



ENGINEERING BULLETIN

Vol.32 No. 03

The Institution of Certificated Mechanical and Electrical Engineers South Africa SEPTEMBER 2023

MISSION STATEMENT: 1. To uphold the image and status of the Certificated Engineer. 2. To represent the Certificated Engineer at ECSA and other decision-making bodies concerning legislation, safety & health standards, the environment and the machinery regulations. 3. To promote continued education and training of its members and future engineers. 4. To promote fellowship in the engineering profession.

EDITORIAL

Welcome to the latest edition of the ICMEESA News Bulletin

We present our third quarterly news Bulletin of 2023.

I once again appeal to members who have not as yet paid their 2023 membership fees, to do so before the end of October 2023. THANK YOU!

Unfortunately we had to cancel our GCC Masterclass presentation in preparation for the November examinations due to a very low number of registered participants. We are not sure what the reason for the poor reception but feel that it may have been due to poor advertising.

The members of the Board of Directors of the Institution are constantly working in the background to keep looking after the interests of the Certificated Engineer.

I would like to appeal to anyone who is in the mining industry and knows of contact person(s) in the DMRE - to contact me so that we can open a channel of communication once again. For some reason we have lost the contacts we had. There is a copy of a letter received from the Mine Engineers Commission of Examiners concerning the ANNEXURE E BOOKLETS in the body of the news bulleting for noting.

In this bulletin, we present our normal GCC examination questions and answers for Factory and Mining.

There are also a few links to Energize and Motion Control publications in a separate article.

Part four of the paper entitled "Multi-rope Winding from Deep Levels" by Mr. R Blair. The paper was published in the 1957 edition of the Journal of the Certificated ENGINEERS, South Africa.

I trust that you will find the content of this news bulletin interesting enough to pass on to your colleagues and friends.

Till next time!!!

Chris Schnehage

chris@icmeewc.co.za

Links for technical publications.

Included in this bulletin are links to publications that may be of interest to members. Should you wish to subscribe to regular publications, please contact the publishers directly.

[Energize Issue 17 of 2023](#)

[Energize Issue 18 of 2023](#)

[engineerIT Issue 18 of 2023](#)

Motion Control is also a publication that is interesting for the mechanically and electrically orientated engineers. Available at no cost, but you need to register.

[Motion Control](#)

Plant Engineering: MINES electrical/mechanical question

QUESTION (November 2007, Question 6.1)

The ventilation fan of a sinking shaft has been supplied complete with a 38 kW motor and a V-belt drive for a final duty of 710 m³/min at 150 mm WG with a fan speed of 1200 rpm. For initial operations, the output is 426 m³/min.

Calculate the following:

- (a) the delivery pressure
- (b) the fan shaft speed
- (c) the shaft power
- (d) the electrical units consumed per 8 hour period.

Assume: Fan efficiency of 60% and motor drive efficiency of 80%.

[8]

Proposed Solution:

$$(a) \quad P_2 = P_1 \left(\frac{q_1}{q_2} \right)^2 = 150 \left(\frac{426}{710} \right)^2 = 54 \text{ mm WG}$$

$$(b) \quad N_2 = N_1 \left(\frac{q_1}{q_2} \right)^2 = 1200 \left(\frac{426}{710} \right)^2 = 720 \text{ rpm}$$

$$(c) \quad \text{Air power} = \left(\frac{q_1}{60} \right) \times 1000 \times g \times P_2 = \left(\frac{426}{60} \right) \times 1000 \times 9.18 \times 0.054 = 3.761 \text{ kW}$$

$$\text{Fan shaft power} = \frac{\text{air power}}{\eta_{\text{fan}}} = \frac{3.761}{0.6} = 6.27 \text{ kW}$$

$$(d) \quad \text{Motor Power, } P_m = \frac{\text{shaft power}}{0.8} = 7.84 \text{ kW}$$

A Legal Knowledge: MINES question

QUESTION (November 2010, Question 2):

What are the requirements for the preparation of a Code of Practice as contemplated in Section 9 of the Mines Health and Safety Act [10]

Proposed answer

9. Codes of practice.

(1) Any employer may prepare and implement a code of practice on any matter affecting the health or safety of

employees and other persons who may be directly affected by activities at the mine.

