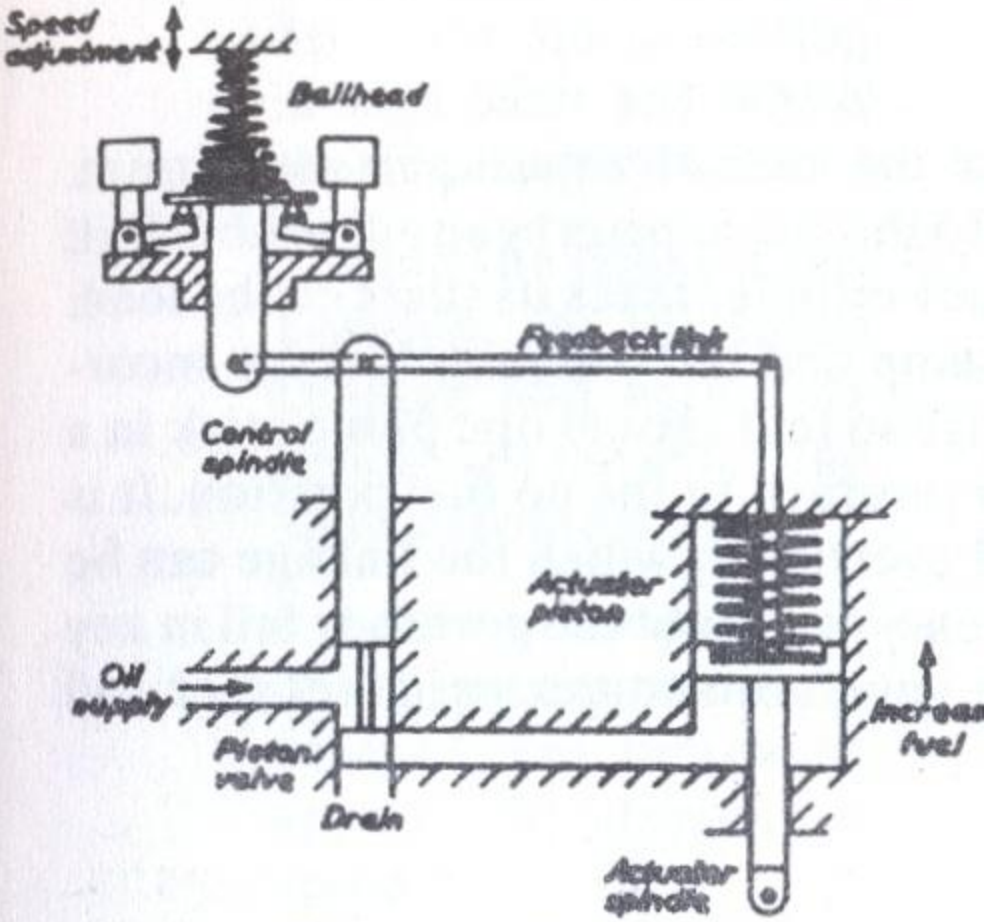
12

GOVERNOR

LESSON TWELVE

GOVERNOR



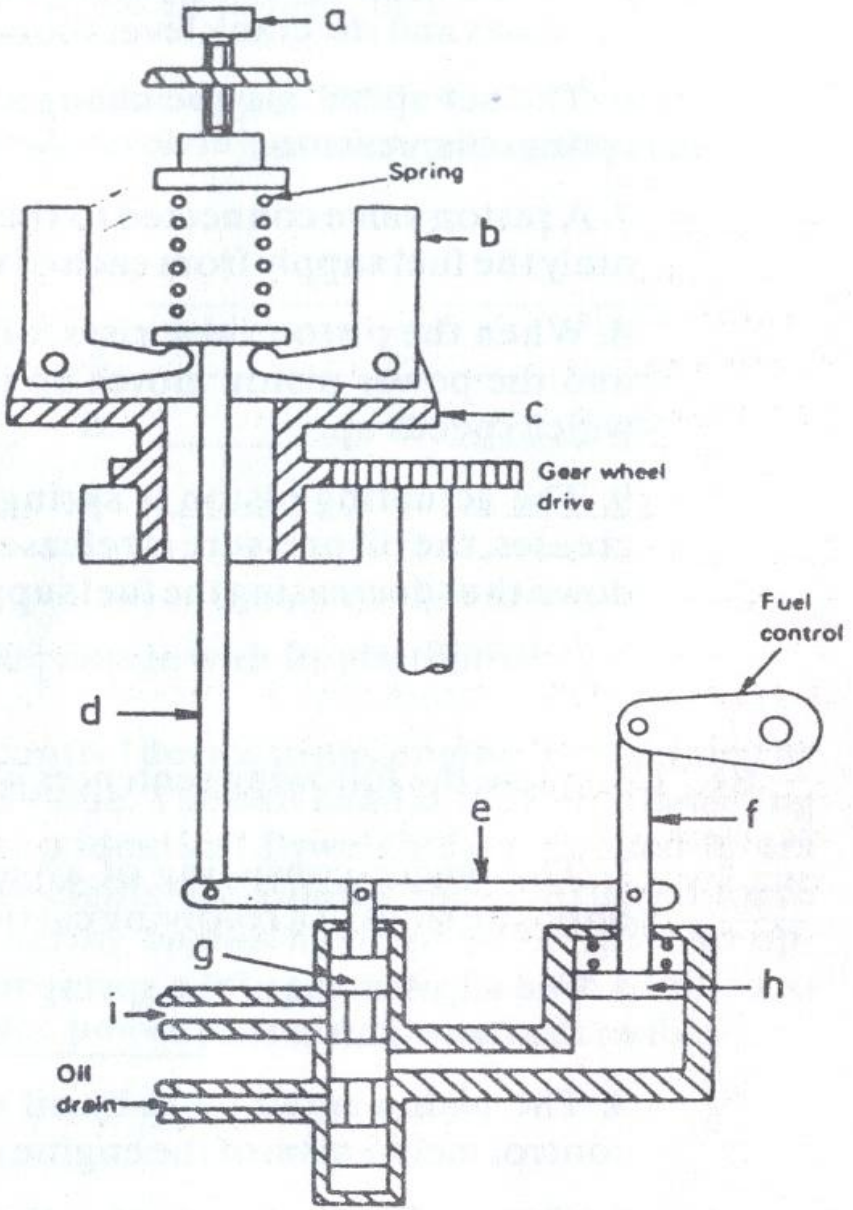
Principle of hydraulic governor.

