WCB ENGINEERING BULLETIN

Vol.31 No4

The Institution of Certificated Mechanical and Electrical Engineers South Africa
Western Cape Branch (WCB)

DECEMBER 2022

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 last quarterly news Bulletin of 2022. It is unbelievable that we are already at the end of another year.

We hope that all our readers have had a good year and have survived the remnants of the COVID19 virus. I know that for some people life has been tough and with the current disastrous state of affairs on the electricity supply side, it is a wonder that we are all still gainfully employed.
This loadshedding is really getting to me and as a private citizen the effect is lousy, but how is Industry and Manufacturers surviving? And what about our Mining Industry? Oi Vei...

Well, we will plod along and do our best in all spheres of society, I am sure.

In this Bulletin, there is a short message from our President/Chairman followed by the normal Questions and Answers for Factories and Mining GCC examinations. I also include a link to a copy of the Energize Magazine. If you want to subscribe to the magazine, follow links within the magazine. Energize
The Motion Control publication is also available to members to read by clicking on the following link. Motion Control.

There is short extract from an email received from ECSA with a link to the latest E-Bulletin.

I have extracted an article for our mining readers, 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. The article will be presented in six or seven parts in future editions of this News Bulletin. (Should someone want a copy of the full document - please email me).

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

I would also like to take this opportunity to wish all of you, our members and guests, a Blessed Christmas and a Prosperous 2023.

Till next time!!!

Chris Schnehage
chris@icmeewc.co.za

****

Dear ICMEESA Member,

This year has indeed challenged us as engineers in every way possible. From days lost because of loadshedding to a weaker rand and everything in between, but we have almost made it through this year. The new year will most certainly bring its' challenges and it is in a time like this where the contributions of every engineer in the country and world wide will be extremely valuable and we will rise to each occasion and play a positive role in making our areas a better and safer place for next year and the years to come.

I would like to wish each member a merry Christmas and a blessed New year.
Sias Borman
President/Chairman ICMEESA

****

Plant Engineering: MINES mechanical question

QUESTION

The following are particulars of a Koepe winder of the mounted type, twin rope, tower mounted type.

Mass of conveyance	: 1 800 kg
Mass of material load	: 4 500 kg
Mass of balance weight	: 4 450 kg
Main and tail ropes	: Diameter 20mm, mass 1,88 kg/m
Angle of contact of rope on Koepe wheel	: 180 degrees
Co-efficient of friction for ropes on friction wheel	: 0,2
Length of each rope from friction wheel to bottom of the loop in the tail rope	: 267 m

Determine the maximum rate of retardation which can be applied by the driver to control a descending fully loaded conveyance without causing the rope to slip.

Proposed Solution:

Mass of Mass of ropes = M_{rope} (on one side of the friction wheel)

$M_{rope} = 267 \times 1{,}88 \times 2$

$= 501{,}96 \times 2$

$= 1003{,}92$ kg

$T_1 = ma + mg$ where m = total mass of ropes, conveyance and balance weight
a = linear accelleration

$T_2 = mg - ma$

$T_1 = (1800 + 1003{,}92 + 4500) \times 9{,}81 + (1800 + 1003{,}92 + 4500)\, a$

$= 71651{,}46 + 7303{,}92\, a$

$T_2 = (4450 + 1003{,}92) \times 9{,}81 - (4450 + 1003{,}92)\, a$

$= 53502{,}96 - 5453{,}92\, a$

Also

$\frac{T_1}{T_2} = e^{\mu\theta}$

$= e^{0.2\pi}$

$= 1.87$

$\therefore T_1 = 1.87T_2$

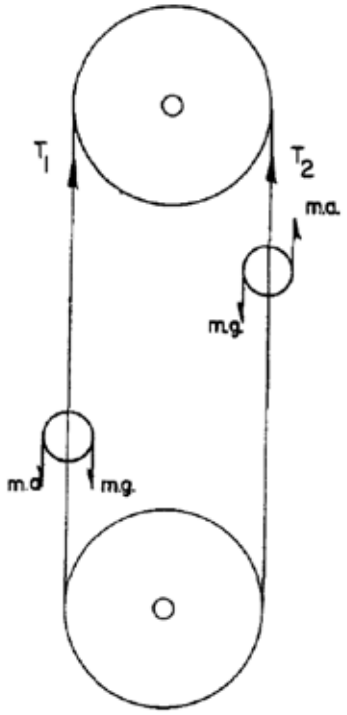
where μ = co-efficient of friction
θ = angle of contact between ropes and friction wheel

