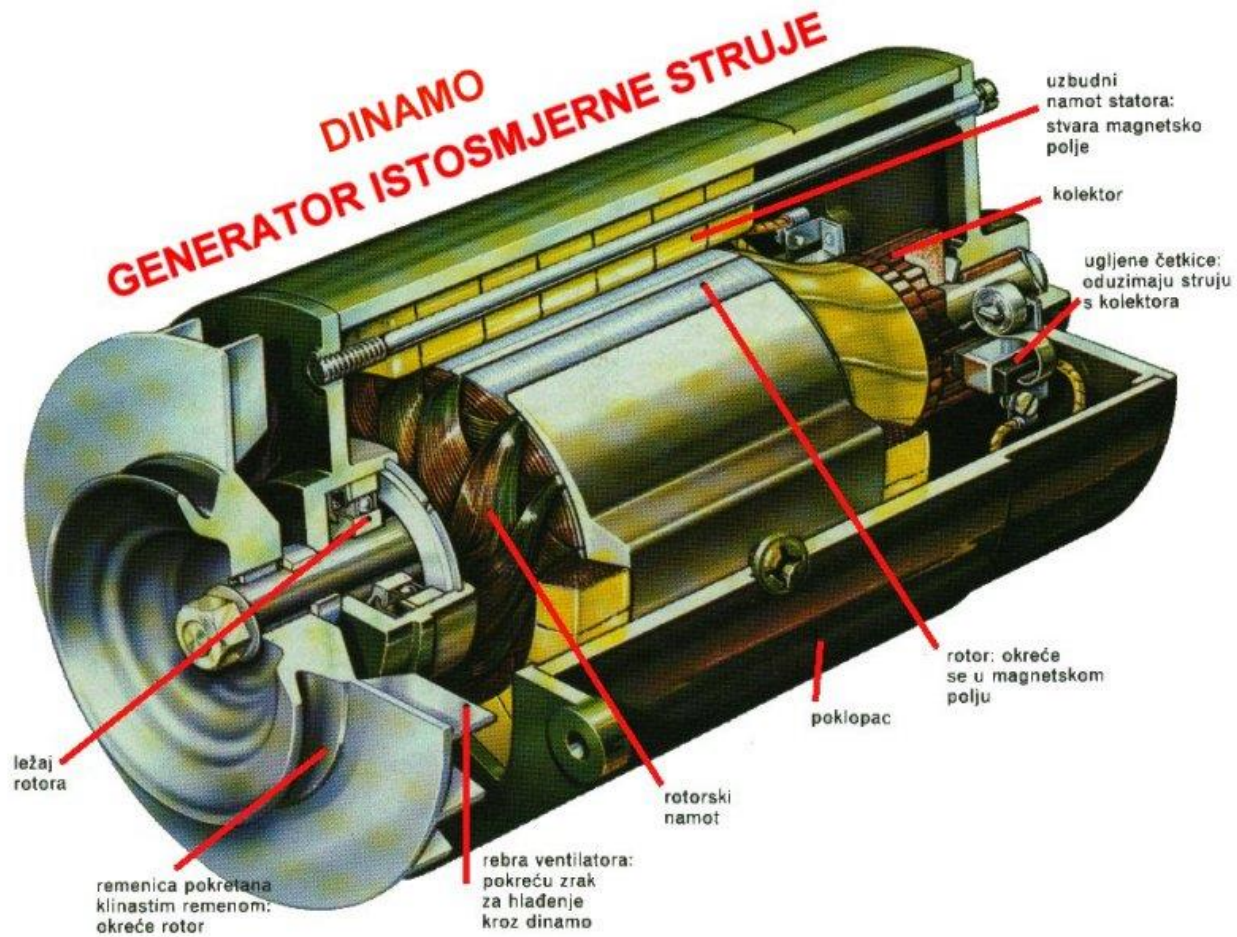


# Pneumatik - dimenzije



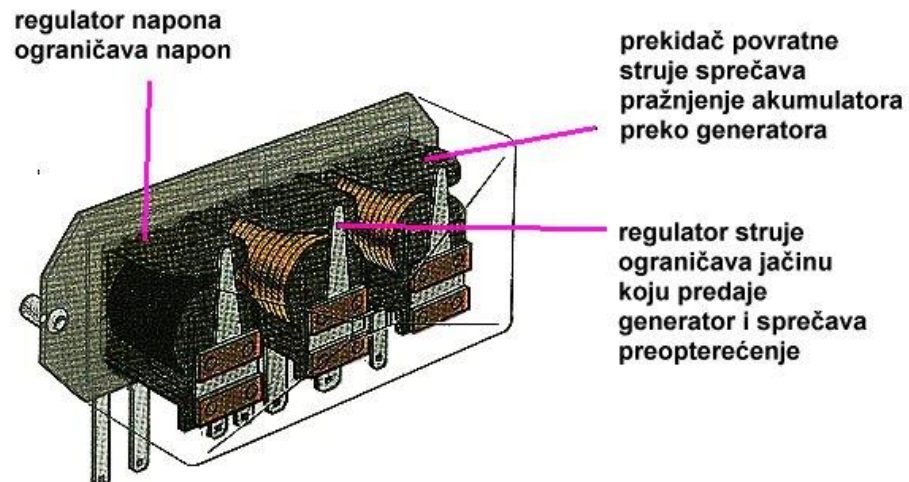
# Električni uređaji na traktoru

## El. generatori