Fig 12.1

All marine vessels ranging from a huge cruise liner, big oil tanker, relatively smaller yacht or even a tiny powerboat need some sort of **speed control system** to control and govern the speed of the marine diesel engine or whatever propulsion plant is being used for the vessel. It would be really impractical and dangerous to have a ship or a boat without speed control mechanism fitted on it, and could lead to accidents such as collision or grounding.

Supply the missing info

- All marine vessels ranging from a huge cruise liner, big oil tanker, relatively smaller yacht or even a tiny powerboat need some sort of **speed control system** to …… of the marine diesel engine or whatever propulsion plant ……
- It would be …… to have a ship or a boat without speed control mechanism fitted on it, and could lead to ……


a
Spring
b
c
Gear wheel
drive
Fuel
control
d
e
f
g
h
i
Oil
drain

- The speed control is achieved with the help of a governor. I would just like to clarify one confusion here that the main role of the governor ***is not to increase or decrease the speed*** which can be done via fuel control system (similar to an accelerator on your car) but once the speed of the engine has been set, the job of ***the governor is to maintain that speed despite the variations in load***. In other words the governor controls the speed variation and keeps the speed within restrained limits despite these variations.
- The variations could arise from several factors such as say rough weather. A ship *rolling and pitching* in heavy weather may temporarily come in such position that its *propeller is literally out of water* and without the governor the speed of the engine could shoot up to such an extent that it could damage the engine itself.

Insert the verbs in the right place:

controls, damage, achieved, clarify, arise, increase, maintain, come

- The speed control is with the help of a governor.
- I would just like to one confusion here that the main role of the governor is not to or decrease the speed which can be done via fuel control system (similar to an accelerator on your car).
- Once the speed of the engine has been set, the job of the governor is to that speed despite the variations in load.
- In other words the governor the speed variation and keeps the speed within restrained limits despite these variations.
- The variations could from several factors such as say rough weather.
- A ship rolling and pitching in heavy weather may temporarily in such position that its propeller is literally out of water and without the governor the speed of the engine could shoot up to such an extent that it could the engine itself.

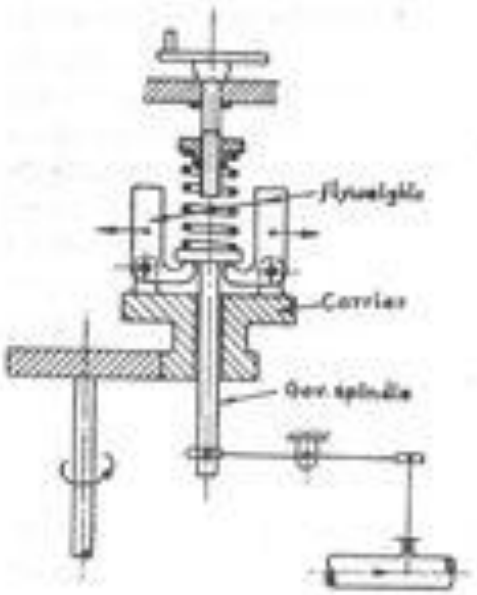
Pair work: Complete the sentences below, first in writing then in a speaking dialogue

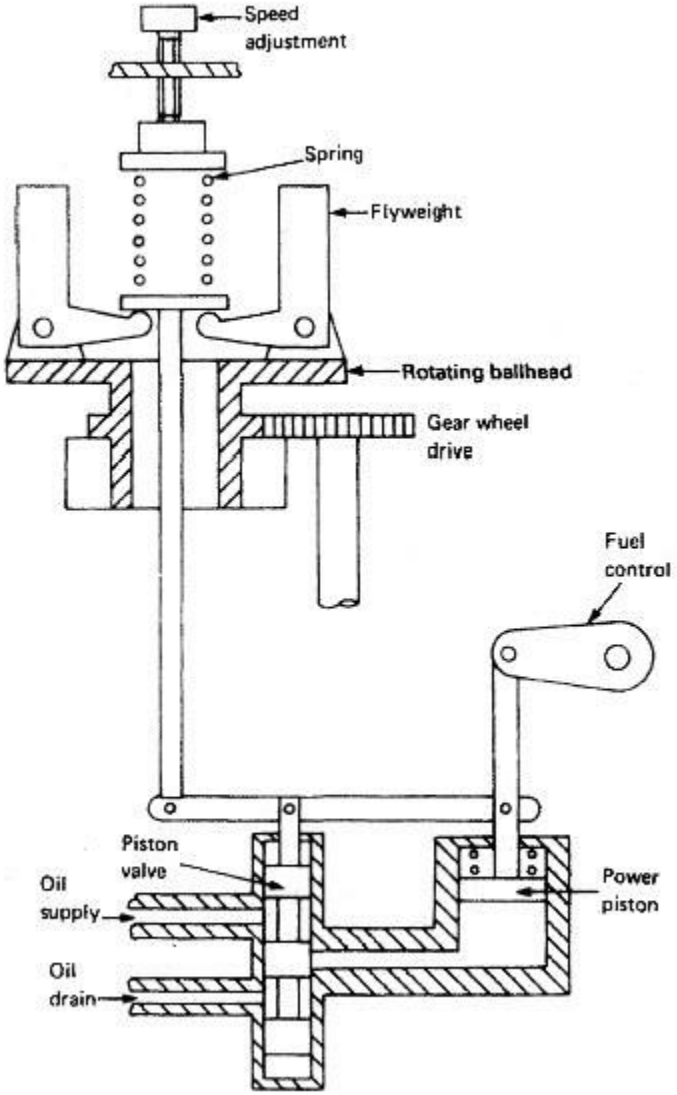
- All marine vessels ranging from a huge cruise liner, big oil tanker, relatively smaller yacht or even a tiny powerboat need … …
- It would be really impractical and dangerous to have a ship or a boat without speed control mechanism fitted on it, and could lead to … … .
- the main role of the governor is not … …
- Once the speed of the engine has been set, the job of the governor is … …
- In other words the governor controls … … and keeps the speed … …
- The variations could arise from several factors such as:
- _____
- a ship *rolling and pitching* in heavy weather may temporarily come in such position that … …
- without the governor the … of the engine could shoot up to such an extent that … ….