$T_1 = 1.87\ T_2$

$\therefore 71651{,}46 + 7303{,}92a) = 1{,}87\ (53502{,}96 - 5453{,}92a)$

$\therefore 17502{,}75a = 28637{,}49$

$\therefore a = \mathbf{-1.64\ m.s^{-2}}$



****

A Legal Knowledge: MINES question

QUESTION (November 2022, Question 5):

1. What shall accompany every new boiler application? (7)
2. What must the Principal Inspector of Mines do on receipt of the application to erect or use a boiler? (3)

[10]

Proposed answer

1.

22.3.2 For every new boiler the application shall be accompanied by-

(a) the **manufacturer's complete specification** on the form for this purpose;

(b) **legible, dimensioned drawings** of the complete boiler showing details of the plating, riveting and welding;

(c) **drawings showing the boiler house**, if any, in plan and elevation and the position of the boiler; and

(d) a **certificate issued by an inspecting authority incorporating the following information:**
(i). that the **authority is satisfied that the boiler is constructed in accordance with the specified code;**
(ii). **results of the physical and chemical tests carried out on the material used in construction;**
(iii). **details of the heat treatment;** and
(iv). **details of the hydraulic test,** witnessed by the inspecting authority.

2.

22.4.1 On receipt of the application to erect or use a boiler, the Principal Inspector of Mines-

(a) **may issue a provisional permit** subject to the conditions and for the period he may determine; or

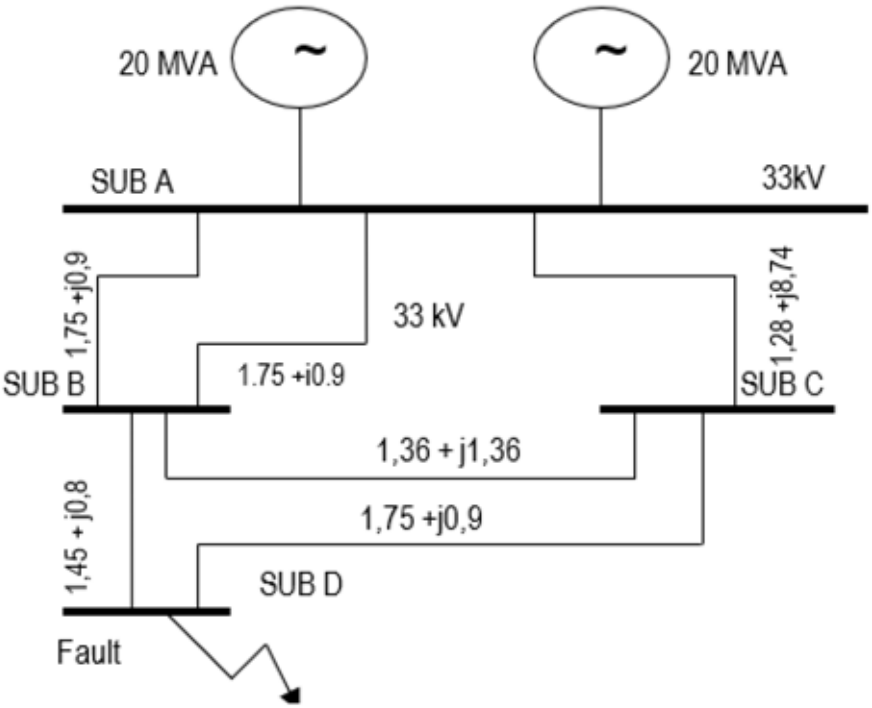
(b) if he is satisfied as a result of inspection and hydraulic test that the boiler is safe to use and that the provisions of these Regulations have been complied with, **may issue a permit subject to the conditions he may specify**.

