Ventillation :-

Ventillation is a process which involves in entering and returning the air from surface to surface through the mine. It helps us to providing normal atmosphere in the u/g mine. to the workers employed. If the working atmosphere is not suitable for the workers, it is difficult to work for them.

The atmospheric air is a mixture of various gases which is found up to 95 km from the MSL in constant ratio. The % of gases in normal air are as follows.

O_2 - 20.93 %
N_2 - 79.04 %
CO_2 - 0.03 %

When this air enters in the mines and returns after passing different places in the mine, its composition is changed. It has been found the composition in return air from degree 2 & 3 mine is follows :-

O_2 - 20.28 %
N_2 - 78.90 %
CO_2 - 0.36 %
CH_4 - 0.46 %.

Date 24/6/18

Damp :-

Damp is the mixture of mine gases and moisture with dust. Various noxious and poisonous gases are found which mixed up with the ~~moisture~~ moisture present in the mine & form a damp.

There are five types of damps found in u/g coal mines which are as follows :-

(1) Black damp :-

It is a mechinical mixture of CO_2 and excess amount of N_2. Excess N_2 means that the % of N_2 in the mine air which is more than the normal % of N_2 in atmospheric air. The % of N_2 & CO_2 vary b/w 80-100% and 0-20% respectively. It depends upon the method of formation of black damp.

(*) Physical Property :-

It is colourless, odourless gas which has acidic taste. It is almost heavier than air and rarely soluable in water. It doesnot burn and not support to combustion. It is not poisonous but increase in its % decrease O_2 in the air. So, the human being is affected due to defficency of O_2.

(*) Physiological effect :-

The physiological effect of this damp is due to defficency of O_2 which choked the respiratory system. So, it also called choke damp.

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The black damp consisting 12% of CO_2 & 88% of N_2 has the following Physiological effect.

Black damp [12% + 88%]

25% [Air - 75%, O_2 → 15%, CO_2 → 3%]
→ Rate of breathing double.

40% [Air - 60%, O_2 - 12%, CO_2 - 5%]
→ Suffocation & distress

60% [Air - 40%, O_2 - 8%, CO_2 - 7.2%]
→ Sever distress & suffocation.

TEST:-
The presence of black damp may be tested by flame safety lamp. It reduce the flame of flame safety lamp by 30%. if it is present in the mine air in 5%.

Remdee :-
The black damp may be treated by sprinkling of lime soln. If the % is high then the the ventilation should be increased till its dilulation. If a person has been victimised the artifical respiration should be given to the victim for restoring his health.

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2) White Damp:- (खुनी गैस)

It is Synomious with CO. It is very poisonous gas yourned by the oxidation of carbonious matters in perdences of in-Suffisient oxygen. It is a colourless, odourless & taste less gas. It burns with blue flame but doesnot support combustion. It is lighter than air have Specific gravity 0.96. It yourns explosive mixture with air, It critical temperature -140°C.

Physiological effect:-

0.02 % - discomfort, pain after 40 min at work, 90 min at rest

0.12% - Pulpitation after 10 minutes at work 30 min in rest.

0.2% - Unconciousness after 10 min at work and 30 min at rest

0.5 to 1% - death after 10-15 min

Method Of formation of CO in mines:-

There are various Sources of CO in u/g mines Some off them are given below.

(i) Oxidation of coal & other carbonceous matters:-

⇒ Oxidation is a chemical reaction in which O_2

Spiral

(i) C
⇒
(ii)
(iii)
(iv)

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combines with an element and produces oxides. When it combines with carbon in its sufficient.

① Oxidation of coal & other carboneous matter:-

⇒ Oxidation is a chemical reaction in which O_2 combines with an element and produces oxides. When it combines with carbon in its sufficient quantity it forms CO_2 gas. But due to insufficient amount of O_2 present in u/g mines. It forms CO after combining with carbon and other carboneous matters.

② Spontaneous heating of coal:-

Completely extraction of coal in u/g mines is never possible. So, the coal left in the mines Produces CO by its spontaneous heating in presence of in-sufficient O_2.

③ Blasting Operation:-

Every explosive has a chemical compound which supplies O_2 to completely the combustion process. But due to insufficent O_2 the completely combustion of explosive doesnot take place & CO is formed

(iv) Operation of Machine having internal combustion engine.

In u/g mines the machine having internal combustion engine are operated for different purposed. The burning

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Perch :- It is place where birds use to sit in the cage.

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of fuel in piston/ cyclinder of the engine remain in complete due to in sufficient supply of O_2 which cause the formation of CO.

(v) Explosion :-

Explosion is very common occurences in the mines. due to mehane & coal dust which termed as gas explosion & coal dust explosion. After every explosion various poisonous gases are formed among which CO is done.

Test Of CO / Dection of CO :-

These 2 methods of dect detecting the CO at its early state in the mines. They are as follows

① By Canary/Munia birds :-

This bird is a warm blooded creature which shows very fast activites. When it breaths the air containing CO. It shows distress (creeping, ruffling of feathers). when 0.15% CO is present in the air. After 3 mins it falls off its perch after 18 min. If the CO % is 0.3 the shows immediate distress and falls of its perch after 3 min. This give sufficient information to the recuse team which visit the mine after an accisedent. The fresh birds should be used because it gets acclimatise. And doesnot shows peroper actives even in prasence of CO.

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(ii) By CO detector :-

The working CO ~~dectr~~ detector are based on the fact that the CO change the colour of some chemical compound when its passes through them. Some ~~dector~~ detector are given below.

(•) PS- Detector :-

This consist of a glass tube filled with silica impregnited/filled with Potassium Palladium Sulphite. The both end of the tube have silica gel to absorbed the other. The end of the tubes are sealed. When it is required to detected the CO in mines. The tubes is inserted in the adaptor of a rubber aspirator after breaking its end. A fixed quantity of air nearly 110 cm³ is sucked through calibrate orifice. By squeezing the aspirator

when the air containing CO passes through the tube having Potassium Palladium Sulphide of light yellow colour changes it colour in brown. A colour chat- is provided with a detector. By which we determined % of CO after compareing the deepness of the colour in chart & in the tube.

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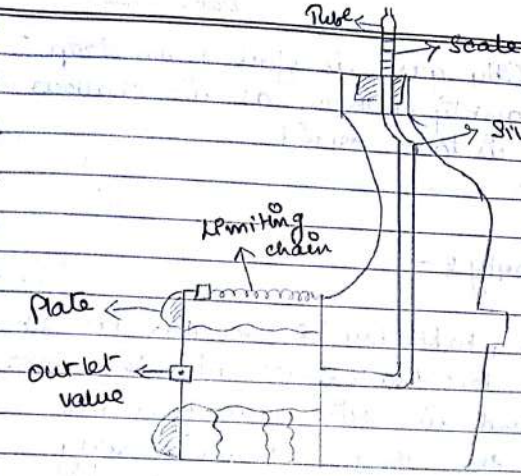
(ii) Multigas ~~detector~~ detectors:-

Now a days many portable instruments have been manufactured by different companies to detect various gases with maximum accuracy. A multigas detector manufactured by MSA LTD. of USA & ~~dagar~~ drager company are very common in the industry. It consist of a hand aspirator and a pack of tubes sealed at there ends special tubes sealed at there ends special tubes are provided for individual gas. And marked with the name of the gas. The required tube is taken out from the packed marked with CO its and both ends are broken and inserted into the adapter aspirator in proper ways. The air is sucked by a fixed no squeeze and the change in colour of the chemical mainly Potassium Palladium ~~Sulph~~ Sto. Sulphite & Ammoni. Ammonium Moly ibadate, is observed % of CO is determine by reading the scale provided with tube it very accurate quick instrument. It can measured the CO from 5ppm to 5000 ppm.



Hand Aspirator :-

4/7/18

(3) Fire damp :- (गरम गैस)

It is a mechanical mixture of inflameable gases which emanate (बहार आना) from the strata of coal in mine.

It consist of methane & other gas like ethane, ethanlene etc in very small amount. Since the major part of fire damp is CH_4. So, fire damp is the synonymous with CH_4. It is also known as mash gas because CH_4 is formed by rottening of wood / vegetable matter under water like mash.

It has been formed millions of years ago during the coal formation. By distruction of

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of cellouse ($C_6H_{12}O_6$). CH_4 gas is found in deep seam in large quantity. where as in shallow seam its quantity is less or nil.

(*) Physical Property :-

It is a colourless, taste less & odourless gas. It specific gravity is less than ~~0.55~~ air i.e. 0.55. So if it is found in this side of mine working and near the roof. It is weakly soluable in water. 3:3 volumn of CH_4 dissolve in 100 volumn of water at 20°C. It is critical temp is -83°C. It is not poisonous but ~~sog~~ Suffocation may take place due to lack O_2 when the CH_4 % rise. This gas is combustible and burn with pal blue flame. It doesnot support combustion. It is major cause of accident in mines due to explosion because. It forms an explosive mixture with air.

(*) Source of CH_4 in mines :-

As we know that the CH_4 is already formed with coallification and hidden in coal seam in cracks & cavities etc.

The following are major sources of CH_4 in mines.

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① Gradual Exudation / Bleeding :-

It is a very slow process by which CH_4 comes out from coal seame and diffuses in with mine air.

② Gas Blowers :-

Sometimes CH_4 blows strongly from cracks with hissing sound which may be heard from long distance. It can also be realised by the palm on cracks. Initially the intensity of flow of gas is high and it reduces as time pass. It may last few day, few months or few years. If there is a permanent blower it can be diverted upto surface by pipe line and use as domestic gas.

③ Gas out burst :-

CH_4 is generally accumulated in large quantity in fold or fault region of seam. which may come out accidently with high pressure it is called gas out burst.

④ Poor Ventillation :-

When ventilation pressure goes down the CH_4 hidden in ~~coal~~ cavity comes out from there and mixed with mine air in the roadways

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Degree and gaseous of seam:-

w/r to gaseous of the seam it has been divided in 3 catagories as given below:-

① Degree I mine:-

When methane is released less than 1 m^3 by producing 1 tonne of coal. The seam is called degree I gassy seam.

② Degree II mine:-

If the methane is released b/w 1-10 m^3 by producing 1 tonne of coal that seam is coal degree II gassy seam

③ Degree III mine:-

If the methane is released b/w 1-10 m^3 by producing 1 tonne of coal. that seam is coal degree II

If the methane is released more than 10 m^3 per tonne of coal produced it is called 3 degree gassy seam.

Detection of fire damp:-

The dection of fire damp is very essential because its high conc^n may cause explosion. If it is detected

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before hand if we can prevent the explosion by diluting it with increase in ventilation there are 3 methods of detecting the CH_4/ fire damp.

① Laboratory process

② By chemical process

③ By flame safety lamp.

① Laboratory process :-

In this process the % of CH_4 is determine in ~~laboratory~~ laboratory by collecting sample air in a sampleing bag from the mine. The sample air is ignited in the laboratory and products obtain from combustion are absorbed by re-agents. Mass of product absorb by re-agent indicate the % of CH_4 in sample air. It is time consuming process which is used for scientific study.

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② By chemical process :-

Various types of Methanometer are based on the fact that methane air mixture reacts with chemical.

The following principle are used for manufacturing the methane detector.

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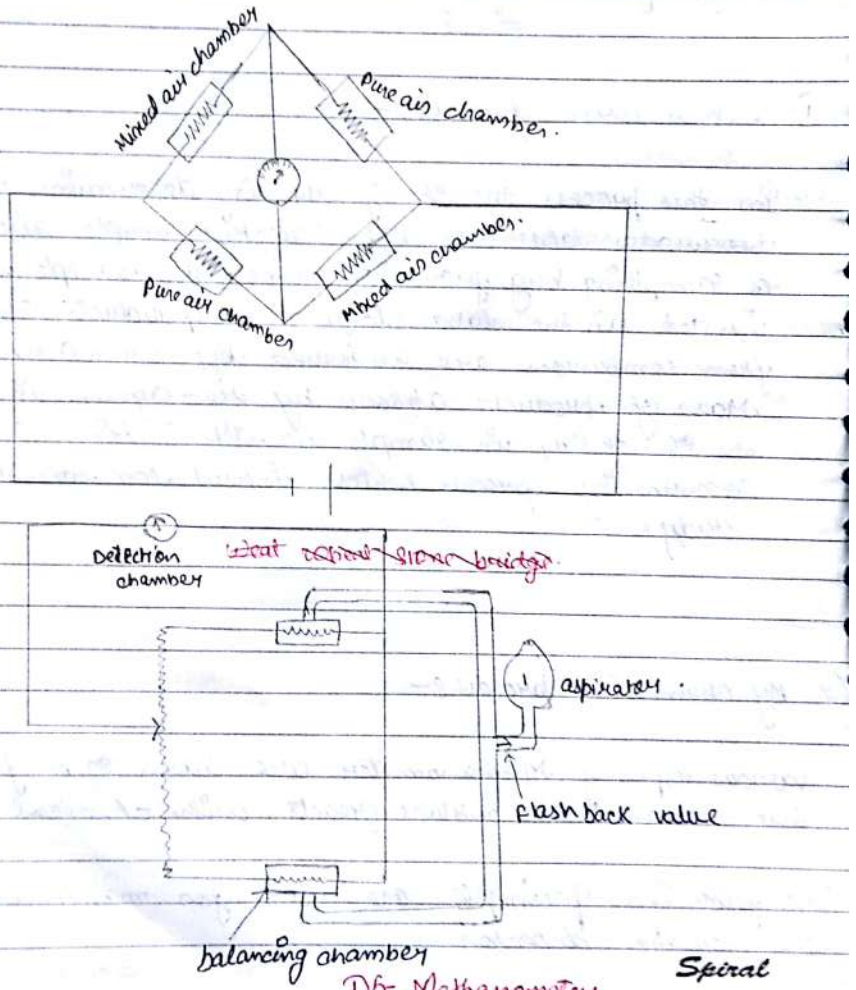
Wheat stone bridge principle is a prominent principle on which MSA D-6 methanometer works. In this principle the unbalance current of the circuit due to reaction of methane with chemical is measured.