- Governors are also fitted in **auxiliary diesel engines** on the ship used for power generation, and their function remains the same in this situation as well. The power delivered by the alternator needs to be **constant** despite load variations and this depends to a great degree on the speed at which the prime mover of the generator diesel engine is rotating since the alternator is getting its movement from that engine only. Hence the role of the governor is equally important in this case as well.

Supply the missing info

- Governors are also fitted in **auxiliary diesel engines** on the ship used for power generation, and their function remains …….
- The power delivered by the alternator needs to be **constant** despite load variations.
- This depends to a great degree on the speed at which the prime mover of the generator diesel engine is rotating since ……. only.
- Hence the role of the governor is …… in this case as well.


Flyvevægte
Carrier
Gov. spindle


Speed
adjustment
Spring
Flyweight
Rotating ballhead
Gear wheel
drive
Fuel
control
Piston
valve
Oil
supply
Oil
drain
Power
piston

The main function of the governor is to *maintain the engine speed at the desired value*. It does this by continually positioning the fuel *pump racks* to control the amount of fuel injected into cylinder per cycle.

Most governors used on diesel engines are self-contained units manufactured by specialist firms. The mechanism can be divided into two parts. There is a speed *sensing portion* and an *actuating portion*.

Fill in the missing term

- The main function of the governor is to _____ *the engine speed at the* _____ *value*.
- It does this by continually positioning the fuel _____ to control the amount of fuel injected into cylinder per cycle.
- Most governors used on diesel engines are _____ units manufactured by specialist firms.
- The _____ can be divided into two parts.
- There is a speed _____ *portion* and an _____ *portion*.

It consists of **revolving carrier** on which are mounted two weights (the **flyweight**) having cranked levers. They are pivoted so that the levers compress a **spring** as the weight fly out under centrifugal force. The force exerted by the spring is controlled by the pressure of an **speed adjustment mechanism** on its other end. This adjustment is the speed control for the engine. Wherever this is set the weights will assume a corresponding position according to the speed at which they are rotated. This position is signalled to the **actuating portion** of the governor by the position of **the control spindle**.

Insert the phrases in the right place:

on its other end, wherever this is set , so that, it consists of, under centrifugal force, by the position of, this adjustment is,

- ..... **revolving carrier** on which are mounted two weights (the **flyweight**) having cranked levers.
- They are pivoted ..... the levers compress a **spring** as the weight fly out .....
- The force exerted by the spring is controlled by the pressure of an **speed adjustment mechanism** .....
- ..... the speed control for the engine.
- ..... the weights will assume a corresponding position according t o the speed at which they are rotated.
- This position is signalled to the **actuating portion** of the governor ..... **the control spindle**.

The **control spindle** is connected to a piston valve which admits oil as required to the actuating piston and cylinder. The position taken up by this actuating piston is fed back to the **pilot valve** so that the oil is controlled to give the actuator the desired final position.

The actuator spindle is connected to a **lever output** from the governor. This lever is connected by the **linkage** to the **fuel pump racks** and controls the fuel quantity from each of the fuel pumps.

MCT

The **control** **axle / spindle / gear** is connected to a piston valve which **admits / leaves / fills** oil as required to the actuating piston and cylinder. The position taken up by this actuating piston is fed back to the **plot / pilot / spot** **valve** so that the oil is controlled to give the **spindle / governor / actuator** the desired final position.

The actuator spindle is connected to a **level / lever / lower** **output** from the governor. This lever is connected by the **linkage** to the **fuel pump racks** and **flows/ controls / feeds** the fuel quantity from each of the fuel pumps.

Matching exercise

1	For any speed setting of the governor there will be a range of output from the fuel pumps	a	to no fuel at the other.
2	It will vary from full at one end of the travel of actuator piston	b	percentage of the set speed.
3	These two positions correspond to	c	according to whether the load torque is high or low.
4	The difference between these	d	two slightly different values of speed.
5	It is usually expressed as	e	values is known as the governor droop.

The **control spindle** is _____ to a piston valve which _____oil as required to the actuating piston and cylinder. The position taken up by this actuating piston is _____ back to the **pilot valve** so that the oil is controlled to _____ the actuator the desired final position.