- (2) An employer must prepare and implement a code of practice on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mine if the Chief Inspector of Mines requires it.
- (3) A code of practice required by the Chief Inspector of Mines must comply with guidelines issued by the Chief Inspector of Mines.
- (4) The employer must consult with the health and safety committee on the preparation, implementation or revision of any code of practice.
- (5) The employer must deliver a copy of every code of practice prepared in terms of subsection (2) to the Chief Inspector of Mines.
- (6) The Chief Inspector of Mines must review a code of practice of a mine if requested to do so by a registered trade union with members at the mine, or a health and safety committee or a health and safety representative at the mine.
- (7) At any time, an inspector may instruct an employer to review any code of practice within a specified period if that code of practice—
 - (a) does not comply with a guideline of the Chief Inspector of Mines; or
 - (b) is inadequate to protect the health or safety of employees.

Plant Engineering: FACTORIES Mechanical question

QUESTION (November 2017 – Question 4.1):

An electric train is required to maintain a scheduled average speed of 45 km/h. The stations are 5 km apart and the train stops at each station for 30 s. The acceleration is $0,7 \text{ m/s}^2$ and the braking retardation is $0,9 \text{ m/s}^2$.

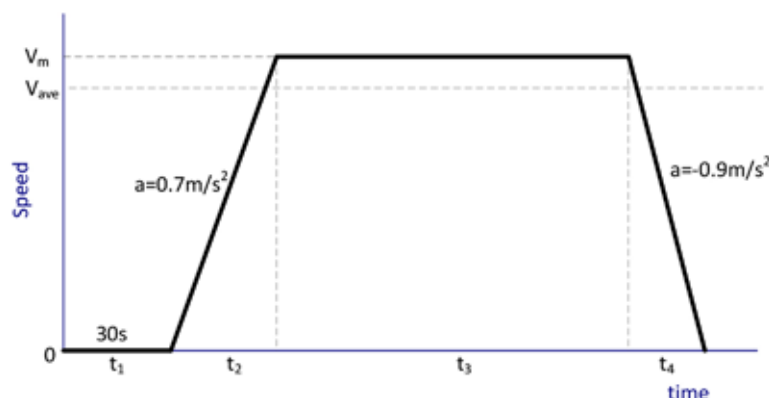
Assuming a simplified rectilinear speed-time curve, calculate the maximum speed of the train.

(12)

Suggested Answer:

Assumption: it does not matter how many stops there are as the examiner has given an average scheduled speed and this applies to each cycle of stopping at a station for 30 sec, then accelerating, travelling at a constant speed and then decelerating and stopping at the next station. The laws of motion are applicable to this question:

$$v = u + at \quad \text{and} \quad s = ut + \frac{1}{2}at^2 \quad \text{and} \quad s = \frac{1}{2}(u + v)t \quad \text{and} \quad v^2 = u^2 + 2as \quad \text{and} \quad s = vt - \frac{1}{2}at^2$$



Average scheduled speed = 45 km/h = 12.5 m/s

Let the maximum speed = V_m

Total time for cycle = $t_t = t_1 + t_2 + t_3 + t_4$ (from arriving at one station to arriving at the next)

$$a_2 = 0.7 \text{ m/s}^2$$

$$a_4 = -0.9 \text{ m/s}^2 \text{ (negative for deceleration)}$$

$$t_1 = 30 \text{ s}$$

$$t_2 + t_3 + t_4 = t \text{ total for 5 km}$$

$$\text{and } s_2 + s_3 + s_4 = 5000 \text{ m}$$

$$t_2 = \frac{v_m - u}{a} = \frac{v_m - 0}{0.7} = 1.43v_m$$

and

$$t_4 = \frac{v_m - u}{a} = \frac{0 - v_m}{-0.9} = 1.11v_m$$

Now substitute in formulae below:

$$s_2 = \frac{1}{2}(u + v)t_2 = \frac{1}{2}(0 + v_m)1.43v_m = 0.72v_m^2$$

$$s_4 = \frac{1}{2}(u + v)t_4 = \frac{1}{2}(v_m + 0)1.11v_m = 0.5v_m^2$$

$$s_3 = 5000 - s_2 - s_4 = 5000 - 0.72v_m^2 - 0.56v_m^2 = 5000 - 1.28v_m^2$$

$$t_3 = \frac{s_3}{\frac{1}{2}(v_m + v_m)} = \frac{s_3}{v_m} = \frac{5000 - 1.28v_m^2}{v_m} = \frac{5000}{v_m} - 1.28v_m$$

$$t_t = t_1 + t_2 + t_3 + t_4 = 30 + 1.43v_m + 1.11v_m + \frac{5000}{v_m} - 1.28v_m$$

$$v_{ave} = \frac{s_t}{t_t} \therefore s_t = v_{ave} \times t_t$$

$$\therefore 5000 = 12.5(30 + 1.43v_m + 1.11v_m + \frac{5000}{v_m} - 1.28v_m)$$

$$\therefore 5000 = 375 + 15.75v_m + \frac{62500}{v_m}$$

$$\therefore 15.75v_m + \frac{62500}{v_m} = 5000 - 375$$

multiply by v_m

$$\therefore 15.75v_m^2 + 62500 = 4625v_m$$

$$\therefore 15.75v_m^2 - 4625v_m + 62500 = 0 \text{ (a quadratic equation)}$$

$$v_m = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-4625) \pm \sqrt{4625^2 - 4(15.75)(62500)}}{2(15.75)} = 14.2 \text{ or } 279.45(\text{roots})$$

Discard 279.45 as this is too high

Answer: 14.2 m/s or 51.12 km/h

A Legal Knowledge: FACTORIES question

QUESTION (June 2023 - Question 2.1)

2.1

You have a large site in an industrial area where 415 persons are employed in the different business activities carried out on the site with the following staff (the head office is also on the site):

1. Head office – 102 persons which includes 17 management staff members of the assembly plant, the 32 members of the sales department and seven office-bound members of the installation division
2. Procurement/Stores – 11 persons
3. Machine shop – 32 persons
4. Assembly plant – 128 persons of which 17 are office management staff with offices in head office
5. Quality control division – 28 persons
6. Sales department – 20 persons employed on site with offices in the head office and 12 sales representatives working off site
7. Installation division – 45 employees of which 38 work off site to install products on clients' premises
8. Foundry, which is a separate company – 60 persons of which seven are office management staff
9. Scrap yard which is a separate company – 21 employees of which three are office management
10. Retail shop which is a separate company – 12 persons

2.1.1 Indicate the number of health and safety representatives to be designate to each of the 10 activities. (Substantiate your answer.)

2.1.2 Indicate the total number of health and safety representatives to be appointed if all the activities are regarded as one business. (Substantiate your answer.)

Suggested Answer:

The number of health and safety representatives for a workplace or section thereof shall in the case of shops and offices be at least one health and safety representative **for every 100 employees or part thereof**, and in the case of all other workplaces at least one health and safety representative **for every 50 employees or part thereof**: Provided that those employees performing work at a workplace **other than that where they ordinarily report for duty**, shall be deemed to be working at the workplace where they so report for duty.

2.1.1

1. Head office = 102 + 17 assembly plant members + 32 sales dept + 7 members of installation division = 158: 2 Health & Safety Representatives
2. Procurement/stores = 11: 1 Health & Safety Reps
3. Machine shop = 32: 1 Health & Safety Rep
4. Assembly plant = 128 – 17(h/o) = 111: 3 Health & Safety Reps
5. Quality control = 28: 1 Health & Safety Reps
6. Sales department = 32: 0 included in H/O appointments
7. Installation team = 45 – 7 = 38: 1 Health & Safety Rep
8. Foundry = 60: 2 Health & Safety Reps (separate company)
9. Scrap yard = 21: 1 Health & Safety Rep (separate company)
10. Retail shop = 12: 0 Health & Safety Rep – less than 20 (separate company)