Wheat stone bridge consist of 4 identical platinum Bourdum circuits connected as shown in fig.



Dr- Methanometer

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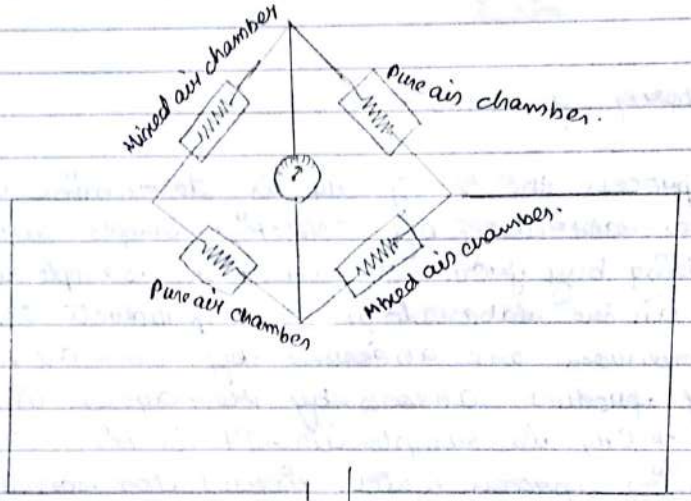
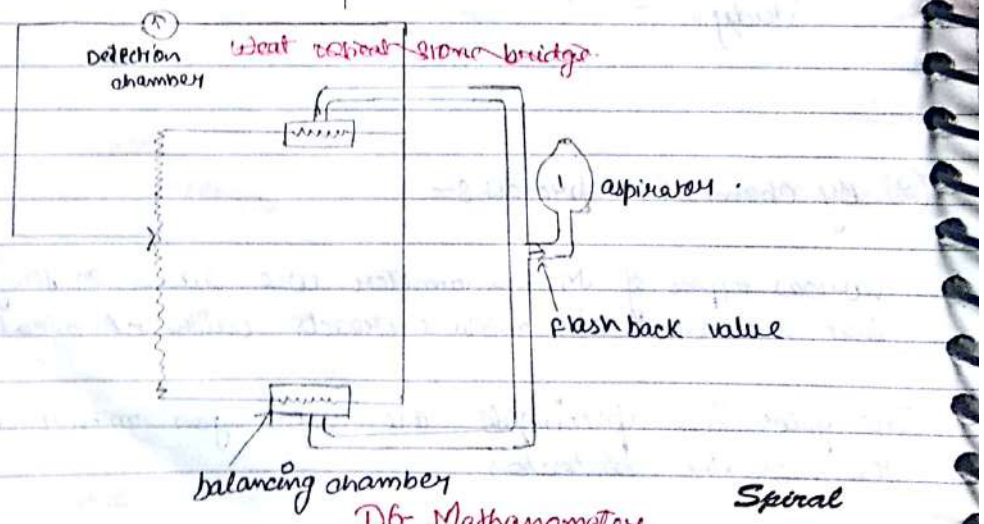
(1) Wheat stone bridge principle is a prominent principle on which MSA D-6 methanometer works. In this principle the unbalance current of the circuit due to reaction of methane air mixture chemical is measured.

Wheat stone bridge consist of 4 identical platinum Tungsten circuits connected as shown in fig.





D6 Methanometer

Date.....

when the circuit is completed b/w terminals A & B no current pass through the conductor which connect X & Y. The reason behined it is the potential difference b/w X & Y is zero. When methane mixed with air pass through the chamber it react with the chemical coating on wire in presence of electricity and makes the wire white hot. Due to which the resistance of the wire is increased it created the potential difference b/w X & Y which cause flow of electricity through conductor b/w X & Y. The ammeter indicates the amount of current in refferences of % of methane present in the air. The pure air chamber are made hermatically sealed.

M.S.A. D 6 Methanometer :-

This methenometer is very commonally used in mines for methane detection it is very simple to operate and portable. It consist of 2 chargeable ~~nikel cardmium~~ nickel cadmium battery of 1.5 V connected in series. It can produces a voltage of 2.2 - 2.64 V. The methanometer is also equiped with aspirator value with telescopic probe which is extended 76 cms to 1.24 ~~cms~~ m. The battery last 1000 ten seconds and its takes 14 hours to charge it completely.

Method of detection :-

The methano meter has 2 buttons. One for detecting the voltage and other for % of CH_4. The dust cover of the methanometer is removed on the spot where methane

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is to be checked. The methanometer is held in left hand ~~the~~ m the middle finger is kepth on the voltage checking button. First of all the button fosvoltage Checking is pushed by finger and see the voltage of the battery. If it is b/10 2.22 – 2.8V. The % Checking button is pushed by thumb & hold it nearly 10sec. The current will flow through the chamber where methane is present with air and the instrument will show the % of CH_4 on the basics of wheat stone bridge. The Range of this instrument 0–5% and takes 1.5 min in complete operation. Where the CH_4 is to be detected on a place 1.5 m above the proper is used.

The battery should be never be taken out the instrument should be used..

(2) The another method of gas detection is base on the formation of gas cap of variable size above the ~~flame of a~~ flame of a lamp:-

On the basics of this a Flame safety lamp is used to measurement CH_4 % in mine air

(3) Diffusion – combustion – contraction is also used to manufactured a methanometer

$$CH_4 + 2O_2 \longrightarrow CO_2 \perp 2H_2O \uparrow$$
1 Vol 2 Vol 1 Vol

The volumn of the gas is reduce by 2/3. Ringrose Spiral

Date.....

methanometer is works on this principle.

(iv) The refractive index of pure air and CH_4 mixed air are different which effects the interference pattern of the light. This is used for detecting the CH_4. Ricken interference methanometer work on this principle.

(v) Infrared radiation is also used to detected the CH_4 in mine air. The instrument works on this principle is infrared radition methanometer.

(vi) The chemical reaction of CH_4 which different chemical also prepares the basics of CH_4 detection in the mine air.

14/7/18

(3) Flame Safety lamp.

It is very simple but effective tools for mining s to test the presence of fire damp and CO_2 in underground mine.

The accumulation of fire damp and its % in mine air may be ~~taken~~ tested by observering size and shape of the flame of the lamp. The height of flame increase with increase of the CH_4 % in the mine air.

(*) Construction of Flame Safety lamps:-

It compaires of 3 main parts given below:-

Spiral

(*) Always say 2.5% - ~~3.5%~~ 3% gas in OMT Exam above flame.

Date.....

(1) Lower portion / Lower part :-

It consist of an oil vessel made of brass. There is an ~~oil~~ oil filling arrangement at the side of vessel. Through which fuel is filled by the funnel. The fuel used in flame safety lamp is a special fuel known as ESSO 1425 Solvent which is used in aeroplane. Due to scarcity of the said fuel the petrol may be used approved by D.G.M.S. There is a flame adjusting screw at the bottom of fuel vessel which is used to lowering & rising of wick fitted in the burner. There is a provision of magnetic lock which insures the safe opening of the lamp. It can be open by only by pulling a magnet which is made available ~~strict~~ strictly in the lamp cabin.

(2) Middle portion :-

This consist of a composite flange which is screwed on the top of the oil vessel and also a composite middle ring assembled with 5 steel pillar having dia of 5 mm. The ~~pro~~ perforous of pillar is to protect the glass provided at middle part the thickness of the glass is kept 5 mm ~~The pro~~ height of 54 mm and inner dia meter 57 mm it made by a company borosil approved by DGMS. The glass ~~protected~~ protect the flame from air current and makes it visible. There are asbestos packing at ~~bo~~ top and bottom of glass set in

Spiral

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retainer. To make the lamp air tight

In GL-5 there is mid feeding devices at the mid position.

(3) Upper position

It consist of a bonnet and chimney with Hood which is fitted with flexilable handle to carry the lamp. There are 2 wire nets name as inner net and outer net fitted in the upper position the wire net is made of iron wire having 28 mesh per inche. Wire net is main safety part of flame safety lamp. When the hot gas produce by flame enters in the wire net it does not allow the flame to go out by reducing its heat by conducting it outside so the gaseous mixture outside the wire does not attain its ignication temp and fails to burns.
As per anomous of DGMS area of contact of wire net/gauge shall not is covered by soot or wire of net. is broken or bent it does not work properly. So, it should be clean regularly by a brush and repaired if required. The distance inner and upper wire net is kept 1.5cm.

The safety lamp is provide with top feeding devices through which fresh air enters in the lamps and hot air pass through outlet to the atmosphere The weight of GL-60 is 1.75kg with fuel where as GL-5 is 1.5kg.

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*) Some additional feature of flame safety lam

① Re-lighting arrangement :-
There is a relighting arrangement consist filament near the wire connect with 2 battery of 1.5 V kept in battery chamber. It is used to re-light the lamp without opening it when the lamp is quenched/ बुझाना during formation of testing flame or by other means.

(ii) Snuffer :- It is a devices which automatics put off the flame when the oil vessel is separated from the lamp.

(iii) The oil vessel is provided with cotton to absorb the fuel which prevents the ~~spillage~~ seepage of fuel.

(iv) Measuring scale :- GL-7 is provided with a scale for reading the % of CH_4. A/c to height of the flame.

(v) Bottom feeding devices & its locking system
In flame safety lamp specially in GL60 & GL-7. there is a bottom feeding devices which can be closed or open by sliding locking system. The bottom feeding devices provides the sufficient air to burn the CH_4 completely it also facilities the testing of CO_2 along floor of gallery

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Gas Testing :-

The presence of CH_4 is tested by flame safety lamp in 2 ways :-

(1) Accumulation test :-

Safety lamp is use to test the accumulation of fire-damp accumulated in roof cavities, blind head gallery / head end gallery, and fault zone. The light is switched off as well as cap lamp and testing is carried out with normal flame by rising the lamp slowly. In the flame of the lamp suddenly jumps. It indicates the accumulation of gas. The mining sardar will soon report the overman who will arrange to dilute the accumulation and inform seniors officals.

(2) Percentage Test :-

When the accumulation of gas is not found % test is carried out. The safety lamp brought to the face as place where testing is to be done. and all the light are switch off including cap lamp. Now a testing flame is made by flame adjusting screw. when testing flame is made of cobalt blue this line will seen on wick. Now the lamp is rised slowly but not very really. The size of the flame is watched carefully which indicates the presence of gas in %. Here height and size as shown in table.

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% of gas	Height of flame (in mm)	Shape & Size.
1	7	A cobalt blue cone organ flame seen.
1.5	8	Blue flame becomes a little bit distinguish.
2	9	Flame grows larger and blue flame become distinguish with out top.
2.5	10	Flame becomes clearer but top invisible.
3	11.5	Top of flame become nearly visible and blue flame seen clearly visible.
~~*~~ 3.5	~~20~~ 14	Blue flame become extremely clear.
4	20	Flame jump off.

Date.....

Stink Damp :- (पोचा गैस)

It is the synonyms of H_2S it is colour less but it smell like rotten eggs. It is heavier than air having Sp. gravity 1.175. It is highly soluable in water and a combustiable gas. It doesnot support combustion

Formation of H_2S :-

It is found in mines mainly by ~~rotte~~ rotting of timber under water. So, we should avoid to reach the area where water is accumulation for long time and distrub it.

H_2S is also forms from blasting operation of coal having pyarites. A little amount of H_2S may forms by spontenous heating also. It may also be found in ~~gas~~ damp.

(*) Physological effect :-

This is a very poisonous gas which cause sudden death. If inhale in large quantity. Its threshold limit is 10 ppm. A man can survives 8 hours if it is present 0.02%.

SO_2 :-

It is colourless gas heavier than air which smell very strongly like sulphur. Its Sp. gravity is 2.21 which heaviest mine gas. The

Spiral

gas is poisonous and extremely irritating to eyes and respiratory passages

Nitrous Fumes:-

It is a mixture of different oxides of Nitrogen like NO, NO_2 & N_2O_3 it has a choking smell. Its colour is reddish brown and it is easily dissolve in moisture present in mine air.