The actuator spindle is _____to a **lever output** from the governor. This lever is connected by the **linkage** to the **fuel pump racks** and _____the fuel quantity from each of the fuel pumps.

- For any speed r_____of the governor there will be a ange of o_____from the fuel pumps according to whether the load t_____is high or low. It will vary *from full at one end of the travel of a*_____ *piston to no fuel at the other*. These two p_____ correspond to two slightly different values of speed. The d_____ between these values is known as the governor d_____. It is usually expressed as percentage of the s_____speed.

The **linkage** to the fuel pumps may take the form of a push-pull mechanism. Each individual fuel pump rack is connected to the mechanism ba an adjustable link so they can be balanced to ensure that each cylinder takes its share of the load. The connection between each individual pump and common linkage incorporates a **spring** arranged as a "fail safe" device so that should one pump stick in a fuel supply position the others can be safely returned to the no fuel position.

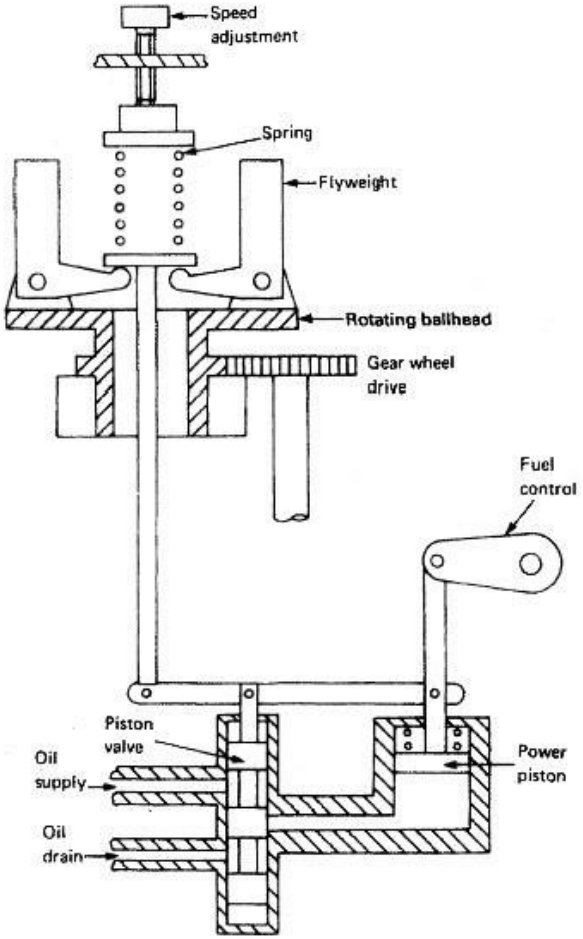
It is also the usual practice to provide a **manual override** by which the linkage can be returned to the *no fuel position* in emergency or should the governor fail in any way. Springs in the mechanism between the governor and the main fuel rack rod enable this operation to be carried out.

Supply the missing terms

The **linkage** to the fuel pumps may take the form of a _____ mechanism. Each individual fuel pump _____ is connected to the mechanism ba an adjustable link so they can be balanced to ensure that each cylinder takes its share of the _____. The connection between each individual pump and common linkage incorporates a _____arranged as a "fail safe" device so that should one pump stick in a fuel _____position the others can be safely returned to the _____fuel position.

It is also the usual practice to provide a m_____ o_____ by which the linkage can be returned to the *no fuel position* in e_____or should the governor fail in any way. Springs in the m_____between the governor and the main fuel r_____rod enable this operation to be carried out.

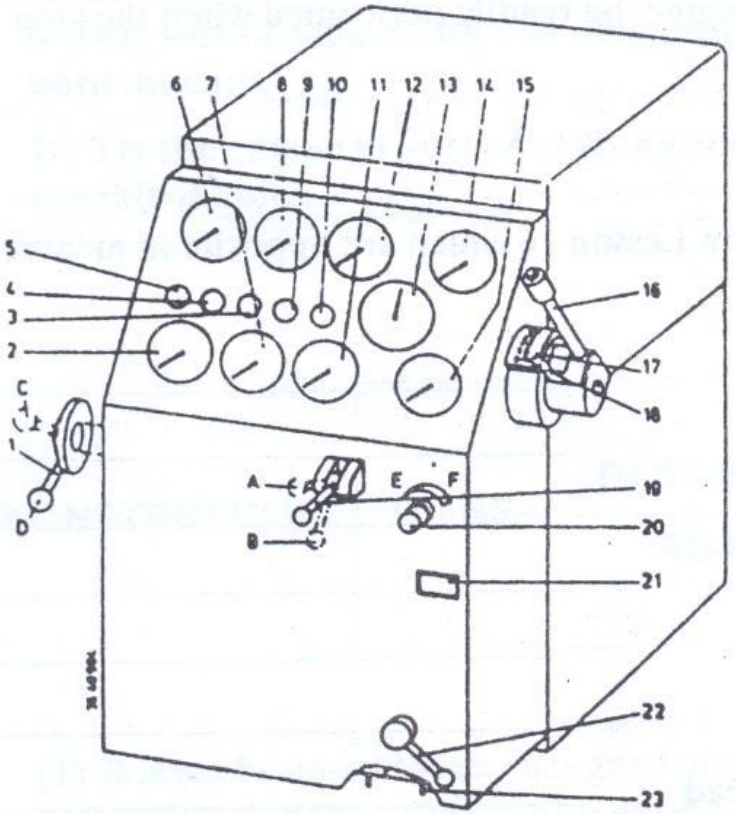
below describe the governor and its operation



QUESTIONS AND DISCUSSION

1. What is the function of the governor ?
2. What are the two main parts of the governor ?
3. Describe the operation of sensing portion ?
4. How is the speed of the engine maintained at the desired level ?
5. What is the actuating portion linked to ? What does the linkage consist of ?
6. What is the governor droop ?
7. What is the usual droop value ?
8. How does each cylinder take a part of the propulsion load ?
9. When is the manual override used ?
10. Why are overspeed trips fitted to the engines ?