2.1.2

Office staff = 102: 2 Health & Safety Reps

Other employees = 313: 7 Health & Safety Reps

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MORE THAN

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mineral resources & energy

Department:
Minerals Resources and Energy
REPUBLIC OF SOUTH AFRICA

MINE HEALTH AND SAFETY INSPECTORATE

Private Bag X 59, ARCADIA, 0007
Trevenna Campus, Building 2C, Ground Floor, 70 Meintjies Street, Sunnyside, PRETORIA

From:	Mine Engineers Commission of Examiners
Enquiries:	The Secretary – Liza Lethole
Tel No:	012 444 3935
E-mail:	liza.moeng@dmre.gov.za

15 September 2023

Engineers-in-Training
Engineers
Engineering Managers

ANNEXURE E BOOKLETS

The Department of Mineral Resources and Energy (DMRE), through the Mine Engineers Commission of Examiners, has resolved to continue accepting old Annexure E until 31 December 2023.

This means that all future applications for examination purposes, will as from 01 January 2024, need to be accompanied by the signed off uniquely numbered Annexure E obtainable from the DMRE only after acceptance as an Engineer-in-Training (EIT). No exceptions will be made including those who might have plans to complete the outstanding modules in the new year.

The Annexure E which was freely available in the industry prior to 01 November 2017 will no longer be acceptable for writing of examination application purposes. Candidates who are still in possession of these old Annexure E are encouraged to finalize their exposure in outstanding modules and ensure the complete signing thereof by 31 December 2023.

Yours in health and safety

MMA ZONDI

CHAIRPERSON: MINE ENGINEERS COMMISSION OF EXAMINERS

DATE: 15/09/2023

By R. BLAIR, M.I.Mech.E., M.S.A.I.Mech.E. (Member)

8. DETAILS OF EXPERIMENTS CONDUCTED FOR BREAKING ROPE

When it was decided to use explosives rather than a mechanical method to sever the rope., a sinking bucket filled with scrap iron (weighing in all 4 tons) was suspended approximately 2 ft above the ground by a steel wire rope 1 in. in diameter and having a breaking load of 48 tons. Eight 60 per cent gelignite primers, 4 in. long by $\frac{7}{8}$ in. in diameter, were tied lengthwise around the circumference of the rope. The explosion merely removed the rope dressing.

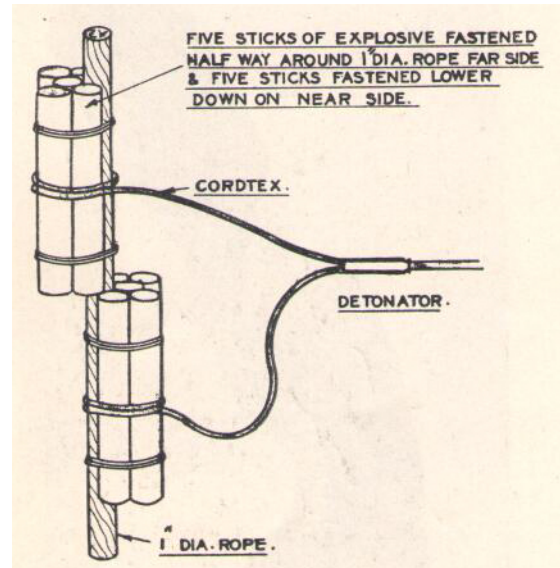


FIG 19

In the next experiment the explosive charge was divided into two, one charge above the other on opposite sides of the rope (Fig. 19). This method was more effective, and after a series of tests during which the amount of explosives was gradually increased, the rope was broken successfully with 5,56 lb of explosives.

An explosion of this order, however, would have been too great for use in the timbered shaft in which the main test was to take place. It was therefore necessary to find some means of breaking the rope with a smaller charge. It was realised that the initial force of the explosion was probably being expended on flattening the rope before starting to break it and a type of shear plate was made to hold the cross-section of the rope rigid and to act as a guillotine against which the rope would be cut rather than broken when the explosion took place. This proved to be so effective that the rope could be broken with a total charge of 3,64 lb of explosives. This explosion was still too big, however, and it was found by using gelignite cartridges of 2 in. diameter moulded to fit in close contact with the rope, the maximum effect of explosion was obtained. Fig. 20 shows this arrangement.