It is formed in mine by blasting operation when Nitro glycerin explosive is used. When ever complete combustion of NO_4 explosive doesn't take it forms Nitrous fumes.

(*) अग्नि dampe:-

It is a mixture of various gases formed after an explosion in underground mines. Explosion may be gas explosion or coal dust explosion or both. The mixture has variable % CO, CO_2, N_2, H_2S, SO_2, and very small % of CO_2.

Threshold limits of mine gases:-

O_2 → 16% से कम नहीं होना चाहिये।

CO_2 → 0.05% से ज्यादा नहीं होना चाहिये।

CO → 50 ppm "

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ess % of CO_2

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Spiral

CH_4 → 1.25%

H_2S → 10 PPM

SO_2 → 5 ppm

NO_2 → 5 ppm

Spiral

:- MINE CLIMATE :-

Date 21/07/18

The workers deployed in U/g mines should be provided a surface like climate to maintain there health and working efficiency the temp of the mine should be moderate. The hummidity in the air and pressure of the air should also be maintain normal. For these purpose a provision has been made in coal mine regulation as well as metal ferrous mines regulation which is known as standared or ventilation. In coal mine regulation as well as metal. In coal mines regulation the regarding these has been brought in regulation number 153 which says that:-

C.M.R 2017 · 153:-

Sub I (i) It shall be the duty of owner agent or manager of every mine to take such step as are necessary to constantly provide in all parts of the mine below ground which are not sealed off. Adiquate ventilation to clear way smoke, steam and dust, due to delute gases that are inflamable or noxious, so as to vandon them harmless To provide air containing sufficient O_2 and to given such excessive rise in temp. or hummidity which may be harmfull to the health of the person.

Sub Reg. II :- For this purpose you securing adequate ventilation as specified in Sub-regulation (I). The Ower, agent, manager shall insure that:-

(a) In every ventilation district not less than 6 m^3/min of air per person is employed

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in largest shift on not less than 2·5 m³/min of air per tonne of daily output; when every is larger, passes along the last ventilation connected in the district.

(b) At every place in the mine where, persons are required to work or pass, the air does not contain less than 19% of O_2 or not more than 0·05% of carbon dioxide (CO_2) or any other noxious gas in quantity sufficient to affect the health of any person

(c) The percentage of inflammable gas does not exceed 0·75% in generally body of returns air or any ventillation district and 1·25 in any place of mines.

(d) The wet bulb temp in any working place ~~shall~~ does not exceed 33·5°C and where the wet bulb temperature exceed 30·5°C, arrangements are made to ventillate the same with the current of air moving with speed of not less than 1 m/sec.

(e) For ensuring compliance with the provision of Clause b, c, & d of sub regulation. Air sample & temperature reading shall be taken at least once in every 30 days & the results shall be recorded in a bound paged book kept for this purpose & every entry shall be signed & dated by ventillation officer & manager.

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Sub reg. iii :- In every mines ventilation as specified in sub regulation(ii) shall be produced by a suitable & mechenical ventilator.

Sub reg iv :- If with respect to any mine or part of their the regional inspector is of the opinion - that ventilation of the mine is not adequate. He may by is order in writting require the installation & maintances of such mechincal ventilator as is capable of prudicing adequate ventillation in the mine ~~or~~ part.

11 Velocity of air at differenct location in the mine.

A/c to DGMS Cir. no 42 of 1974

LOCATION	Maxm Speed.
• Man Hoisting shaft & Haulage	8 ms^{-1}
(•) Other roadways	6 ms^{-1}
(•) conveyor roadways. Loading point and tranfer point	4 ms^{-1}
(•) Working Places in developing and depillaring faces	4 ms^{-1}

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Air Pressure :-

The force applied per unit area is called pressure. The force exerted by atmospheric air is called atmospheric pressure. It is measured by an instrument called barometer. There are two types of barometer. There are two types of barometer used for measuring the air pressure:-

(i) Fortin barometer

(ii) Aneroid barometer.

(i) Fortin Barometer:-

It is the most accurate barometer used by meterologist to determine the elevation. There is a assumption based on practical observation that the air pressure changes by 1 mm of Hg if height of the place changes by 12 m.

Fortin barometer consists of a glass tube of 920mm length and 8mm internal diameter whose 1 end is sealed and other end is opened. The open end dip into a cistern made of wood filled with mercury. The cistern is provided with chamois ~~leather~~ leather on its base a glass plate is kept beneath the leather fitted with a screw by which it can be lowered or raised. The barometer is kept at the place where atmospheric air pressure is to be measured and level of the mecury is adjusted by screw so that it touches the ivory. The height of mercury column in the tube indicates the atmospheric air pressure.

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(ii) Aneroid Barometer :-

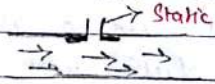
This barometer is used to measure the difference in atmospheric pressure between two place. It is used in mine for ventilation survey.

As there is no liquid used in this this barometer So it is called aneroid barometer. It consists of a corrugated air tight box filled with gas. It is made up of a spring metal so the box can expend and contract according to the pressure of surrounding air and indicator is attached with a system of levers which moves when the box expends or contracts due to change in atmospheric pressure and it is measured in mm by the indicator moving on a scale.

22/07/18

Ventilating Pressure :-

The difference b/w atmospheric pressure and the pressure. It is also known as total pressure. The sum of static pressure and velocity pressure is known as total pressure. The pressure exerted by the air on surface // to air is static pressure.



The pressure which is created by the velocity of the air is called velocity pressure.

Spiral

difference
2. It is

barometer
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Water gauge :-

It is a devices by which the difference b/w atmospheric pressure at 2 place/point is measured. It is basically a U-shaped glass tube filled with water. Both end of the tube are kept open while measuring the pressure difference. One end of the tube is kept at one point and other end is kept at next point. It is seen that the water level goes down. In the arm of the tube where pressure is more consequently the water level rises into the arm which is at point of low pressure. The difference in the height of water level in mm. represented the pressure difference.

1 mm of water gauge = 1 kgf/m² = 10 Pascal.

Humidity :-

The pressure of moisture in the air is known as humidity. The air which is capable of absorbing the moisture from its surroundings it is called unsaturated air. The saturated air not capable of absorbing the moisture ~~practical~~ practically no air is completely dry or saturated. The extend of moisture in the air is termed as relative humidity.

$$R.H = \frac{\text{Presence of water vapour per m}^3 \text{ of air}}{\text{water vapour required to saturated the 1 m}^3 \text{ of the air.}}$$

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Effect of humidity on human body.

When the person employed in mines works his body temperature rises. Due to this perspiration starts and his skin is covered by sweat. It prevent the conduction of heat from his body resulting the increase in his body temperature ~~required~~ regularly. in such condition he feel un-comfortable. If the air around him is capable of absorbing the moisture. The evaporation of sweat will taken place and its cooling effect will give the relief to the worker. So, It is essential to supply un-saturated air continuously in the mine. To insure the humidity of mines the mines management is responsible.

Hygrometer :-

It is an equipment by which the relative humidity of a place is measured. It consist of 2 thermometer placed side by side fitted in a frame.

The bulb of one thermometer is kept in dry which is known as dry bulb thermometer & temperature measured by it called dry bulb temperature. The bulb of another thermometer and temperature measure by it is called wet bulb temperature.

Whirling Hygrometer :-

It has both thermometer are place side by

Spiral

DBT = Dry bulb temp
WBT = wet bulb temp.

Date

Side is hygrometer the water vapour produced by evaporation at wet- bulb is deposit around the dry bulbs. So, it is not- remain dry and gives inaquate results. This is by a handle is provided to the hygrometer by which it- can be rotated such type of hygrometer is called whirling hygrometer. When the hygrometer is rotated the water vapour deposited near the dry bulb is remove. Before taking the reading by hygrometer it is rotated by 200 rpm upto 1 min.

GI The process calculating relative humidity is as follows.

(1) When wet bulb temperature is more than 25°C

R.H = 100 − 7% × diff of DBT & WBT

2) When wet- bulb temperature is more than 20°C but less than 25°C.

R.H = 100 − 8% × difference of DBT & WBT

(3) When wet bulb temperature is less than 20°C

R.H = 100 − 9%. × difference of DBT & WBT.

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28/4/18 Date.....

Ut.

Cooling power of mines air :-

There is an effect of humidity on human body similarly to the atmospheric temp^{re} & pressure is also effect the human body. The combine effect of all these 3 factor i.e humidity, temp & pressure on the person working in mine below ground is called cooling power. It is measured by an instrument known as kata thermometer.

This is basically an alcohol thermometer which has 2 graduation 35°C & 38°C. When it is required to measured the cooling power of the mine air the kata thermometer is carried to the place along with a thermus filled with boiled water. The thermometer is taken out and its bulb is dipped into the hot water until the alcohol touched 38°C marking/graduation. It is then taken out from the hot water and its bulb is wiped with a dry cloth and the time is noted during falling of temperature from 38°C to 35°C.

There is a kata factor provided by manufacturer which is 480. Kata factor is regarded as a no of calories of heat released by 1 cm^2 surface area of the bulb during falling of temp^{re} from 38°C to 35°C.

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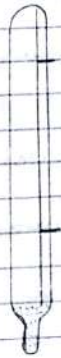
Cooling power (K) = $\frac{480}{\text{time taken in second during fall in temp}^{n} \text{ in } 38°C \text{ to } 35°C}$

It is called dry kata cooling power.

If the bulb of thermometer is covered with wet cotton cloth after taking out the thermometer from thermos filled with hot water. It is called wet bulb kata cooling power.

Here is a provision of maintaining cooling power in mines which is as follows:-

Nature of work	Dry kata	wet kata
(•) Sedentary work	6	18
(•) Light work	8	25
(•) Hard work	10	30



Alcohol thermometer :-

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Date

Method of improving cooling power of mine air.

Cooling power of mine air can be improved by watching the temperature humidity & pressure of air continuously in the mine. When the wet bulb temp of the mine exceed 30.5°C. The velocity of air should be kept not less than 1 m/sec. The water gauge of fan should always be monitored if a drop in water gauge occures the required modification in the fan should be done. The intake of mine should be arrange through the roadway in which there is no water drain or water dam exist.

Imp

Source of heat in mines :-

The major sources of heat in any u/g mines are as follows :-

(i) The heat given off by Strata.

(ii) Generation of heat in internal combustion engine running in mines.

(iii) By respiration of person employed in mines

(iv) Heat given off by human body

(v) Heat ~~en~~ evolved due to Spontaneous heating of ~~coal~~ coal.

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(vi) By mine fire if occurs in any part of the mine

(vii) By lamps used for lighting in mines.

(viii) By friction b/w rope & pully / rollers in haulage roadways.

(ix) Explosion in mine.

(x) The heat carried with atmospheric air.

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Natural Ventillation :-

Date 28/7/18

Air always flows from high pressure to low pressure point. It means that to start the ventillation in mines the pressure difference must be created b/w the 2 ends of the mines. If this pressure difference created naturally that ventillation is called natural ventillation and artifical ventillation the pressure difference is created by artifical means such as installing the mechanical ventilator.

As we known that higher density air has more pressure than the air having low density. It means that the change in density affects the pressure. So, the flow of air will take place from the point having high density air to the point low density air.

The following factors may be responsible to change the density :-

(i) Presence of fire damps.

(ii) Presence of fire near the pit bottom.

(iii) Steam introduced intentionally into the shaft

(iv) Difference in depth of shaft.

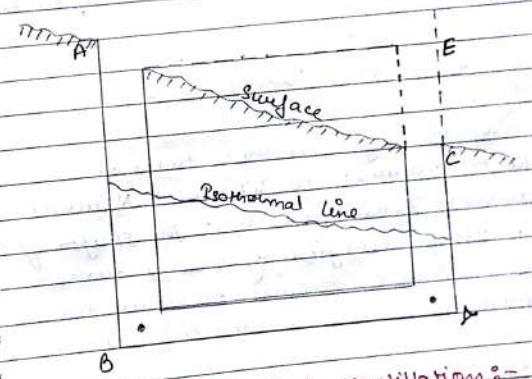
Spiral

Isothermal line is upto 15 m.

Date.....

Geothermic Gradient:-

The effect of atmospheric temperature on the earth crust is limited upto certain depth. Beyond that depth the temperature of earth crust is almost same. The line passing through the points of equal temperature of the strata rises at depth increase from the isothermal line at a constant rate which is called Geothermic gradient. It differes from place to place as for example:- In Jharia coal field the temperature increase by 1°C at every 33m depth. Where as in Kolhar coal field it is 68m and Rand Gold mine in South Africa is 140m.



Natural Ventilation:-

In fig there are 2 shafts AB & CD which are join by level roadway BD. The surface level of the shafts is different. So, the air pressure created in shaft AB

Spiral

Date.....

at point B is due to the air column AB where as in shaft CD the pressure creating air column is CD + EC. The air column EC will be highly effected by atmospheric temperature. In summer season the density of air column in shaft AB. So, the air ~~column in shaft AB. So~~ will flow from B toward D. Once the flow of air starts. It continous until the pressure difference is maintain. The shaft AB is called down cast shaft & CD is called up cast shaft.