ENGINE - MOUNTED CONTROL STAND



A = AHEAD
B = ASTERN
C = MANUAL
D = REMOTE CONTROL
E = LOW SPEED
F = HIGH SPEED

Fig. 16.1

I Study Fig. 16.1 and give in the correct sequence the positions of the control levers for starting and running ahead, reversing and regulating speed.

1 Lever MANUAL-REMOTE CONTROL
2 Luboil pressure
3 Final position indication camshaft ASTERN
4 Final position indication camshaft AHEAD
5 Lamp TURNING GEAR ENGAGED
6 Speed nominal value (double gauge)
7 Piston cooling water pressure
8 Control air pressure
9 Lamp EMERGENCY SHUT-DOWN
10 Lamp REMOTE CONTROL REQUESTED
11 Cylinder cooling water pressure
12 Starting air pressure
13 Speed (engine)
14 Charging-air pressure
15 Charging-air cooling water pressure
16 Fuel control lever
17 Scale
18 Pointer
19 Lever REVERSING AND STARTING
20 Precision control valve (speed nominal value)
21 Key EMERGENCY STOP
22 Change-over valve (pressure reducing equipment)
23 Drain valve

II Refer to the previous exercise and state what occurs in the engine when the control levers are moved to the various positions.

I. Study Fig.12.2. on the previous slide, representing a speed governor.

Now do the following exercises:

1. Complete the labelling of the diagram.
2. Say which components form the speed sensing arrangement and which the actuating system.
3. State the connections between: (a) the speed sensing and actuating system, (b) the actuating and fuel control system.
4. Describe the speed governor in case of: (a) increased speed, (b) decreased speed.

II Say which of the following statements are TRUE and which are FALSE. If FALSE, say why.

1. Governors for diesel engines are usually made up of two systems: a mechanical arrangement and hydraulic unit.
2. The mechanical portion of the governor acts directly on the fuel control to change the engine power output.
3. The hydraulic unit detects any change in the speed of the engine and transfers the indication to the actuator.
4. The rotation of the flyweights produses a centrifugal force which is opposed and balanced by a spring.
5. If the engine speed slows down, the centrifugal force on the flyweights increases and the crank levers compress the spring.
6. The set speed may be changed by the speed control which alters the spring compression.
7. A piston valve connected to the control spindle admits or cuts immediately the fuel supply from each of the fuel pumps.
8. When the piston valve rises, oil is drained from the actuating cylinder and the power piston moves up increasing the fuel supply to the engine which speeds up.
9. The actuating piston is spring loaded and when the engine speed increases, the oil pressure is released allowing the spring to force the piston down thus decreasing the fuel supply.

III Complete the following sentences with the appropriate terms:

1. The device consisting of a pair of identical flyweights, mounted on opposite sides of revolving carrier is the _____ .
2. The adjustment of the spring force which resists the centrifugal forces of the flyweights is the _____ of the engine.
3. The piston acted upon by oil under pressure which actuates the fuel control mechanism of the engine is the _____ .
4. The small cylindrical valve that slides up and down in a bushing containing ports wich control the oil flow to and from the actuating cylinder is called the _____ .
5. The rod transmitting the position assumed by the flyweights to the pilot valve is known as the _____.
6. The straight bar having teeth suitable for engaging with a pinion used for setting the fuel supply is the _____ .
7. The change in the governor rotating speed which causes the governor's fuel control mechanism to move from its full-open position to its full-closed position is called _____ .
8. A manually operated device that enables the fuel supply mechanism to be returned to no fuel position in case of emergency or governor's failure is known as the _____ .

IV Fill in the blanks with the pairs of words or phrases listed at random below:

a. _____ - _____

b. _____ - _____

c. _____ - _____

d. _____ - _____

e. _____ -_____

f. _____ - _____

g. _____ - _____

h. _____ - _____

i. _____ - _____

Fly out, rotating plate, govern, sense, apply, actuate, throw outwards, exert, piston valve, detect, actuator, control, revolving carrier, pilot valve, cause to move, power piston, pivot.

Now replace the boldface words in the passage with its alternative:

- The governor, which is the principal control device in any engine, is so termed as it **controls** the engine speed at some fixed value. The ball head is the speed **detecting** portion of the governor. It consists of two identical flyweights on cranked levers fitted to a **rotating plat**e. When the flyweights are **rotated** the centrifugal force **throws** the weights **outwards**. A helical spring **applies** a compression force to oppose and balance the centrifugal force providing a set speed. A **pilot valve** linked to the control rod supplies or drains oil from the **power pist**on which **causes** the fuel control to **move**.