****

Plant Engineering: FACTORIES electrical question (November 2022 – Question 5.3)

QUESTION:

5.3 The network below needs to be upgraded. Determine the fault current in F in the network below to ensure that the switchgear is ordered. (10)

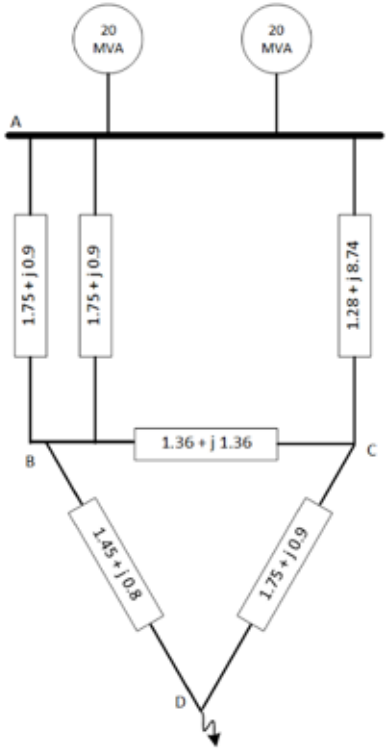


Suggested Answer:

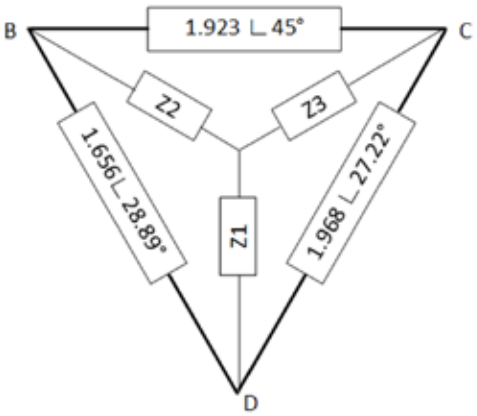
5.3

Assumption: The impedances given in the question are in ohms and therefore the Ohm-notation method may be used and that this is a symmetrical fault. The Voltage is 33kV through the network as no transformation is shown. To calculate the fault current at Substation D the total impedance for the network needs to be established.

Firstly, the single line diagram shown in the question must be converted to an equivalent impedance diagram as shown below:



In order to solve at Substation D the star-delta transformation method must be used to establish values of Z_1, Z_2 and Z_3



$$Z_1 = \frac{Z_{BD} \times Z_{CD}}{Z_{BD} + Z_{CD} + Z_{BC}}$$

$$= \frac{(1.656\angle 28.89°) \times (1.968\angle 27.22°)}{(1.45 + j0.8) + (1.75 + j0.9) + (1.36 + j1.36)}$$

$$= \frac{3.259\angle 56.11°}{4.56 + j3.06}$$

$$= \frac{3.259\angle 56.11°}{5.49\angle 33.864°}$$

$$= 0.593\angle 22.25°\Omega$$

$$= 0.549 + j\ 0.2245\Omega$$

$$Z_2 = \frac{Z_{BD} \times Z_{BC}}{Z_{BD} + Z_{CD} + Z_{BC}}$$

$$= \frac{(1.656\angle 28.89°) \times (1.923\angle 45°)}{(1.45 + j0.8) + (1.75 + j0.9) + (1.36 + j1.36)}$$

$$= \frac{3.185\angle 73.89°}{4.56 + j3.06}$$

$$= \frac{3.185\angle 73.89°}{5.49\angle 33.864°}$$

$$= 0.58\angle 40.03°\Omega$$

$$= 0.444 + j\ 0.373\Omega$$

$$Z_3 = \frac{Z_{CD} \times Z_{BC}}{Z_{BD} + Z_{CD} + Z_{BC}}$$

$$= \frac{(1.968\angle 27.22°) \times (1.923\angle 45°)}{(1.45 + j0.8) + (1.75 + j0.9) + (1.36 + j1.36)}$$