In winter season the situation is reverse. The density of air in air column ED will ~~greater~~ greater than the air column AB. So, the dirn of air is change. Due to which the shaft CD acts as downcast shaft & AB as upcast shaft.

Limitation of Natural Ventillation:-

If the depth of the shaft is more than it is difficult to start natural ventillation. Natural Ventillation cannot take place b/w the shaft of equal depth. In the region of nearly same ~~climate~~ climate allover the year the Natural ventillation is some-weard difficult.

Motive column:-

The air column b/w two shafts has tendencies to balances each other if the air flows b/w them it's means that there is a part of air column in down cast shaft which has not been

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NVP = Natural ventillating pressure.

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balance by the air column of upcast shaft. This unbalance part of air column in downcast shaft is motive column. It is denoted 'h'.

$$\text{Motive column } (h) = \left(\frac{T_u - T_d}{T_u + 273}\right) \times \text{diff}^{n} \text{ in height of shaft}$$

where, T_u = Temp^{n} of upcast shaft

T_d = Temp^{n} of downcast shaft

$$\text{NVP} = \text{Motive column} \times \text{density of air in downcast shaft}$$

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ques) Mean air temp^{n} in DC shaft 400 m dip is 28°C and in UC shaft is 38°C. Calculate the motive column & NVP assuming avg. barometric pressure in DC shaft is 750 mm.

⇒ Given

$T_d = 28°C$

$T_u = 38°C$

depth = 400 m.

$$h = \left(\frac{38 - 28}{38 + 273}\right) \times 400$$

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$\Rightarrow \frac{10 \times 400}{311} = 12.86 \text{ m.}$

Density of air column in DC Shaft

$$= \frac{0.4645 \times B}{276 + Td.}$$

Where B = Barometer pressure.

$$= \frac{0.4645 \times 750}{276 + 28}$$

$$= \frac{348.375}{301}$$

$$= 1.15$$

NVP. = Motive column x density of air in DC shaft

$= 12.86 \times 1.15$
$= 14.789 \text{ kgf/m}^2$
$= 147.89 \text{ Pas.}$

Note :- Depth always in m.
Temperature in °C

$$\frac{F - {}^{\circ}C}{5} = \frac{f - 32}{9}$$

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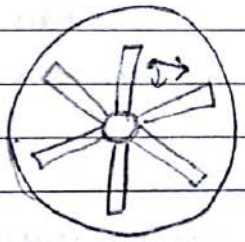
Artifical VENTILATION Date 29/7/18

Different types of fan use in mines :-

There are 2 main types of fan used in mines for ventilation these are centrifugal fan & axial flow fan. Other types of fans used in mines are booster fan, forcing fan & Exhaust fan which are basically axial flow fan or centrifugal fan.

Centrifugal fan :-

(•) Principle :- ~~Suppo~~. Suppose an air particle 'a' is colliding with the fan blade as shows in fig.



The tendency of blade is to drive the air particle in circular path but the air particle due to moment of interia tendency to move in straight line. So, the air particle ultimately follows the inter-meddiate path and left the fan casing tangential dirn. This process continously going on. So, vaccum is created at the centre of the fan wheel. The air rushes towards the fan centre to fill up the vaccum. This the principle on which

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centrifugal fan works.

construction of Centrifugal fan:-

This fan consist of a wheel on which the blades are provided. The blades may either we curved forward or backward. The backward blade fan is more common the wheel is attached to a shaft which rotated by a prime mover i.e by electronic induction motor. the speed of the fan is varying from 110 - 300 rpm.

The SIROCCO fan used in mines is very common types of centrifugal fan this fan has a cylindrical wheel on which blades can be attached in more than 1 stage. At single stage of the SIROCCO fan contains 64 blades. where as at second stage the no of blades are 128.

These fan produces high water gauge at low volumn.

(c) Installation of centrifugal fan:-

The centrifugal fan is install on a firm platform and provided with a special casing which incloses the fan wheel and prevent the re-entry of discharge air.

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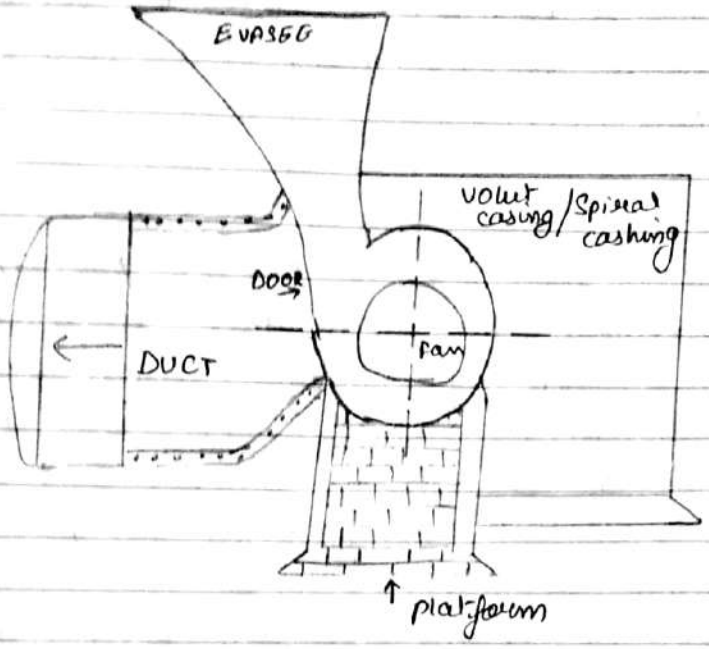
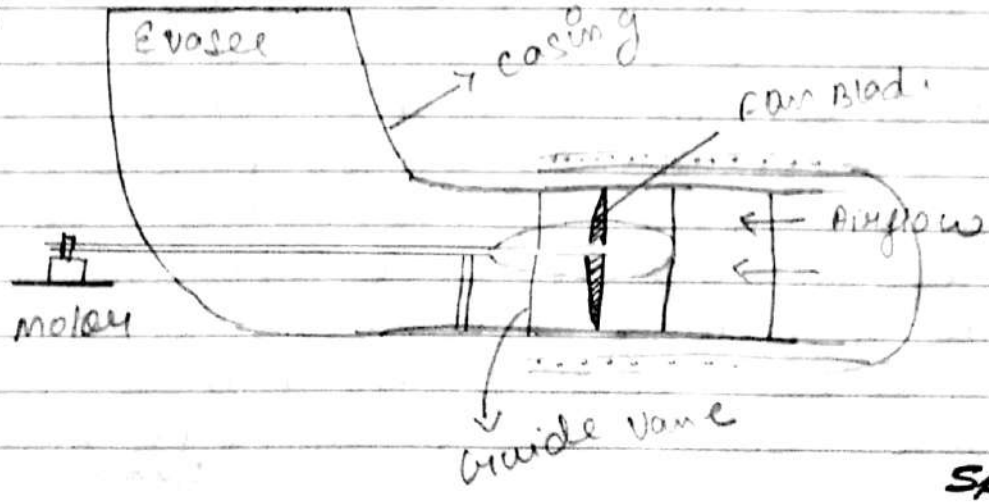


A passage of increasing cross sectional area is provided in fan duct which is called Evasee. When the air leaving the fan casing enters in evasee. Its velocity reduces due to increases cross sectional area. The velocity reduce is converted into pressure energy which reduce the power cost.

Axial Flow Fans -



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The axial flow fan the air moves in the dirn parallel to axis of the fan. So, it is called axial flow fan.

(*) Principle:-

The axial flow fan works on the principle of aero dynamics which is also the principle of aeroplane. This principle may be explain by assuming it a nut confined on a long bolt at its middle point if the nut is rotated it will not move from its place because it is totally confined. Consequently the nut will move forwarded if the dirn of rotation is reversed the Bolt will move backward dirn in axial flow fan the fan blade acts as nut and air as bolt. When blade moves the air moves in dirn of axis of fan.

Construction of axial flow fan:-

In axial flow fan there is a rotor which carry a no of blades and it revolves in a cylindrical casing. The casing is also provided with guide ~~vanes~~ vans. which are stationary the Blades of rotor are set at angle vary from $10^\circ - 15^\circ$ to the plane of rotation. This angle is also known as pitch. By varying the pitch of the blade the quantity of air can be vary but pressure will be almost same. Each set of rotors blades

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along with the satationary guide vanes from 1st stage. The water gauge develop can be increase by increasing the stage of the fan. The fan is driven The fan is driven by Synchronous induction motor.

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Exhaust & Forcing fan:-

In coal mines Exhaust fan is mostly used as main mechanical ventilator where as forcing fan is perffered in metal mines because the no of entries in metals mines is more than coal mines. By forcing fan is used to in coal mines. It help to compressed the inflamable gases so, it does not mixed with mine air. But when the fan the fan stopped due to any unavoidable reason the compressed air starts to come ing the gallery due to low air pressure and mixed with mine air to from a dangerous mixture.

The Exhaust fan install at upcast shaft doesnot required any air lock where as Incase of forcing fan air lock can not be avoided in DC shaft. Due to this the winding operation and communication through DC shaft become some how difficult. Air leakage also occurs through air lock which reduces the efficiency of ventilation.

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Purpose of Evasee & volute casing :-

*Evasee :-

Evasee is a gradually expanding duct ~~mouth~~ mean- for converting a part of kinetic energy in the air leaving the fan to usefull pressure energy. Evasee are generally attached to exhaust fan. They are fitted to the fan outlet. In order to reduce the velocity of air by increasing the cross sectional area of discharge. The increase in area should be gradual and symmetrical in order to minimum ~~sock~~ loss in the evasee. From this point of view a suitable angle of deivens of ~~at~~ the side of evasee. Angle of deivens is kept 6° to 7°. If the angle of deivens is small the length of the evasee will increase. due to which it construction cost increase. On the other hand if the angle of deivens increase it will increase the sock loss and consquently the efficiency of the fan will reduced.

(*) Volut Casing :-

Volut Casing is a fan casing which is usually provided with fixed guide vens. The guide vens convert the tangential compent of absoulet velocity of air leaving the impeller into pressure energy by straighting the dirn of the flow ~~to~~ an in an axial dirn.

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Reversal of air current :-

⇒ There is provision in CMR that the mechanical ventilator used in mines shall have provision of reversing the air to control the eventualities by fire in intake side of the mines. The dirⁿ of the air is first reversed. So that the entrance of fresh air in fire zone maybe checked. The axial flow fan is most suitable in which the dirⁿ of air can be reversed by just ~~to~~ reversing the dirⁿ of the fan.

Difference b/w axial flow fan & centrifugal fan

Axial flow fan	Centrifugal fan
(i) It required less space for installing	(i) Centrifugal fan requires more space in comparison of air screw fan.
(ii) Reversal of air can be achived by changing the dirⁿ of air rotation	(ii) Reversal of air is more difficult. The blades are required to be changed
(iii) It is very noisy because it runs at high speed i.e 4200 m/min.	(iii) It is less noisy because of its low ~~velocity~~ speed i.e. 300 rpm.
(iv) Manometric efficiency is low	(iv) Manometric efficiency is more

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(v) It is most suitable for low water guage and high volumn	(v) It is produces high water gauge at low volumn.
(vi) This fan can use as booster fan in u/g	(vi) It cannot be used as booster fan in u/g because it required large space to install.

* Difference/comperison b/w Exhaust Fan & Forcing Fan

Exhaust Fan	Forcing Fan.
(1) It sucks the air from the mine	(1) It forces the air in mine or roadways
(2) It deals with return air containing dust, fumes etc. So crossion is take place in there	(2) It always deals with fresh air so its life is long.
(3) It is install at up-cast shaft	(3) It is install at DC shaft
(4) It doesnot requires air lock except some case	(4) It always requires air lock to prevent the leakage of air

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Fans law

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~~some data of~~

Fans laws:-

The laws which relates the Quantity of air (Q) water gauge & Fan speed is called Fan law. Fanlaw ∞ is of 3 types states as :-

~~Fans~~

1st law :-
The Quantity of air in m³/sec vary directly wt fan speed i.e.

$$Q \propto N \propto V.$$

Where
N = RPM of the fan.
V = Peripheral speed of blades tips in m/sec.