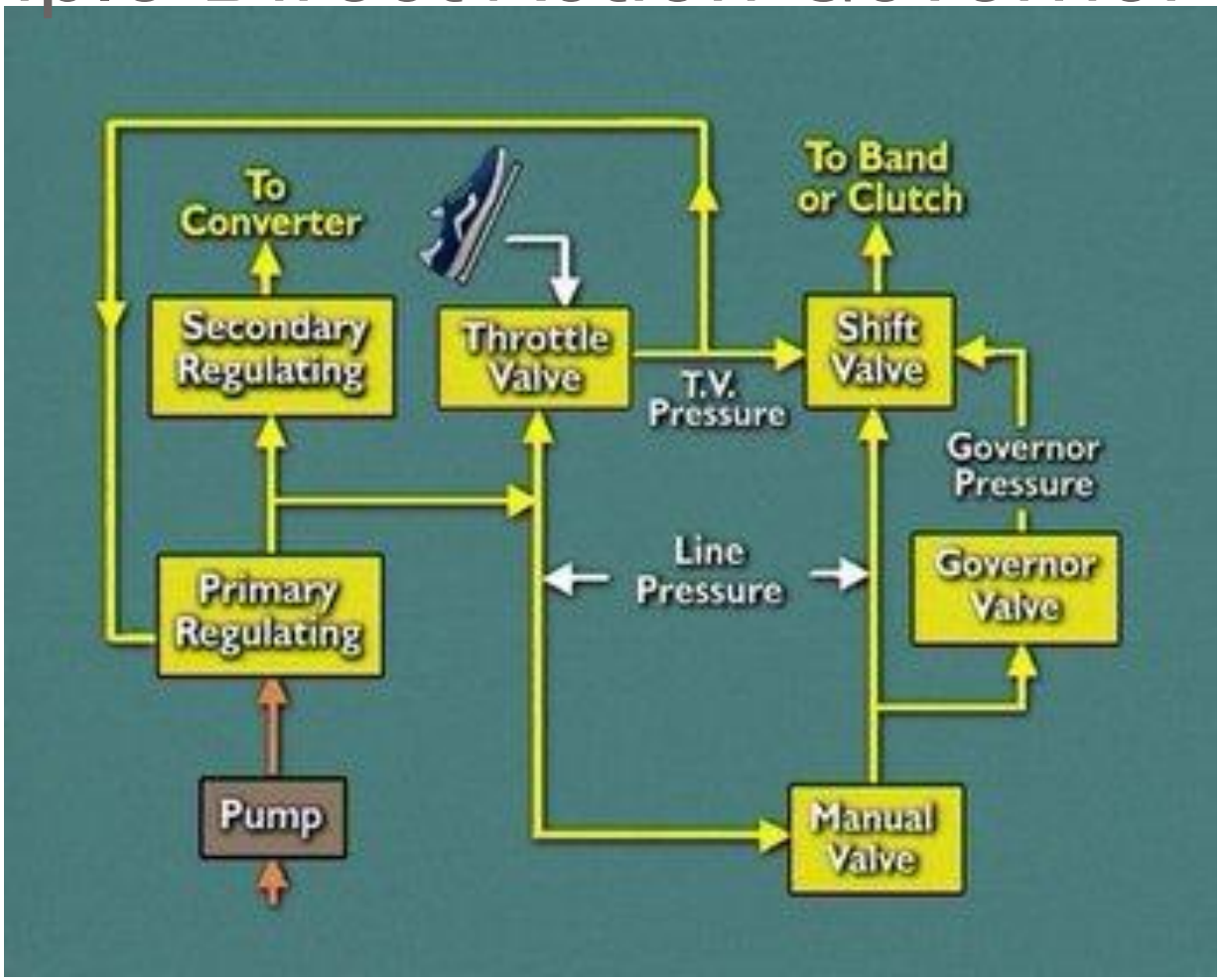
Re-tell this lesson in writing by following these headlines:

- the function of the governor
- main parts of the governor
- the speed sensing portion: weights, spring, adjustment, control spindle
- the actuating portion
- governor droop
- linkage to the fuel pumps
- fail-safe spring
- manual override

1. FUNCTION

- To maintain the engine speed at the desire value by controlling the fuel injection.