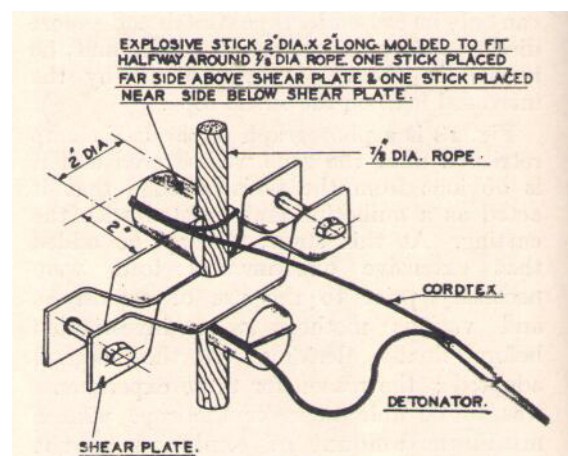


FIG 20

The rope used for this experiment was of the same construction as that to be used in the actual winding test, namely, 7 in. diameter, having a breaking load of 27 tons. The rope was broken with 0.48 lb of explosives which incidentally was exactly half the amount of explosives needed to break the rope without a shear plate. As this amount was still excessive for use in the timbered shaft when conducting the final experiment, the author decided to cut away four of the six strands in the rope and sever the remaining two by the method described, thereby utilising the minimum amount of explosives; the final test was conducted by this means with the amount of explosives reduced to 2 oz.

The next problem was to arrange to detonate the explosives at the correct position in the shaft when the conveyance was ascending at full speed. To avoid placing the full responsibility of split-second timing on the winding engine driver, it was decided to avoid the use of fuse or other timing mechanism and to keep the exact timing of the explosion in the hands of the person conducting the experiment; therefore, the method of detonation employed was to send a high frequency signal down one winding rope and to use the signal to detonate the explosives. The advantage of this procedure was that the detonation could be effected at a time when the position and speed of the conveyance was as required.

For this operation, a Carrierphone equipment was installed, consisting of a 100 kilocycle transmitter, electromagnetically coupled to the winding rope near the head-frame sheave, using a toroidal coil through which the rope could travel. A battery-operated receiver tuned to 100 kilocycles was placed in the conveyance and electromagnetically coupled to the winding rope by a coil fixed on the rope just above the compensating device. The receiver was fitted with a relay which, upon receipt of a signal impulse from the transmitter on surface, applied six volts from the receiving battery to the detonator and exploded the charge.

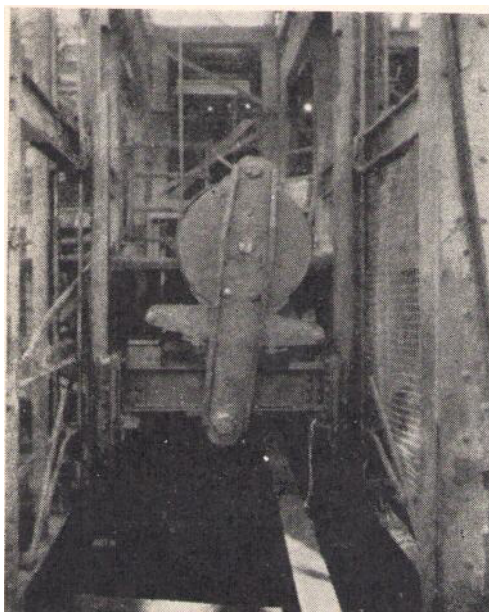


FIG 21

This photograph Fig. 21, taken on surface before lowering the conveyance for the final test, shows on the left rope the electrical connection to the relay in the conveyance, which, when energised, closes the circuit and by means of electric blasting ignites the charge attached to the right hand rope. As it was decided to conduct the test with the load ascending, the conveyance was lowered to the bottom level 4,000 ft below surface. The winder was then accelerated to full speed, that is over 3,000 ft p.m. and when this speed was attained the charge was ignited and the right hand rope severed. The winder was then brought to rest at normal deceleration rate, which amounted to approximately 10 turns of the 11 ft. diameter drum, or say, 350 ft. of rope travel.