2nd law :-
Water change develop by the fan ~~is~~ vary directly at square of fan speed or of Quantity of air. i.e.

$$wg \propto N^2 \propto v^2$$

3rd law :-
Horse power ~~(B.H.P)~~ drive the fan (B.H.P) vary as the ~~•~~ cube of the fan speed

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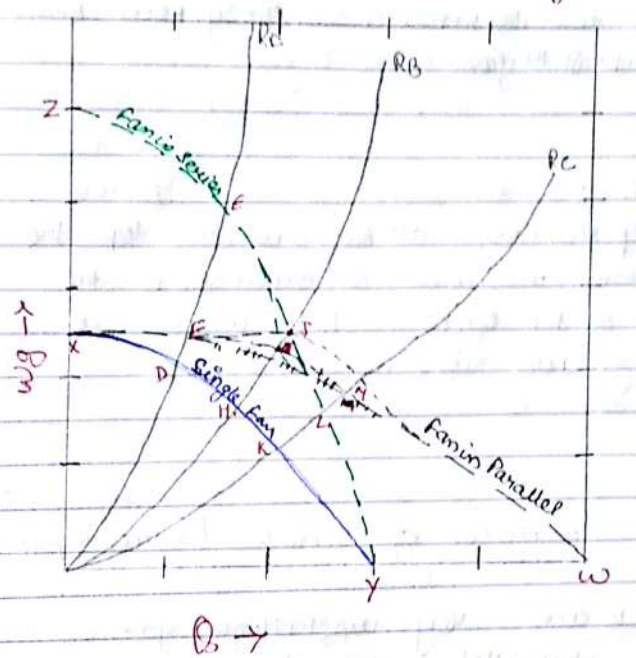
Fans in Series & Parallel :-

1) Characteristic Curves of Fan :-



Combination of Fans :-

All through the use of the single fan to meet the demand of pressure & quantity of the mine is the most efficient practices when the mine resistance is higher than what can be negotiated ~~sat~~ satisfactorily by a single fan. The second fan is install in series. But for increasing the quantity the second fan has to

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be install in parallel.

Fan in series:-
Each of fan in series circulates the same volumn of air as the systems, the pressure require to over come the resistance of the system being shared by both the fan.

Fan in Parallel:-
In Parallel operation all the fan develop the same pressure required to overcome the resistance of the system. But resultant volumn of air is increased.

~~The result~~

characteristic curves of fan:- (series & parallel)

The result obtain by installing fan in series or in parallel depends very greatly on characteristics of fan. ~~f~~ mine consult. as soon by curves.

Let us considered 2 identical fan running in series/parallel.

- XX - The characteristics curve of a single centrifugal fan

- ZY - The series characteristics curve of fan.

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- XW → The parallel characteristic of fan
- RA → Mine of high resistance.
- RB → Mine of Medium resistance.
- Rc → Mine of low resistance.

The series characteristic (=Y) shows that the pressure generated by 2 fans in series for any given Quantity of air flowing is same that for same the same air flow through single fan.

The parallel characteristic (XW) shows that the quantity of air flow with 2 fans in parallel is twice that for same pressure with a single fan.

It is seen that with a single fan the operating point is at D in case of RA, H in in RB, K in Rc.

When fans are parallel in mine RA the operating point moves from D to F showing the water gauge develop & Quantity flowing are almost same. In mine RB operating point moves from H. to J exactly as in series case so that same result will be obtain by both combination

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of the fan. In mine Rc the operating point moves from K to M showing that there is a minor increase in water gauge by the volumn increase by 50%.

When the fan in series the delivery of air in the mine is given by intersection of series fan characteristic (ZY) with characteristics consult. In mine RA the operating point of the fan moves from D to E which shows that the water gauge develop by the two fan is about 1.8 time that of a single fan where as the volumn is increase nominally (लगभग). In mine RB the operating point moves from H to I which shows that water gauge develop is about 1.35 time that of a single fan. And quantity of air is increase by less than 20%.

In Mine RC the operating point moves from K to L which shows that negligible change in pressure & quantity

~~# Characteristic~~

~~Characteristic~~ →

Characteristic curves of Fan :-

The characteristic curves is a curves which shows that how the manginitude of one quantity varies with

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∴ Prime mover mtlb wo jo pankhe ko chala rha hai :- Jaise motor ek prime mover hai.

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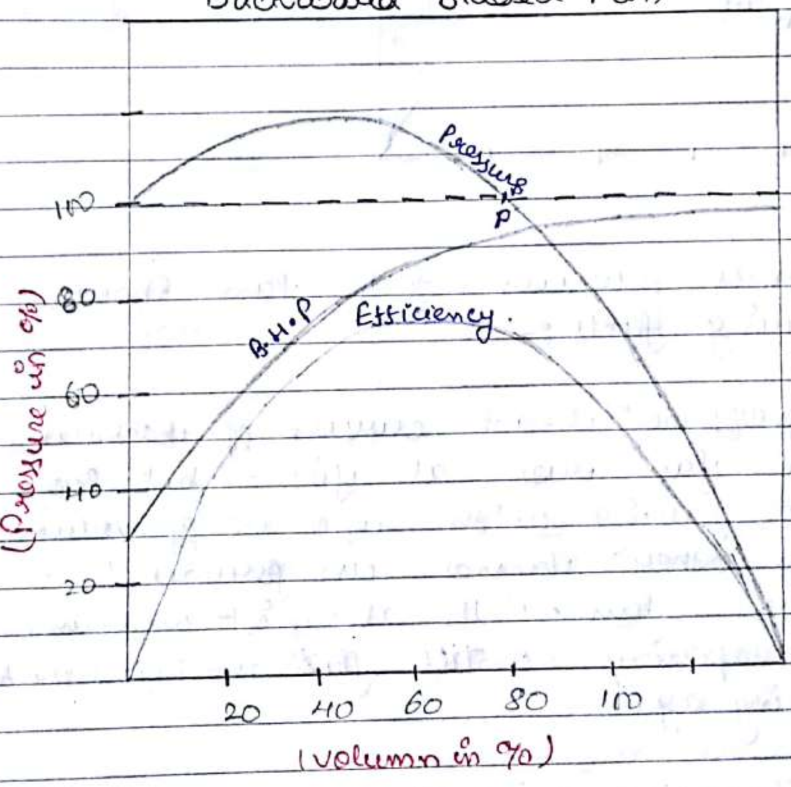
Change in some other related Quantity. In the cases of a fan for every speed. A set of curves can be drawn to show the variation in pressure break Horse power (B.H.P) of prime mover & mechanical efficiency of the fan. The curves are indicatives of the performance of the fan. Sometime the term fan characteristics is use to denote the P-V curve.

Backward Bladed Fan.



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...delivery of ... by intersection ... Z Y) with ...ine RA the ...ves from D to E. ... gauge develop ... time that of ...lumn will increase ...ine RB the ... to J which ...lop is about ... the Quantity ...an 20%. ... & point moves ... that ... ... & Quantity

Fan :-

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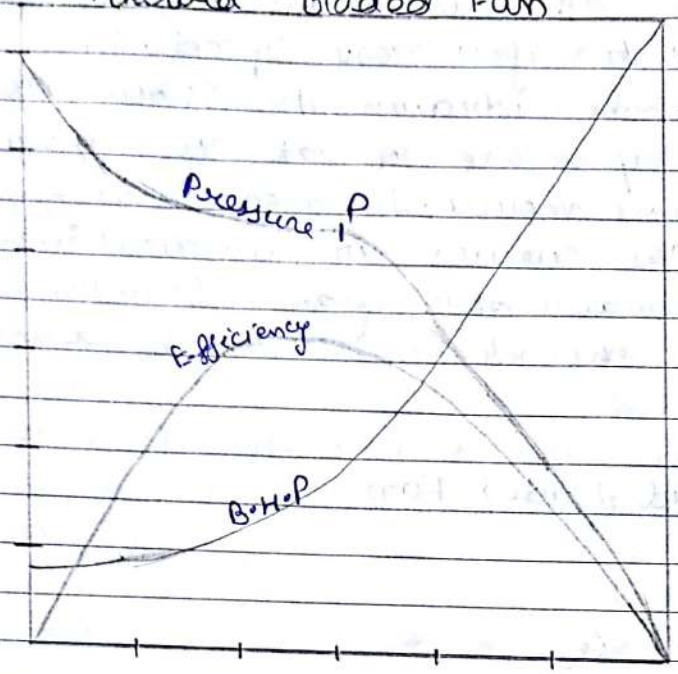
Forward Bladed Fan



The characteristics curves of the fan shows the following facts :-

① The pressure or head curves of backward bladed fan rise at first but soon starts falling with increase of volume on the other hand in forward bladed fan. Falls at first with increase in capacity until flattens before starting falling again

The Operation point (P) should be fixed to right of point P because at capacity less than this these the performance of the fan become unstable and fluctuation of air velocity characterise by

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throbbing (to log ~~sta~~ ta hai ki chill raha hai) and raise the efficiency characteristic of all centrifugal fan are usally with a flat ~~prac~~ peads. Good efficiency ~~its~~ ~~ma~~ will be maintain over wide range of the operation.

Manometric efficiency (η_{man}) :-

It is the ratio of the actual total head (water gauge) to theoretical head.

$$\eta_{man} = \frac{H}{He}$$

Where,

H = effective water gauge/head/total pressure.

He = theoretical head.

Manometric efficiency may also be expressed as the ratio b/w the effective water gauge & theoritical water gauge produce by the fan with same dimension and ~~same~~ running at same speed.

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Over all efficiency

Fan can never give out as much useful work as is put into it. And ratio of power output & power input is always less than one. The useful power output of the fan is termed as "H.P in air" while input power given to the fan shaft / driving engine / motor known "Break horse power (B.H.P)". The ratio air in H.P to B.H.P is called over all efficiency of the fan.

Theoretical depression :-

It is pressure difference that would be produced by a mechanically perfect fan running under ideal condition and connected an evacuated of infinite height. Its value is calculate one & depends on the speed of blades tip and shapes of the fan blades. And its vary as square of the speed.

The theoretical depression of a centrifugal fan is given by following formula

$$H = \frac{U(U \pm V_1 \cot\theta)}{g}$$

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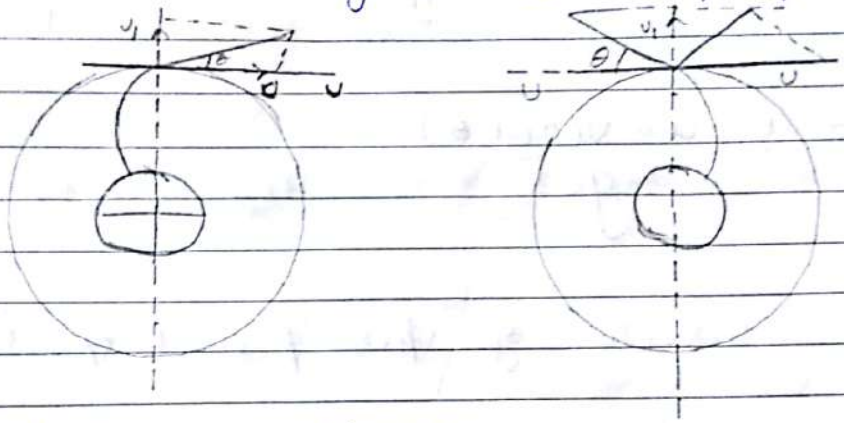
where,

U = Peripheral speed of the fan in m/s

V_1 = Radial velocity of air leaving the fan in m/sec

θ = External angle b/w the fan blade and tangent at the periphery.



Unit = mm of wg.

'+' sign is used for forward bladed fan

'-' sign is used for backward bladed fan

In case of radial blade $\theta = 90°$ so.

$$\left[H = \frac{U^2}{g} \right]$$

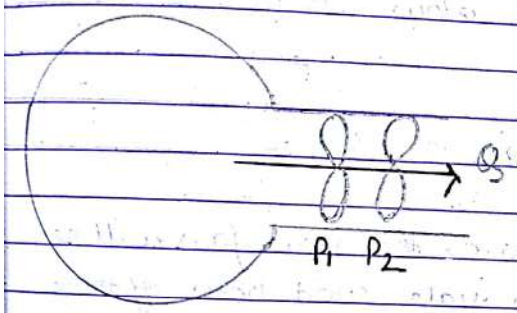
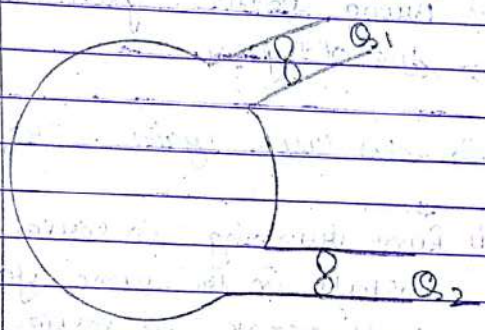
It is also applicable for axial flow fan

Spiral

(5) ~~when~~ When RIM desire.

(6) Moreover there is any increase in make of gas ventilation survey is necessary.

Fan in Series & Parallel:-

Fan in Series	Fan in Parallel
	
Same Quantity flows through both the fans	Quantity add up i.e. $Q = Q_1 + Q_2$
Pressure add up $P = P_1 + P_2$	Pressure remains same.
Recommended when mine resistance is high	Recommended when mine resistance is low.

Ans

During the preparation of project reported mine fan shall be so, recommended that it remain fit for the whole year the mine.

If not there are 2 solution:-

(1) Replace the old fan by new, however this costly & time taking.

(2) Bring another fan and allow it to work with the old fan.

In this case, again there are 2 option:-

(i) Fans running in series, i.e. the new fan will be install in the same fan rate and both of them will work in series. In this case pressure of the fan add up. Increase Quantity flows both fan. This system is recommended when mine resistance is high.

(ii) Other method is to install fan are in parallel. In this case a new fan might have to constructed for installation of the new fan.