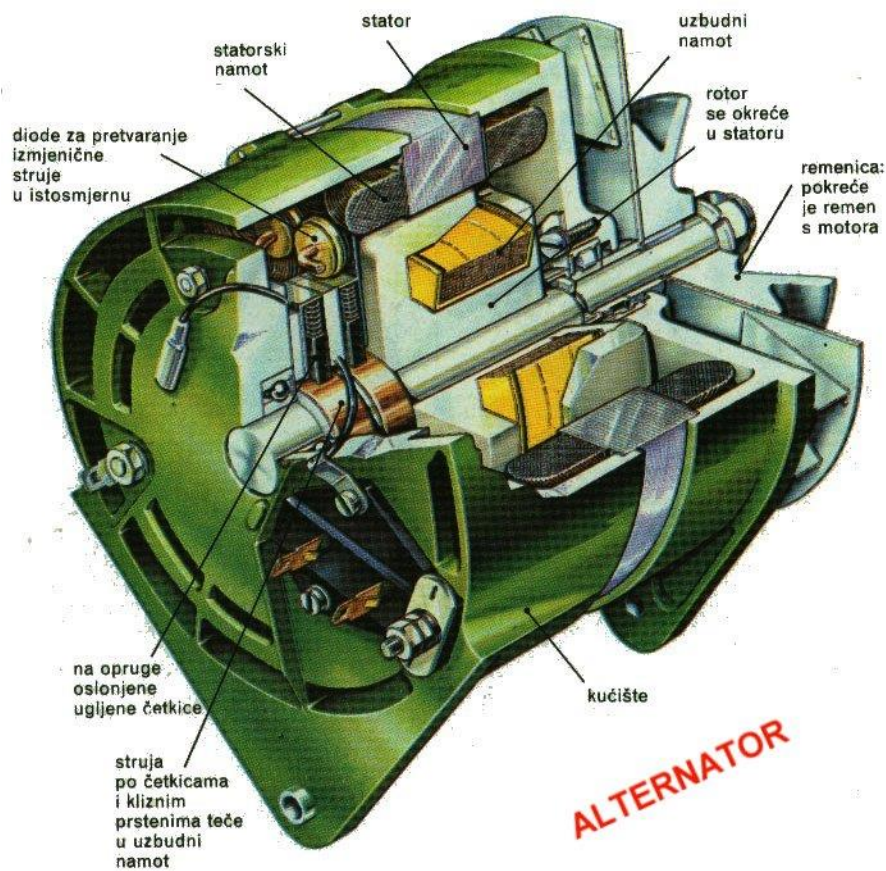


# Regulator dinama (regler)

## REGULATOR GENERATORA ISTOSMJERNE STRUJE



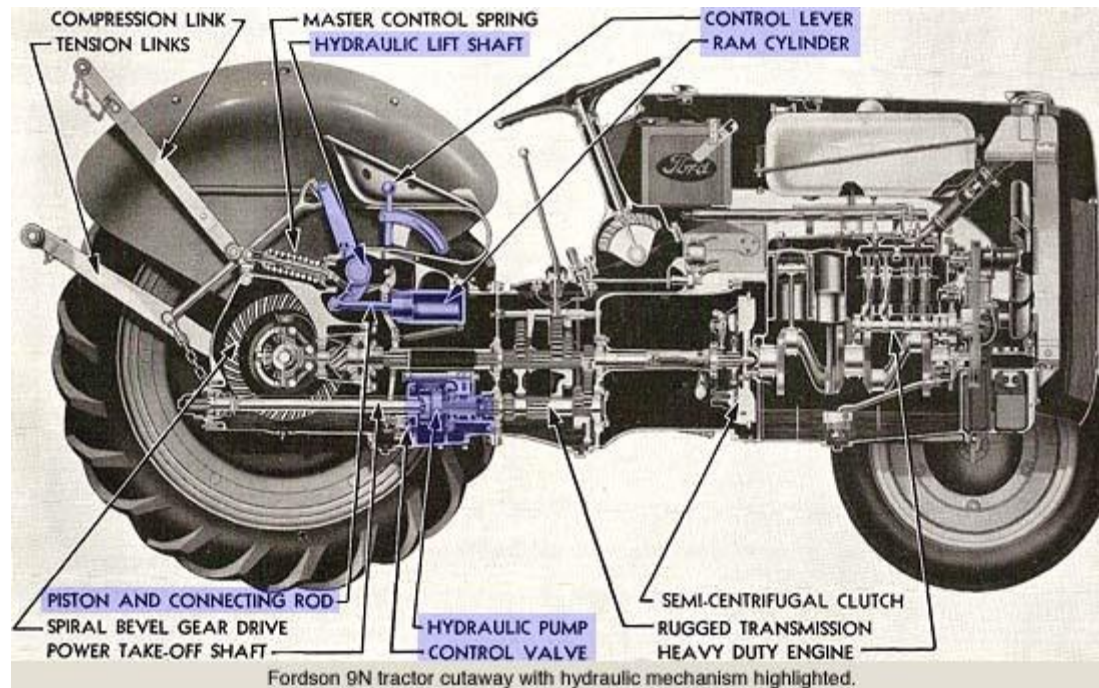