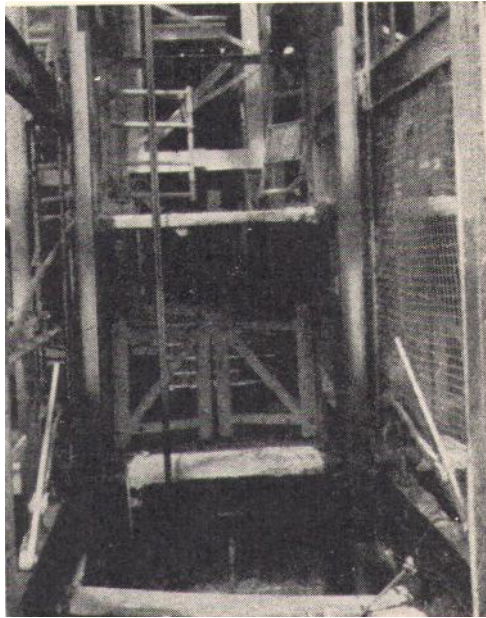


FIG 22

Without further inspection the conveyance was raised at slow speed, and when approaching the surface, it was obvious that the broken rope had twisted around the other. However, this was of no consequence as both ropes travel at the same speed in the shaft. This condition is clearly shown on Fig. 22, which is a photograph taken as the conveyance was approaching, and approximately 50 ft. from the shaft collar.

Fig. 23 is a photograph taken when the conveyance finally reached the surface after the completion of test. It illustrates how the device has heeled over, thereby applying the brake to the compensating wheel, on which the broken end of the rope can be clearly seen.

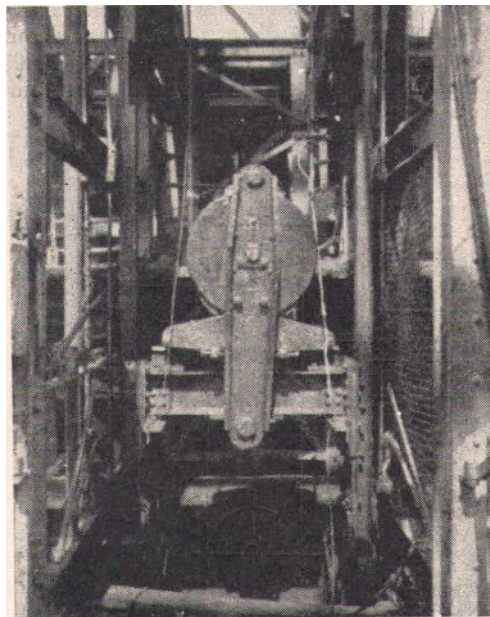


FIG 23

It must not be wrongly construed because the author has tested and proved the system to be safe even with a broken rope, that this condition is anticipated. On the contrary, with the introduction compensating device which, as previously described, has an indicator fitted and will show at a glance any deterioration of either rope, there should be adequate warning enabling the faulty rope to be removed before a disaster can occur.

9. DETECTION OF BROKEN ROPE

A method of detecting a broken rope and of stopping the winding system automatically in this event can be included. However, the immediate and certain detection of a broken rope presents unusual difficulties as the two ropes are electrically inter-connected at top and bottom.

It is therefore convenient as shown in Fig. 24 to regard the two ropes as forming a short-circuited loop, whose interruption must be detected electrically, and this suggests the employment of a high frequency current which can be readily induced into one rope by a toroidal coupling coil, mounted around it in the headframe and detected by a similar coil mounted around the other rope.

In practice, one coil would be connected to a stable high frequency oscillator and the other to an amplifier detector and relay. The system has the advantage of failing to safety.

The two ropes, however, are very close to one another and are strongly coupled both inductively and capacitively; it can be shown that complete fracture of one rope would cause practically no reduction in the current in the detector coil under certain conditions. This surprising effect is due to the generation of standing waves wherever the length of the rope between sheave wheel and break approximates to one-quarter of a wavelength at the frequency used. In order to prevent this effect, it is necessary to ensure that the total depth of the shaft does not correspond to more than about a tenth of a wavelength, which for a 6,000 ft. shaft, limits the frequency used to not more than 16,5 kilocycles.