In this mine air Quantity will be addition of both the fan quantity.

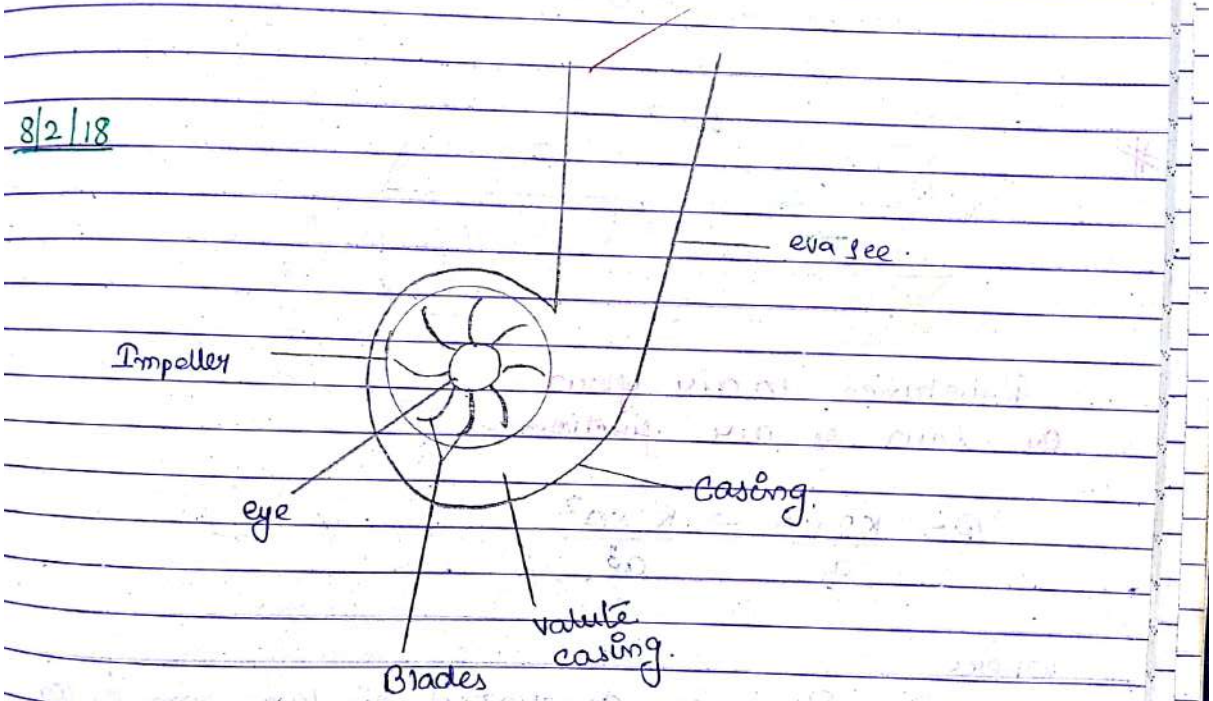
Pressure will remain same however the

System is recommended when more resistance is low.

Note :-

Quantity increase will be √2 times of old Quantity i.e. roughly 1.5 times

8/2/18

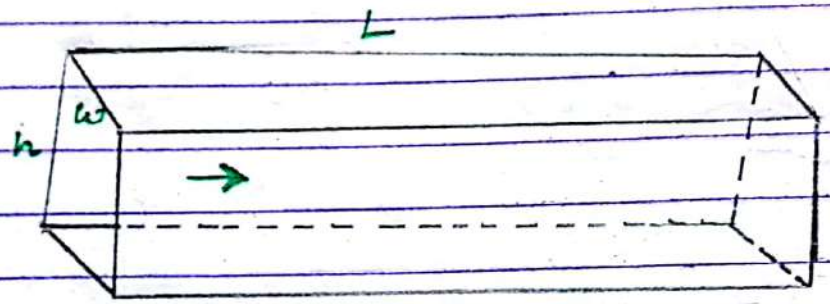


Volute casing :-

In centrifugal fan the casing is so design that the crossection of the space beyond the impellar gradually increase.

The purpose this the air velocity coming out the impeller gradually decease. This decrease of velocity increase the water gauge of the fan. Because of this water gauge of fan increase and electric bill reduces.

Note:-
No volute casing in case of axial flow fan.



Resistance to air flow
or Law of air friction:-

$$P = \frac{KS v^2}{a} = \frac{K S Q^2}{a^3}$$

where

P = Pressure generated by fan, mm of wg
S = Rubbing Surface, $m^2 = 2(h+w)L$
Q = Quantity of air flow in m^3/s.
V = velocity of air flow in m/s.
a = Area of crosssec^n of gallery m^2.
K = co. eff of air friction 0.001

$a = w \times h$

Ques A stone drift 200 m long and 3m x 2m in cross section is passing 50 m³/sec of air. Calculate the pressure required for this air to flow. Assuming co-eff of air friction is 0.0025.

⇒ $S = 2(3+2) \times 200$

$= 10 \times 200 = 2000\ m^2$

$Q = 50\ m^3/s$

$K = 0.0025$

$a = 6$

$$P = \frac{0.0025 \times 2000 \times 50 \times 50}{10000 \times 6 \times 6 \times 6^3}$$

$$= \frac{25 \times 5 \times 50}{108} = \frac{6250}{108} = 57.87\ mm\ of\ wg$$

$$\# P = \frac{KSV^2}{a} = \boxed{\frac{KS}{a^3}} Q^2$$

R.

$P = RQ^2$

P = Pressure in mm of wg

Q = Quantity of air flow in m^3/s.

R = Resistance of mine.

Ques) A Quantity of air flowing through a mine is 900 m³/min. water gauge develop by the fan 22.5 mm. Calculate the resistance of the mine.

$\Rightarrow$ $Q = 900 \text{ m}^3/\text{min}$

$= \frac{900}{60} = 15 \text{ m}^3/\text{sec}.$

$P = 22.5$ mm of wg.

$P = RQ^2$

$22.5 = R\,(15)^2$

$\frac{22.5}{225} = R$

$0.1 = R.$

$R = 0.1$

Laws of Mine air friction :-

Laws.

① Pressure $\propto$ Rubbing surface (S)

② Pressure $\propto$ V^2 (velocity Square)

③ Pressure $\propto \frac{1}{a}$ (a = area of crossection)

④ Pressure ∝ K (co-efficient of friction)

Combining all these we get

$$P = \frac{K S v^2}{a}$$

This equⁿ is also known as Atkinson's equation

The general P is expressed in Pascal.

(1 mm of wg = 9 pascal = 9.8 pascal)

K is co-efficient of friction the unit of this is Kg/m^3 or $Ns^2 m^{-4}$.

S is the area of rubbing surface in m^2

v = velocity of air in m/s.

a = Area of crossection of air wave.

NOTE

Another form Atkinson equation is

$$P = \frac{K S Q^2}{a^3}$$

Ques) Calculate the pressure required for ventilating a drift 2.5 m high. 3 m wide and 300 m long for flow of air 300 m^3/min. CO-efficient of Resistance is 0.001 $N s^2 m^{-4}$.

$\Rightarrow$ $S = 2(2.5 + 3) \times 300$

$= 11 \times 300$

$= 3300$

$a = 7.5$

$K = 0.001$

$Q = 300\ m^3/min = \frac{300}{60} = 5\ m^3/sec.$

$P = \frac{KSQ^2}{a^3}$

$= \frac{0.001 \times 3300 \times 5 \times 5}{7.5 \times 7.5 \times 7.5}$

$= \frac{82.5}{421.875} = 0.195$

$P = R Q^2$

P — Pressure; R — Resistance; Q — Quantity.

Pa	Kauss Ns^2m^{-4}	m^3/s	(SI Unit)
mm	Weisbach (Wb)	m^3/s.	(MKS Unit)

Ques) A mine only one district of 500 m length. Size of roadways 4.3 m x 2.7 m air velocity 320 m/min Calculate the pressure is $K = 0.001\ Ns^2m^{-4}$.

$V = 320\ m/min = \frac{320}{60} = 5.33\ m/sec.$

$a = 11.61$

$S = 2(4.3 + 2.7) \times 500.$

$= 2 \times 7 \times 500.$

$= 7000$

$P = \frac{0.001 \times 7000 \times 5.33 \times 5.33}{11.61}$

$= \frac{7 \times 5.33 \times 5.33}{11.61} = \frac{198.623}{11.61} = 17.128$ pascal

Ques) In a mine pressure develop by fan is 40 mm of wg resistance of mine is 0.156. Calculate the quantity of air flow.

$\Rightarrow$ $P = RQ^2$

$40 = 0.156 \times Q^2$

$\sqrt{\frac{40}{0.156}} = Q$

$\sqrt{256.41} = 16.01 \ m^3/s.$

Ques) In a mine total resistance is 0.01 Ns²/m⁸ Quantity of air flow is 3400 m³/min. Calculate the pressure required for that air flow in the mine.

$\Rightarrow$ $R = 0.01$

$Q = 3400 \ m^3/min = \frac{3400}{60} = 56.66 \ m^3/s$

$P = R \cdot Q^2$

$= 0.01 \times 3210.35$

$= 32.11$ mm of wg.

[(*) Q = V × cross section]

Ques) The velocity of air 6m diameter down cast shaft (DC shaft) 300 m deep 4m/s. Calculate assuming 0.001 $Ns^2 m^{-4}$.

(a) Quantity of air entry in mine per min.

=>

$S = \pi r^2$

$S = \frac{22}{7} \times 9$.

$= 28.28$

$V = 4 m/sec$

$a = \pi r^2$

$= 3.14 \times (3)^2 = 28.26 m^2$

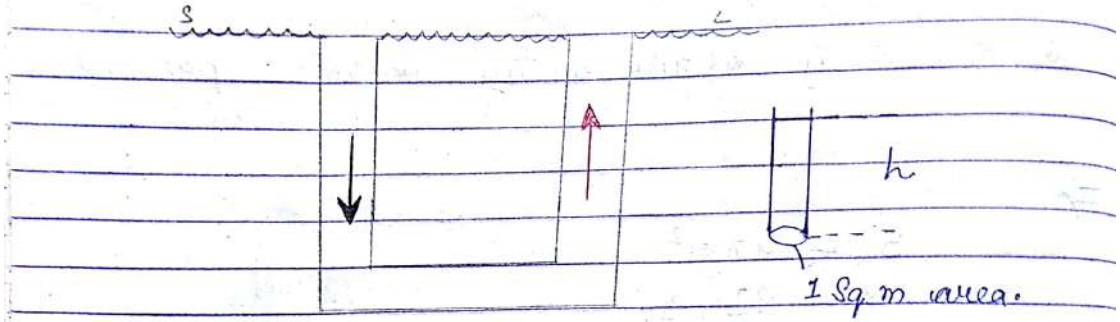
$\therefore \quad V = \frac{Q}{a}$

$Q = Va$

$= 4 \times 28.26 = 113.04 m^3/sec$ Ans

12/02/18

MOTIVE COLUMN:-



It is the height of intake air over 1 sq m cross section which gives the same pressure equal to the pressure of intake pit bottom & returns pit bottom.

$$\text{MOTIVE COLUMN} = h = \frac{Cu - Cd}{273 + Cu} \times D.$$

where

Cu = Mean temperature of UC shaft in °C
cd = Mean temperature of DC shaft in °C.
D = Depth of the largest shaft in m
h = Motive column.

ques If the mean temp of UC shaft is 26.5°C and that of DC shaft is 15°C. What is the height of mercury column the depth of shaft 730 m.

⇒ $C_u = 26.5°C$

$D = 730\ m.$

$C_{el} = 15°C$

$$h = \frac{26.5^\circ - 15^\circ}{273 + 26.5^\circ} \times 730$$

$$= \frac{11.5}{299.5} \times 730$$

$$= 28.03\ m.$$

Geo thermic Gradient :-

If we go below the Earth surface temp remain constant upto 15 m depth. There after it is increase 1°C per 40 m depth.

However this various from place to place.

Indian coal field 1°C per 38.4 m.

Kolar coal field 1°C per 91 m

Ques) Calculate the temp at the depth of 1200 m from the surface due to heat from strata only assumming avg. surface temperature as 15°C and Geothermic gradient 1° per 40m. for east coal field.

Ans) Surface temper = 15°.

depth = 1200 m.

Gradient = 1° per 40 m.

∴ After 1200 m = 15
+30
45°C

Ques) The surface temperature at KGF is at present 40°C the depth champion vijf mine is 3000 m. Calculate the temperature of stop. Geothermic gradient of KGF is 1°C per 90 m.