A Simple Direct Action Governor

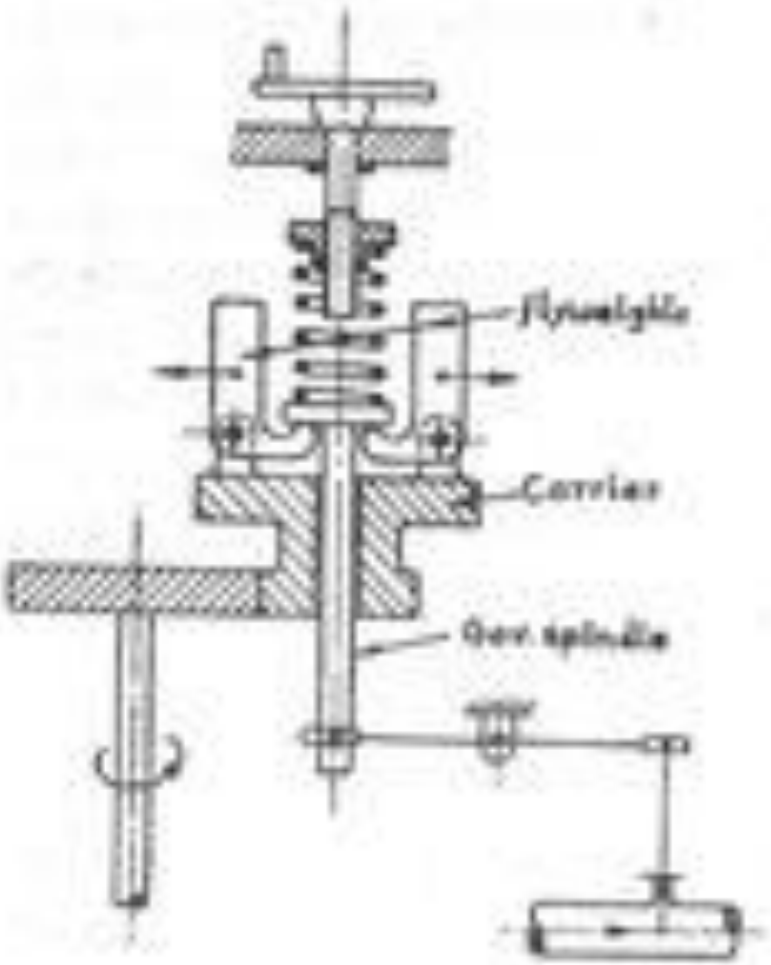


The governor spindle is rotated through a gear mechanism via the engine shaft whose speed needs to be governed. There are **flyweights** which rotate along with the governor spindle and they are thrown outwards (as shown by arrows in diagram), and the degree of their outward motion is in proportion to the speed at which the shaft and hence the spindle is rotating.

The spring fitted on the **spindle** acts to return the flyweights to their original position and hence counters the centrifugal force acting on the flyweights.

The net results of all this action is that the spindle moves vertically up or down depending on the position of the flyweights and this motion is transmitted to the appropriate mechanism which results in actual speed change.

Read more:
http://www.brighthub.com/engineering/marine/articles/41669.aspx#ixzz1bys7o2W4


Flyweights
Carrier
Governor spindle

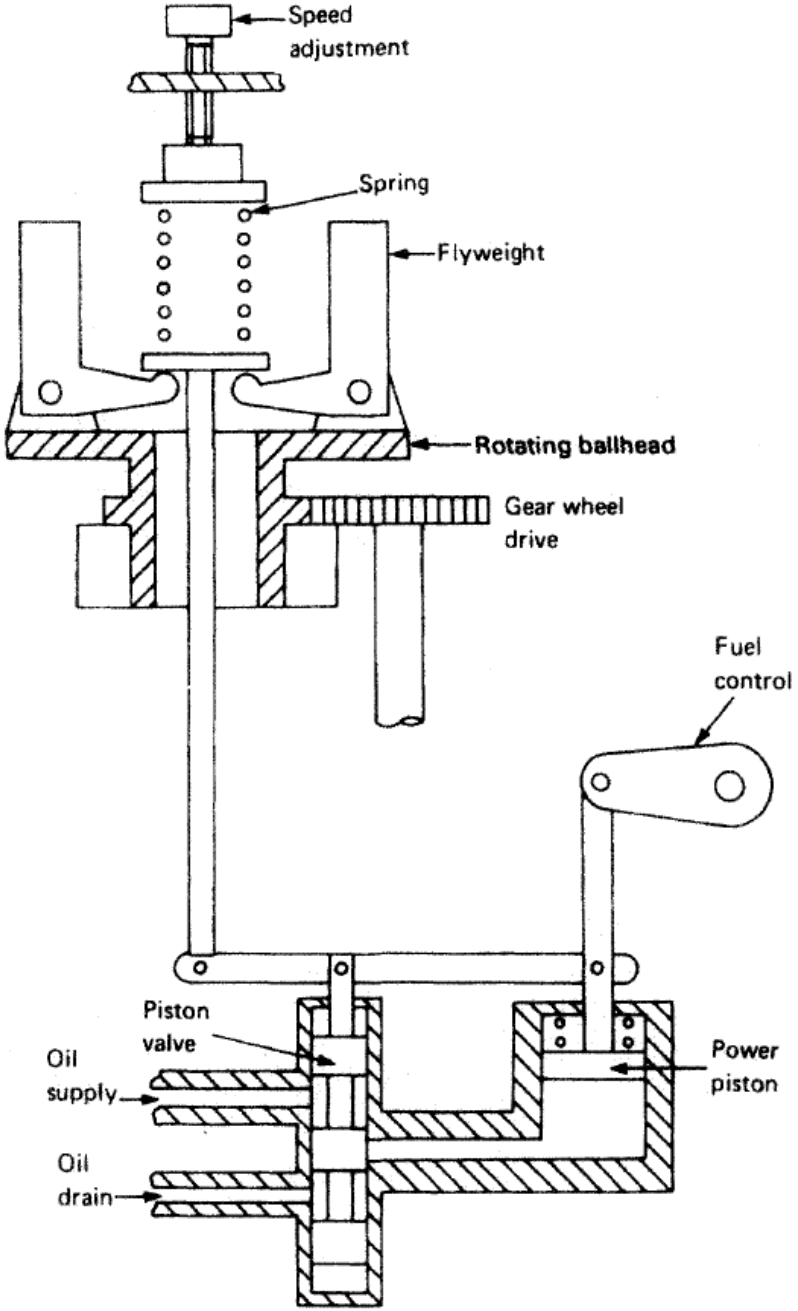


Figure 2.22 Mechanical governor

TEST

All marine vessels ranging from a huge cruise liner, big oil tanker, relatively smaller yacht or even a tiny powerboat need some sort of speed _____ system to control and _____ the speed of the marine diesel engine or whatever propulsion _____ is being used for the vessel. It would be really impractical and dangerous to have a ship or a boat without speed control _____ fitted on it, and could lead to accidents such as collision or grounding.

The speed control mentioned above is achieved with the help of a _____ and we will study about this device here. I would just like to clarify one confusion here that the main role of the governor *is not to* _____ *or* _____ *the speed* which can be done via fuel control system (similar to an accelerator on your car) but once the speed of the engine has been set, the job of *the governor is to* _____ *that speed despite the* _____ *in load*. In other words the governor controls the speed variation and keeps the speed within restrained limits _____ these variations.