# Alternator – generator izmjenične struje



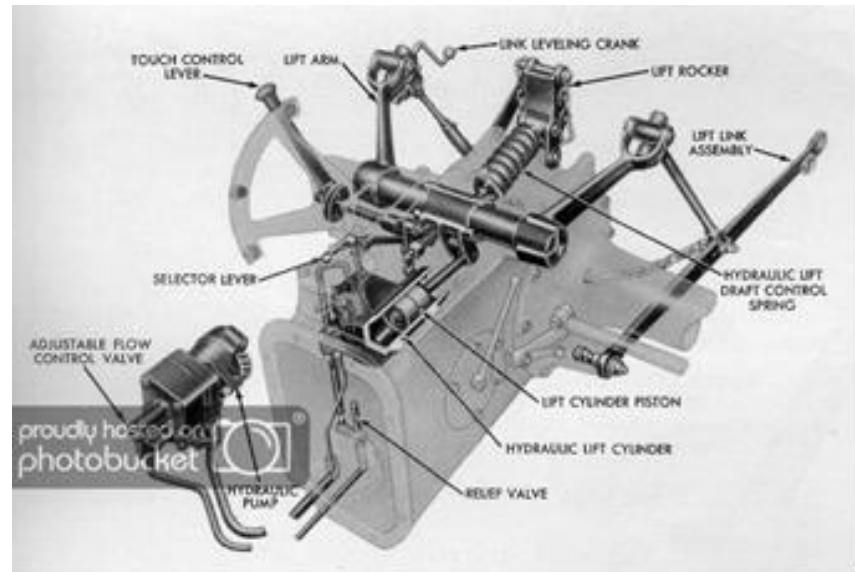
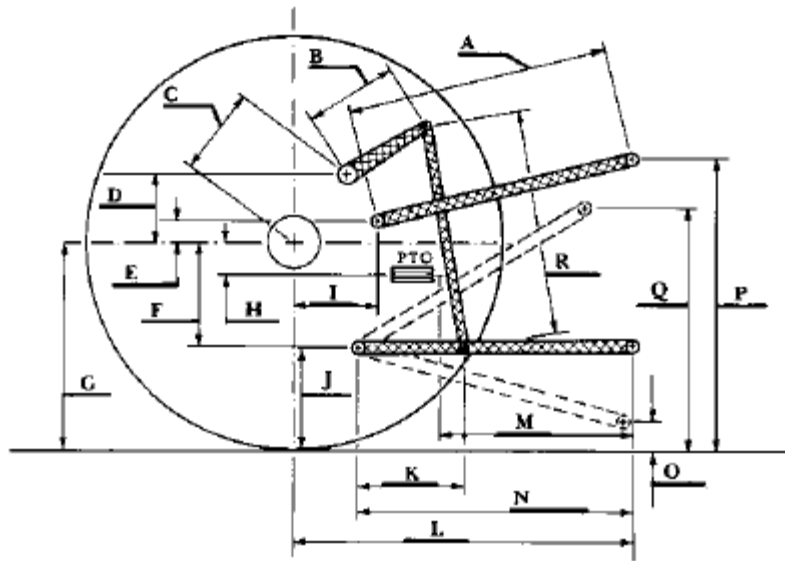
# HIDRAULIČKI PODIZAČ TRAKTORA