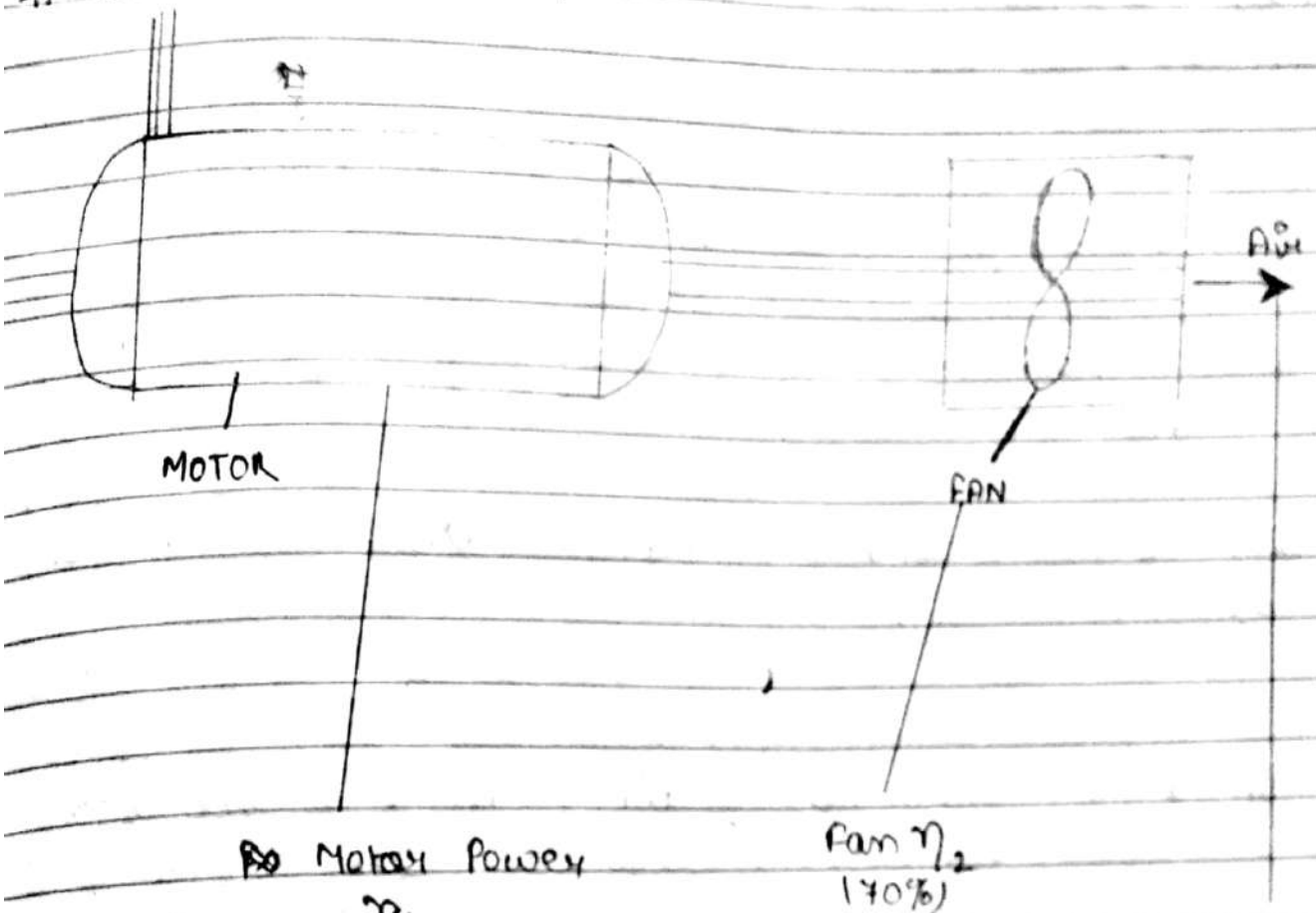
⇒ Surface temperature = 40°

increase 1°C at every 33 m.

∴ stopping temperature = 40
+33
73°C

* If we move left to right we multiply
* If we move right to left we divide

OVERALL EFFICIENCY :-



Overall efficiency $\eta = \eta_1 \times \eta_2$

Air Power
$= \frac{PQ}{60 \times 102}$ KW.

where
P = Pressure in mm of wg
Q = Quantity of air flowing in cubic meter per min.

Over all efficiency of the ventilation system is given by the above statement.

(1) Motor get 100% from the supply system. It consume something power to the fan.

(2) Again fan consume something given power to the air.

(3) Air power is given by the formula as mention above.

Ques In a mine Quantity of air flowing is 600 m³/min. the motor efficiency is 90% and fan efficiency 70%. Calculate the motor power fan develop a pressure of 100 mm of wg.

=> Air power $= \frac{100 \times 600}{60 \times 102}$ (10)

$= \frac{1000}{102} = 9.80$ Kw.

% fan power $= \frac{100}{70} \times 9.8$

$= 14$ Kw.

% motor power $= \frac{100}{90} \times 9.8 = 15.55$

ques) In a ventilation system of a mine of motor power is 100 KW. its efficiency is 90%. Fan efficiency 70%, calculate the air power.

η_1 = 100 KW.

$\eta_2 = \eta_1 \times 90\%$

$= 100 \times \frac{90}{100}$

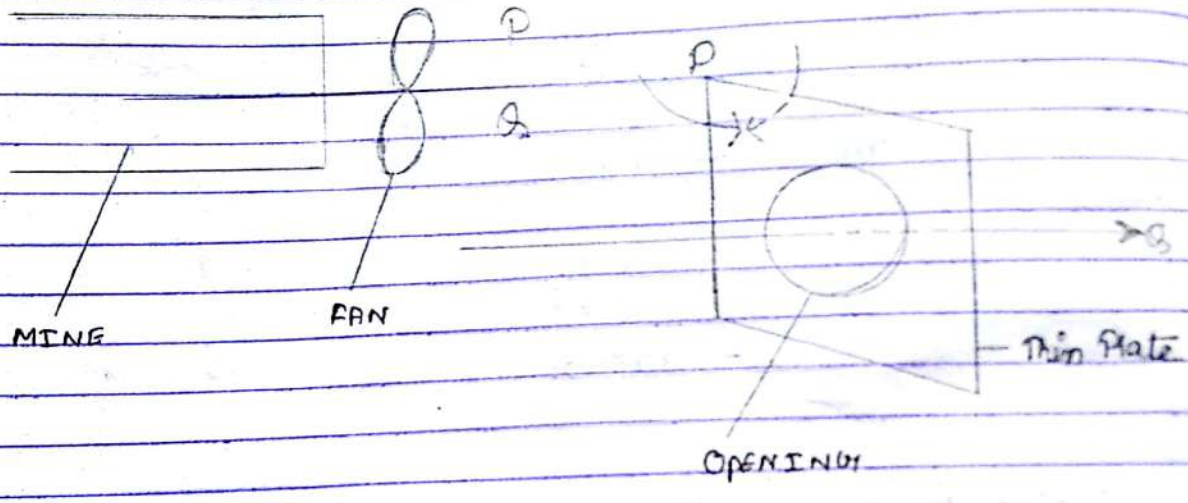
$= 90$ KW

Air power $= 90 \times \frac{70}{100}$

$= 63$ KW.

13/02/2018

EQUIVALENT ORIFICE OF A MINE:-



⇒ let us assumed that through a mine Quantity of air Q is flowing at a pressure of P.

Now take thin Plate in the laboratory, make a cutting in a thin plate apply a pressure difference P plus both the side of thin plate. Some Quantity of air will flow through the opening change the size of the opening.

A time will come when quantity Q which is equal to mine air Quantity will flow. At this stage the area of the opening is known as the equivalent orifice of the mine.

(x) Purpose :-

The purpose is to compare the resistance of different mine

(x) Formula :-

$$\text{Equt orifice} = a = \frac{0.385\ Q}{\sqrt{P}} \quad \text{(In MKS Unit)}$$

Where

Q = Quantity of air flowing in cubic meter per sec.

P = Pressure in mm of wg.

Ques) At the certain colliery the volumn of air flowing is 9200 m^3/min and yan drift wg is 101.7 mm Calculate the equt. of orifice?

$$\Rightarrow Q = 9200\ m^3/min = \frac{9200}{60} = 153.33\ m^3/sec.$$

$$P = 101.7\ mm\ of\ wg.$$

$$\therefore a = \frac{0.385 \times 153.33}{\sqrt{101.7}} = \frac{59.03}{10.06} = 5.86\ m^2$$

13)

(*) In SI Unit Formula:-

Equt. Orifice (m^2) $= a = \frac{1.19\,Q}{\sqrt{P}}$

Where

$a = m^2$

$Q = m^3/sec$

$P =$ Pascal

[1 mm of wg = 9 pascal = 9.8 pascal]

Ques) 15 m^3/sec of air pass through a roadway when pressure across it 50 mm of wg. Calculate the area of equt orifice.

$\Rightarrow Q = 15\ m^3/sec$

$P = 50$ mm of wg.

1 mm of wg = 9.8 Pascal.

$\therefore$ 50 mm of wg $= 9.8 \times 50 = 490$

$= \frac{1.19 \times 15}{\sqrt{490}} = \frac{17.85}{22.13} = 0.80\ m^2$

Ques) Quantity

when th

Calculat

$\Rightarrow Q = 150$

$a =$

MANOME

It is

depress

pres

m

Pa

wher

H =

g

v

Q(es) Quantity of air flow through split is 1500 m3/min when the ventilating pressure was 600 pascal. Calculate the area of equivalent orifice

$\Rightarrow Q = 1500\ m^3/min = \frac{1500}{60} = 25\ m^3/sec.$

$a = \frac{1.19 \times 25}{\sqrt{600}} = \frac{29.75}{24.49} = 1.215\ m^2$

MANOMETRIC EFFICIENCY OF A FAN:-

It is the ratio of actual depression and Theoretical depression. This means it is a ratio of actual wg produces by a fan to the theoretical wg that may be produce.

This is given by the formula.

$$\text{Manometric } \eta = \frac{H \times g}{v^2}$$

Where

H = actual depression produce in m of air column.

$g = 9.81\ m/sec^2$.

v = Tangential speed of blade in m/sec.

Ques) A centrifugal fan 6 m in diameter is running at 96 rpm and developing 73 mm of wg. Calculate manometric efficiency of the fan assuming weight of air 1.2354 Kg/m³.

$$\Rightarrow V = \frac{96 \times 3 \times 2 \times \pi}{60} = 30.15$$

Monometric efficiency $= \frac{H \times g}{V^2}$

$$= \frac{73 \times 9.81}{30.15 \times 30.15}$$

Tangential speed of fan = Tangential speed of blade

$$= \pi \times 6 \times \frac{96}{60} = 30.15$$

Monometric efficiency $= \frac{H \times g}{V^2}$

$$= \frac{59.12 \times 9.81}{(30.15)^2}$$

$$= \frac{59.12 \times 9.81}{909.02}$$

$$= 0.63$$

$$H = \frac{73}{1.2354} = 59.12$$

(*) Theoretical Depressions-

Theoritical depression produce by the fan is given by

$$T = \frac{V^2}{g} \text{ m of air column.}$$

Where

V = Tangential speed of the tip of the blade in m/sec

$g = 9.8$

Unit = m of air column.

This also equal to $\frac{w \times v^2}{g}$

Where

w = is the weight 1 cubic meter of air in kg

Unit = mm of wg.

Law Of Air Flow In Mines:-

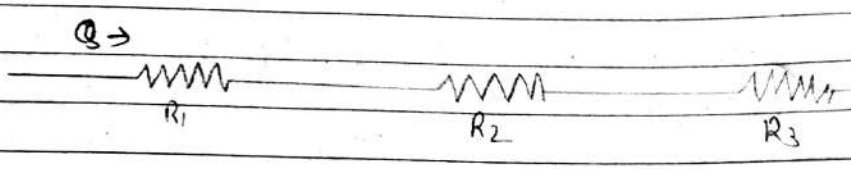
This given $P = RQ^2$

Where

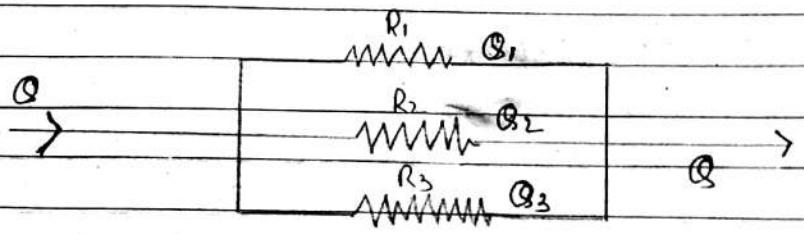
P = Pressure in mm of wg.

R = Resistance of mb

Q = Quantity of air flow in cubic metes / sec.



$R = R_1 + R_2 + R_3$ Series



$$\frac{1}{\sqrt{R}} = \frac{1}{\sqrt{R_1}} + \frac{1}{\sqrt{R_2}} + \frac{1}{\sqrt{R_3}}$$

Ques In a mine
1,489 cub
what is
mine.

⇒ R = 1+
P = 15

Ques In a
mb th
Calcul

⇒ P = R
100 =
Q1
Q2

Ques In a mine there 3 splits in series with resistance 1, 4 & 9 units if fan produces 100 mm of wg. What is the quantity of air flowing in the mine.