At this frequency a toroidal coil is very inefficient, so that increased power and detector sensitivity must be employed. Construction of equipment for this purpose is now being considered.

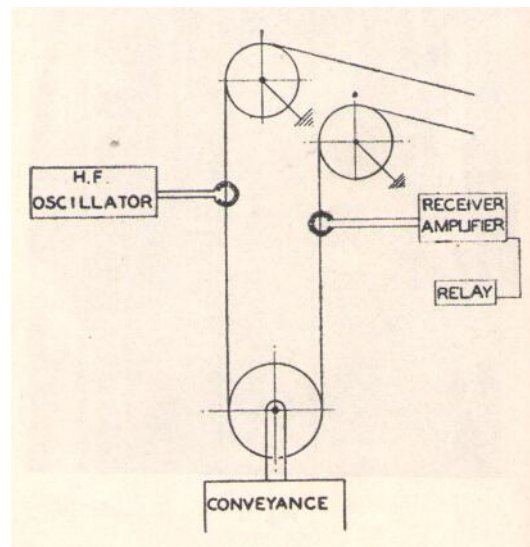


FIG24

(Where the conveyance is fitted with metal guide shoes and operates on metal guides in a shaft, a third path for high frequency current exists through the conveyance, guides, headframe, and sheave wheels but this can be ignored since an alternating current always chooses that return path which makes the inductance of the complete circuit as low as possible – in this case, the adjacent rope).

10. SAFETY FACTORS

10.1 *Specification of ropes used during test*

Supplied by Rand Ropes Limited, Seven eighths in. diameter. Langs Lay. Fibre Core – 6/6/1 construction. Diameter of outer wire – .096 in. Centre wire – .102 in. Class of core – steel wire. Best Patent Basic. Tensile – 90/100 tons. Weight per foot – 1.228 lb. Breaking load – 27 tons.

10.2 Loading and factor of safety during test

Weight of 4,000 ft of rope

= 4,912 lb therefore twin rope = 9,824 lb.

Weight of conveyance and contents = 16,000 lb.

Therefore total suspended weight ... = 25,824 lb.

Breaking load of rope 27 tons = 54,000 lb.

therefore twin rope = 108,000 lb.

Therefore factor of safety at 4,000 ft = 4.182

and capacity factor = 6.75.

Therefore factor of safety with broken rope at 3,500 ft = 2.66.

Headframe sheaves of 6 ft. diameter were utilized for these tests (representing only 82 rope diameters), and the angle of rope between engine room and head frame 35° , resulting in a load on each headframe sheave of 22,000 lb, or a pressure of 450 p.s.i. on the rim. When one rope was severed, the resulting pressure on the single sheave was approximately 730 p.s.i.

With this low factor of safety and capacity factor, the safety of the whole system has been thoroughly proved. The author is therefore of the opinion that it is reasonable to assume that an approach to the Department of Mines for a lower capacity factor and factor of safety when commissioning the multi-rope drum winder might be favourably considered.

Should a reduced capacity factor, say, 6.75, be obtained, and a factor of safety 4 without balance rope, comparison when operating the new multi-rope winder as compared with the present single-rope system when winding from 6,000 ft. would be as follows (see Table I).

For comparison, two ropes of $1\frac{3}{16}$ in. diameter have been chosen for the multi-rope system, and a $1\frac{3}{4}$ in. diameter for the standard drum winder, the reason being that the weight per foot and breaking load of the $1\frac{3}{16}$ in. diameter is almost half that of the $1\frac{3}{4}$ in. diameter rope.

From the above comparisons, it is obvious that by utilising multi-rope drum winding with reduced factors, the end load can be increased by 5 tons for the same rope weight.

Due to utilising smaller diameter ropes, drum diameters can be reduced and the winder operated at increased revolutions per minute for the same rope speed.

The following example compares multi-rope drum winders with the Koepe system for equivalent pay load from 6,000 ft. (see Table II).

Although the total weight of rope installed with the multi-rope drum winder is 48.4 tons, 24.2 tons only is suspended in the shaft at any one time, whereas with the Koepe system the full 111.6 tons is constantly hanging.

To be Continued...