- S JEDNOSTRANIM DJELOVANJEM
- S DVOSTRANIM DJELOVANJEM (rjeđe, na starijim istočno-europskim traktorima)

# Hidraulički podizač s jednostranim podiznim cilindrom



# 3-zglobna poteznica



# Kategorije 3-zglobne poteznice traktora

Kategorija	Snaga traktora KS	Promjer osovine upornice (in)	Promjer osovine hidrauličkog podizača (in)
0	< 20	5/8	5/8
1	20-45	3/4	7/8
2	40-100	1	1 1/8
3	80-225	1 1/4	1 7/16
4	180-400	1 3/4	2

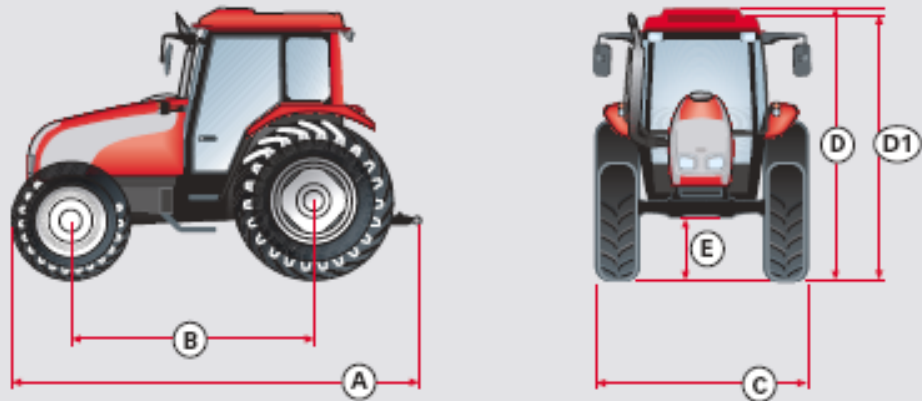


- 3-zglobna poteznica



# Dimenzije traktora Valtra serije A

## Dimenzije



- A = Dužina
- B = Međuosovinski razmak
- C = Širina
- D/D1 = Visina do vrha krova
- E (4WD) = Klirens ispod prednje osovine

Modeli	A,mm	B,mm	C,mm	D,mm	E,mm
A72 4WD, 2WD	4056/3957	2387/2244	2137/2137	2655/2655	442
A82 4WD, 2WD	4056/3957	2387/2244	2175/2175	2680/2680	457
A92 4WD, /2WD	4056/3957	2387/2244	2175/2175	2680/2680	457

D1\* 155 mm niže sa opcijom snižene kabine

Modeli	Gume Prednje/Stražnje
A72 4WD, 2WD	16.9R34/13.6R24, 16.9R34/10.00-16
A82 4WD, 2WD	16.9R34/13.6R24, 18.4R34/11.00-16
A92 4WD, 2WD	16.9R34/13.6R24, 18.4R34/11.00-16

# Tehnička specifikacija traktora Valtra serije A

Model	A72	A82	A92
<b>Motor</b>	33DTA	44DTA	44DTA
Maks. snaga kw/ks/obr./min*	54/74/2270	65/88/2270	74,5/101/2270
Maks. moment sile Nm/obr./min*	296/1400	324/1400	360/1400
Broj cilindara	3	4	4
Kapacitet, ccm	3,3	4,4	4,4
Intercooler	da	da	da
<b>Transmisija</b>	Kompletno sinhronizirana		
Brzine naprijed/nazad	12+12R		
HiShift	Dodatna oprema		
Kardansko vratilo obr./min	540+540E / 540+1000		
<b>Hidraulika</b>	Odvojeno ulje hidraulike. Maks. količina ulja za vanjsku hidrauliku 24 l		
Maks. podizni kapacitet kN	28	33	33
Maks. podizna snaga sa dodatnim cilindrom, kN	33	-	-
Maksimalni kapacitet pumpe l/min	55	55	55
<b>Volan</b>	Hidrostatski. Namjestivi volan		
<b>Kapacitet rezervoara</b>	79 l +24 l dodatni rezervoar (dodatna oprema)		
<b>Kočnice</b>	Hidraulički mokri diskovi sa automatskim paljenjem pogona na sva četiri kotača kod kočenja sa sva četiri kotača		
<b>Elektrika</b>			
Starter	2,8 kW		
Alternator	95 Ah		
Akumulator	136 Ah		
<b>Težina kg 4WD/2WD</b>	3560/3330	3680/3450	3680/3450

\*ISO 14396