$\Rightarrow$ $R = 1+4+9 = 14$ units

$P = 100$ mm of wg

$$Q = \sqrt{\frac{P}{R}}$$

$$Q = \sqrt{\frac{100}{14}}$$

$$Q = \sqrt{7.14}$$

$$= 2.672 \ m^3/sec$$

Ques In a mine 3 splits in parallel having resistance 1, 4 & 9 units the water gauge produce by the fan is 100 mm. Calculate the quantity of air flowing in each split.

$\Rightarrow$ $P = RQ^2$

$100 = 1 Q_1^2$

$Q_1 = 10 \ m^3/sec$

$$Q_2 = \sqrt{\frac{100}{4}} = 5 \ m^3/sec$$

$$Q_3 = \sqrt{\frac{100}{9}} = \sqrt{11.11} = 3.33 \text{ m}^3/\text{sec}$$

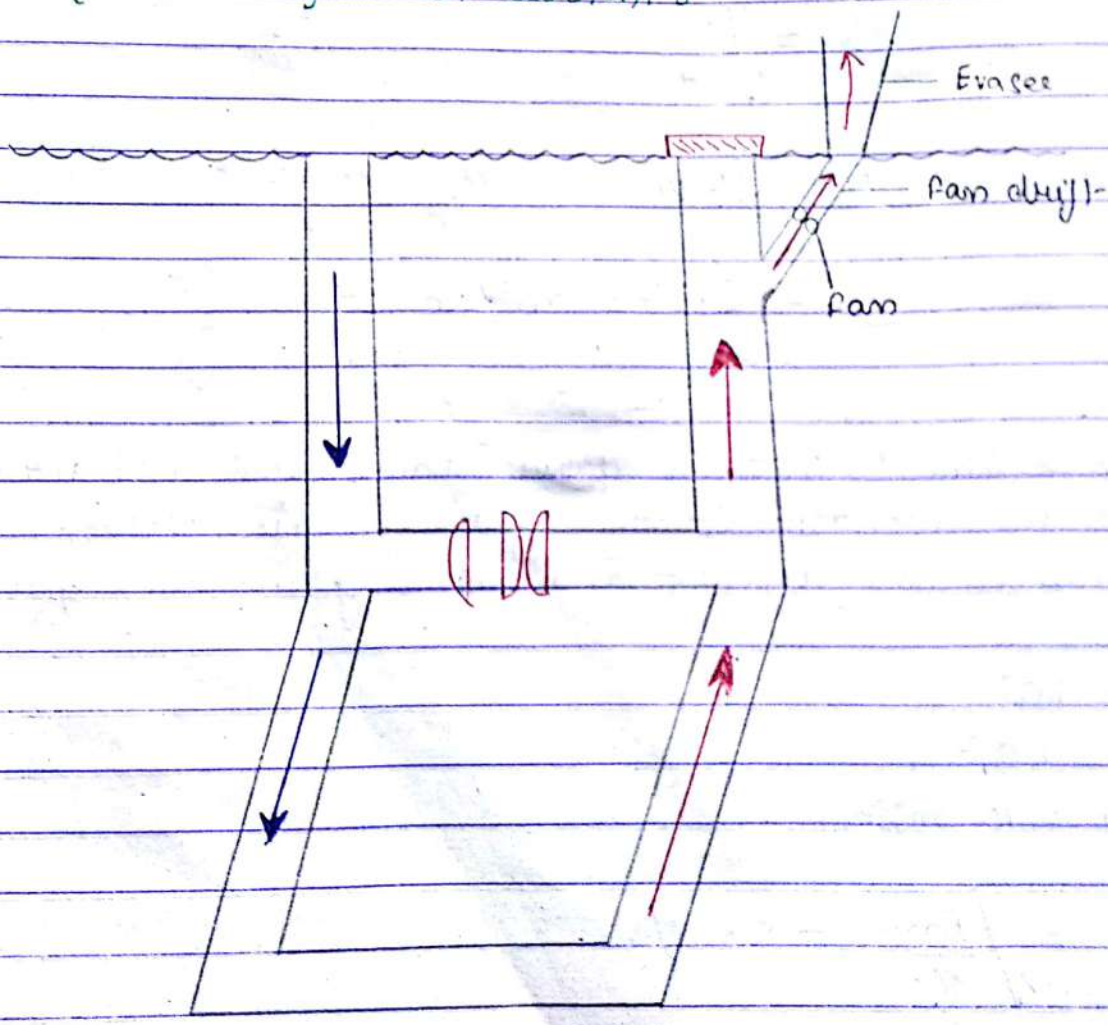
Total Quantity $= Q_1 + Q_2 + Q_3$

$= 10 + 5 + 3.33$

$= 18.33 \text{ m}^3/\text{sec}$.

14/02/2018

Reversal Of air currents:-



Fire in the ...

⇒ In general ... less than ... fan sucke... in a opposi... mine air ... pressure.

Normally ...

If the ... true ... known ...

(*) Reverse ...

① Suction ... dange... pressu... work...

② The ... flow...

③ Over... fa...

④ Affi... wi...

Fire in there than we use forcing fan.

⇒ In general the air pressure inside the mine is less than the atmospheric pressure. This is because the fan sucke the air from the mine if the fan rotated in a opposite dirn this will give pressure to the mine air pressure will more than atmospheric pressure.

Normally the fan sucke the air from the mine

If the fan is rotated in a opposite dirn. It gives the pressure inside the mine. This operation is known as reversal of air current

(*) Reversal of air current has following disadvantage:-

(1) Suction ventilation become pressure ventilation which is dangerous because when the fan will stop the ~~pressur~~ pressured gas from the goaf will come to the mine working.

(2) The advantage of suction system will become nil ~~from 75% to 35%~~. when it reverse.

(3) Overall efficiency of the ventilation system will fall from 75% to 35%.

(4) After reversed the single if any will open and there will no ventilation in the district this will cause the

of explosion.

(5) There will drastic reductions of air velocity.

(6) Chance of fire will increase.

(7) The total ventilation system will be badly effected.

Refference is MS-4 Page NO - 200.

METHANOMETER :-

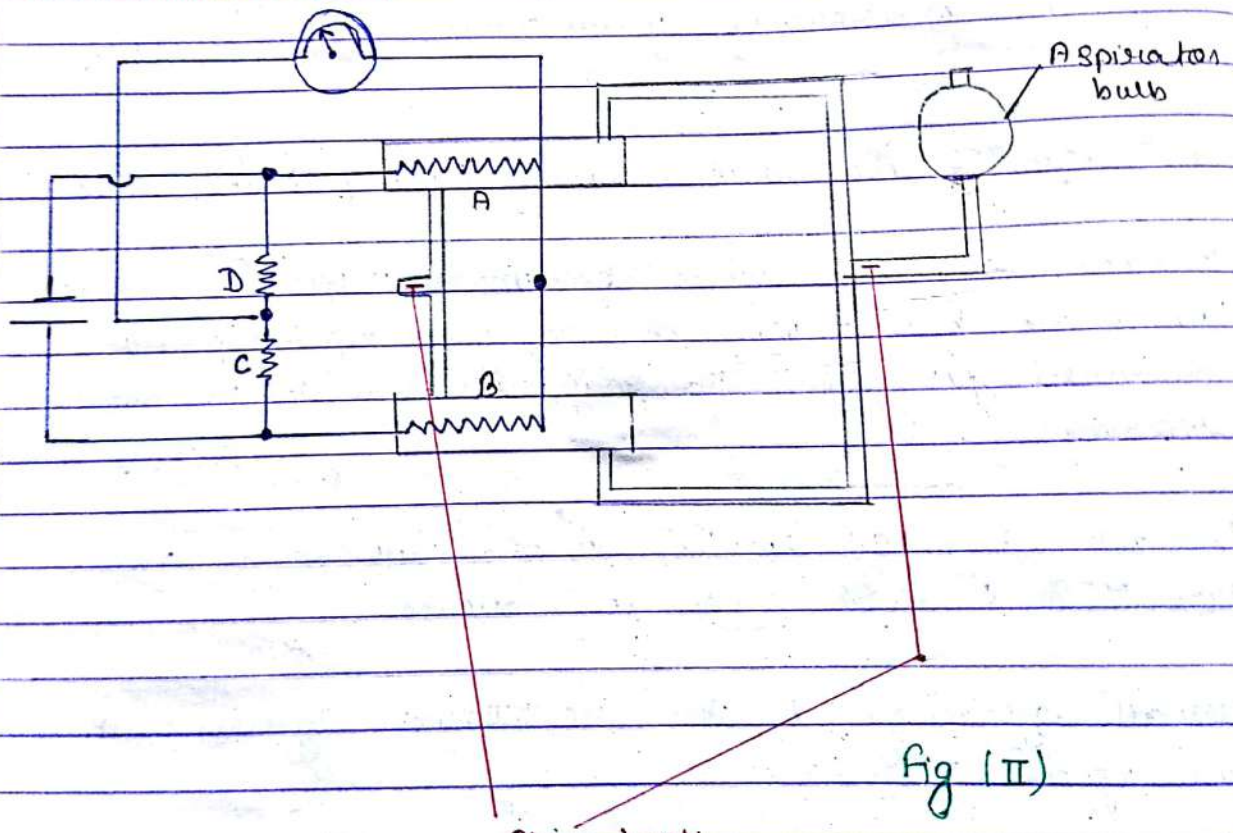


fig (II)

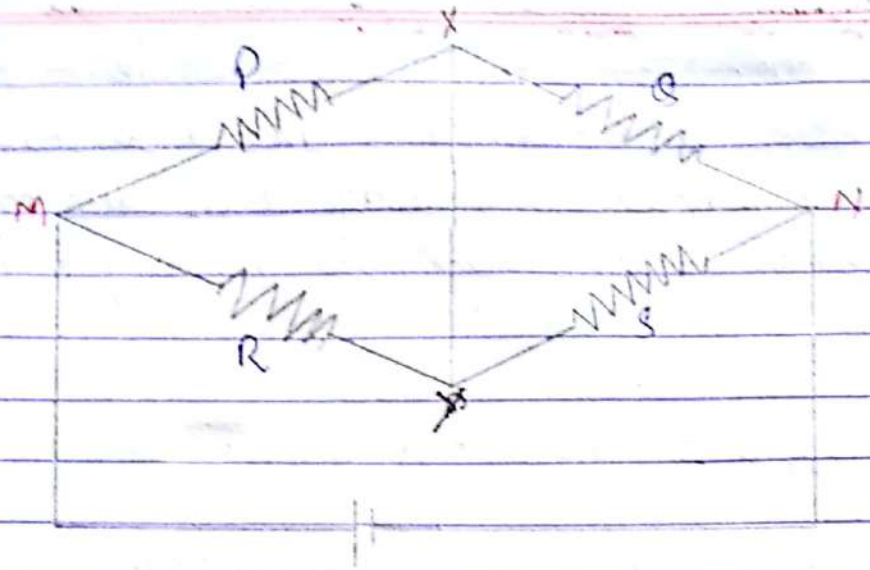


Fig (II)

Principle Of METHANOMETER :-

Methanometer works on wheat stone bridge

In wheat stone bridge there are four resistance. There in the form of Quadilateral. If the resistance are P, Q, R & S and if certain voltage apply in b/w function MN. There will current flow in all the resistance But if $\frac{P}{Q} = \frac{R}{S}$ or $\frac{P}{S} = \frac{Q}{S}$ there will be no current flow b/w function XY.

If there is a distrubation in the value of any resistance there will some current flowing b/w XY.

⇒ In Fig(II) the disposition of different element of the methanometer is shown. There are 4 resistance A, B, C, & D in wheat stone bridge A & B are coiled in chamber A is activitated for burning methane B is not

Similarly C & D are also not activitate.

There is an aspirator bulb provided with the Methemeter when the bulb is squizzed mine air containing Methane enters into the chamber of A & B.

A is activitate so CH_4 burne here resistance of A increase. In balance current b/w the junction of C & AB pass through indicator more the methane, more is the rise of temperature & more is the unbalance current.

This is indicate in the indicator as % of methane

MSA-D6 methanometer is very popular. Over Weight is about 0.47 Kg. It is provide with probe for sucking mine air from upper head.

Note :-

There are 2 types of Methanometer

(1) Measurement of Methane % upto 5% & other upto 100%

Note :-

(1) In the wire back arrester mine atmos

(2) Methanomet one year. months

(3) Methane is not

(4) Shot fi IS th current

Special are:-

(1) Ro he

(2) clere

(3) Soli

(4) Me

(5) Auto

Note :-

(1) In the instrument there are 2 Number flash back arrester. These prevent not air to come to mine atmosphere for presence of explosion.

(2) Methanometer are to be calibration atleast in one year. ~~However~~ However this should be 4 in 6 months or even 3 months.

(3) Methanometer FLP (Flame proof) apparatus is not IS (Intrinsically set)

(4) Shot giving apparatus FLP is neither FLP nor IS this because voltage much more than 50V. Current more 1.5A.

Special feature for avoid danger in exploder are:-

(1) Robest constructions

(2) detected Key

(3) Solid state mothers board.

(4) Metering devices

(5) Automatic power cut after 4 milli second.