The variations could arise from several factors such as say rough weather. A ship *rolling and pitching* in heavy weather may temporarily come in such position that its _____ *is literally out of water* and without the governor the speed of the engine could _____ up to such an extent that it could _____ the engine itself.

- Governors are also fitted in _____ **diesel engines** on the ship used for power _____, and their function remains the same in this situation as well. The power delivered by the _____ needs to be _____ despite _____ variations and this depends to a great degree on the speed at which the prime _____ of the generator diesel engine is _____ since the alternator is getting its movement from that engine only. Hence the role of the _____ is equally important in this case as well.

The main function of the governor is to *maintain the engine speed at the desired* _____. It does this by continually positioning the fuel *pump* _____ to control the amount of fuel injected into cylinder per _____.

Most governors used on diesel engines are self-_____ units manufactured by specialis firms. The mechanism can be divided into two parts. There is a speed _____ *portion* and an _____ *portion*.

A common form of speed sensing device is a _____ head. It appers in _____ form at the top left hand portion of Fig.12.1.

It consists of _____ **carrier** on which are mounted two weights (the _____ **)** having cranked _____. They are _____ so that the levers compress a _____ as the weight _____ out under centrifugal force. The force exerted by the _____ is controlled by the pressure of an **speed** _____ **mechanism** on its other end. This adjustment is the speed _____ for the engine. Wherever this is set the _____ will assume a corresponding position according to the speed at which they are _____. This position is signalled to the _____ **portion** of the governor by the position of **the control** _____.

The **control spindle** is connected to a piston valve which _____ oil as required to the _____ piston and cylinder. The position taken up by this actuating piston is _____ back to the **pilot valve** so that the oil is controlled to give the _____ the desired final position.

The actuator spindle is connected to a _____ **output** from the governor. This lever is connected by the _____ to the **fuel pump racks** and controls the fuel quantity from each of the fuel _____.

- For any speed setting of the governor there will be a range of _____ from the fuel pumps according to whether the load _____ is high or low. It will vary *from* _____ *at one end of the travel of actuator piston to* _____ *fuel at the other*. These two positions correspond to two _____ different values of speed. The difference between these values is known as the governor _____. It is usually expressed as percentage of the _____ speed.

The **linkage** to the fuel _____ may take the form of a push-pull mechanism. Each individual fuel pump _____ is connected to the mechanism ba an _____ link so they can be balanced to ensure that each cylinder takes its share of the _____. The connection between each individual pump and common linkage incorporates a _____ arranged as a "fail safe" _____ so that should one pump _____ in a fuel supply position the others can be safely returned to the no _____ position.

It is also the usual practice to provide a **manual** _____ by which the _____ can be returned to the *no fuel position* in emergency or should the governor _____ in any way. Springs in the mechanism between the _____ and the main fuel rack rod enable this operation to be carried out.

A Simple Direct Action Governor

- The figure below explains the working of an elementary governor known as _____ governor. It is a purely mechanical device working on the principle of _____ force acting on rotating/revolving bodies. The working of this governor can be clearly understood if you see the _____ carefully before reading further.

The governor _____ is rotated through a gear mechanism via the engine _____ whose speed needs to be governed. There are _____ which rotate along with the governor spindle and they are thrown _____ (as shown by arrows in diagram), and the degree of their outward motion is in _____ to the speed at which the shaft and hence the _____ is rotating.

The spring fitted on the _____ acts to return the flyweights to their original _____ and hence _____ the centrifugal force acting on the flyweights. The net results of all this action is that the spindle moves _____ up or down depending on the position of the _____ and this motion is transmitted to the appropriate mechanism which results in actual _____ change.

Read more:
http://www.brighthub.com/engineering/marine/articles/41669.aspx#ixzz1bys7o2W4

1. MECHANICAL GOVERNOR

Speed sensing portion: ballhead (carrier, flyweights on cranked levers)

Actuating portion (control spindle, piston valve, actuating piston, pilot valve)

CONNECTION (by linkage to the fuel pump racks)

Depends upon the load torque

Droop is the variation in engine speed following a load change, approximately 4% for a full load change.

2. HYDRAULIC GOVERNOR

Woodward governor is commonly used on board

A hydraulic amplifier amplifies the governor's signal to the fuel pump.

The hydraulic pressure for the amplifier is delivered by the camshaft lubricating oil system.

3. ELECTRONIC GOVERNOR

The electronic governor uses a combination of electrical and mechanical components.

Speed sensing device: magnetic pick-up coil.
The rectified voltage signal is used in conjunction with a set speed signal to operate a hydraulic unit.

Then the fuel controls are moved in the appropriate direction to control the engine speed.

4. REMARKS ON FAILURES AND IRREGULAR OPERATION (1)

Parts of governor jamming
Pump or non-return valve in governor defective
The governor does not function properly
The governor does not operate the regulating linkage
The governor does not respond to load changes
The governor has just undergone repairs
The governor has tripped
The governor is blocked
The governor is cold

5. REMARKS ON FAILURES AND IRREGULAR OPERATION (2)

The governor is defective
The governor is gear-driven
The governor is hunting
The governor is incorrectly adjusted
The governor is warm
The governor operates irregularly
The governor has picked up errors
The governor speed setting incorrectly adjusted
The governor sticks

(of a gauge indicator, engine speed, etc.) to oscillate about a mean value or position

A Simple Direct Action Governor

- The figure below explains the working of an elementary governor known as direct action governor. It is a purely mechanical device working on the principle of centrifugal force acting on rotating/revolving bodies. The working of this governor can be clearly understood if you see the diagram carefully before reading further.