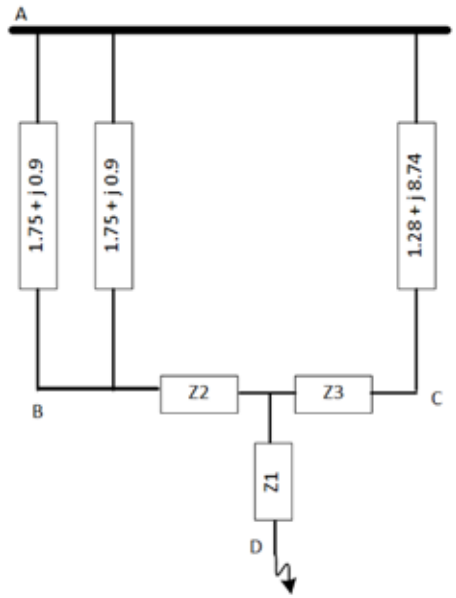
$$= \frac{3.784\angle 72.22°}{4.56 + j3.06}$$

$$= \frac{3.784\angle 72.22°}{5.49\angle 33.864°}$$

$$= 0.689\angle 38.356°\Omega$$

$$= 0.54 + j\ 0.428\Omega$$

Now the equivalent impedance diagram will be:



Now calculating the parralell branch between A and B:

$$\frac{1}{Z_{AB}} = \frac{1}{1.75 + j0.9} + \frac{1}{1.75 + j0.9}$$

$$= \frac{1}{1.968\angle 27.22°}$$

$$= \frac{1}{1.968\angle 27.22°}$$

$$= (0.508\angle -27.22°) + (0.508\angle -27.22°)$$

$$= (0.452 - j0.232) + (0.452 - j0.232)$$

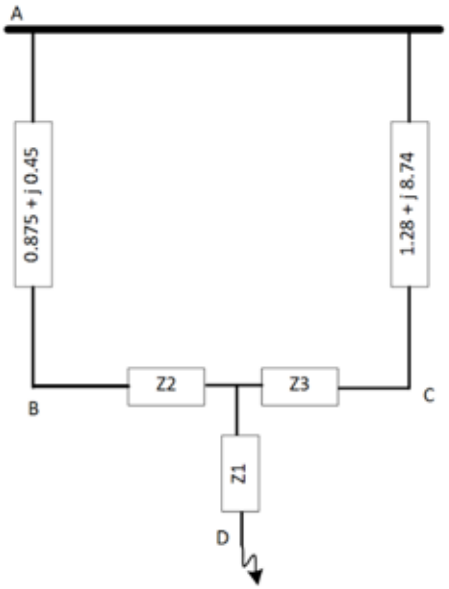
$$= 0.90348 - j0.464$$

$$= 1.016\angle -27.184°$$

$$\therefore Z_{AB} = 0.9846\angle 27.184°$$

$$= 0.875 + j0.45\Omega$$

Now the diagram will look like this:



Now by adding Z_{AB} to Z_2 and Z_{AC} to Z_3 we get the following:

$$Z_{left\ leg} = Z_{AB} + Z_2$$

$$= (0.875 + j0.45) + (0.444 + j\ 0.373)$$

$$= 1.319 + j0.823$$

$$= 1.555\angle 31.96°$$

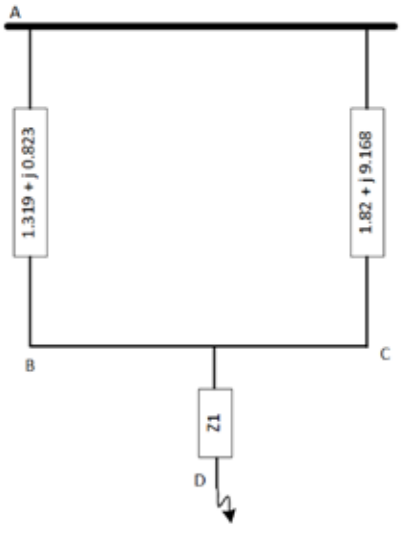
$$Z_{right\ leg} = Z_{AC} + Z_3$$

$$= (1.28 + j8.74) + (0.54 + j\ 0.428)$$

$$= 1.82 + j9.168$$

$$= 9.347\angle 78.77°$$

And now the equivalent simplified diagram will look like this:



Now calculate the parallel leg Z_{AB} and Z_{AC}:

$$\frac{1}{Z_{\parallel}} = \frac{1}{1.319 + j0.823} + \frac{1}{1.82 + j9.168}$$

$$= \frac{1}{1.555\angle 31.96°}$$

$$= \frac{1}{9.347\angle 78.77°}$$

$$= (0.6431\angle -31.96°) + (0.107\angle -78.77°)$$

$$= (0.5456 - j0.3404) + (0.0208 - j0.105)$$

$$= 0.5664 - j0.4454$$

$$= 0.721\angle -38.18°$$

$$\therefore Z_{\parallel} = 1.388\angle 38.18°$$

$$= 1.091 + j0.858\Omega$$

Now calculate the total impedance, Z_T:

$$Z_T = Z_{\parallel} + Z_1$$

$$= (1.091 + j0.858) + (0.549 + j\ 0.2245)$$

$$= 1.64 + j1.083$$

$$= 1.965\angle 33.434°\Omega$$

Now calculate the short-circuit current, I_{SC}:

$$I_{SC} = \frac{V_L}{\sqrt{3} \times Z_T}$$

$$= \frac{33 \times 10^3}{\sqrt{3} \times 1.965}$$

$$= \mathbf{9.6962\ kA}$$

Fault Level, S_{SC}:

$$S_{SC} = \sqrt{3} \times V_L \times I_{SC}$$

$$= \sqrt{3} \times 33 \times 10^3 \times 9.6962 \times 10^3$$

$$= \mathbf{554.211\ MVA}$$

****

A Legal Knowledge: FACTORIES question (November 2022 - Question 3)

3.1 Define the following terms as given in the Ergonomics Regulations, 2019:

3.1.1 Adverse health effect (2)

3.1.2 Ergonomic risk (1)

3.2 Any designer or manufacturer of machinery, plant or work systems for use at work must ensure that it optimise human well-being and overall system performance.

Name TWO other aspects which must be met to optimise human well-being and overall system performance. (2)

3.3 An employer must ensure that exposure of a person to ergonomic risk is prevented or adequately controlled.

3.3.1 What must the employer implement to prevent or control ergonomic risk? (1)

3.3.2 Explain the hierarchy of control? (1)

3.4 When an employee is placed under medical surveillance, what must the medical surveillance consists of-

3.4.1 In the case of a new employee? (1)

3.4.2 In the case of periodic health examinations? (1)

3.5 What must the employer do with the records of ergonomic risks when he or she ceases activities? (1)
[10]

Suggested answer:

3.1.1 "adverse health effect" means the causation, promotion, facilitation or exacerbation of a structural or functional abnormality, with the implication that the abnormality produced has the potential of lowering the quality of life, contributing to a disabling illness or leading to premature death.

3.1.2 "ergonomic risk" means a characteristic or action in the workplace, workplace conditions, or a combination thereof that may impair overall system performance and human well-being.

3.2
5. Any designer, manufacturer, importer or supplier of machinery, plant or work systems for use at work must-
(a) as far as is reasonably practicable, ensure that machinery, plant or work systems optimise human well-being and overall system performance;

(b) as far as is reasonably practicable, supply machinery, plant or work systems that can be transported, received, stored and handled in a manner that optimises human well-being and overall system performance;

(c) provide information, instruction and training as deemed necessary to allow potential users to achieve optimal human well-being and overall system performance during use of machinery, plant or work systems;

(d) as far as is reasonably practicable, install machinery, plant or work systems to achieve optimal human well-being and overall system performance; and

(e) provide information to potential users on the appropriate maintenance of machinery, plant or work systems to ensure safe operation and use.

3.3.1
7(2) In order to comply with subregulation (1) an employer or self-employed person must, as far as is reasonably practicable, remove or reduce exposure to ergonomic risks by implementing control measures in accordance with the hierarchy of controls.

3.3.2
Firstly remove the risk before reducing exposure to the risk.

3.41
8(2)(a) in the case of a new employee, an initial health examination before the employee commences employment or within 30 days of commencement of such employment.

3.42
8(2)(b) a periodic health examination informed by the ergonomic risk assessment, at intervals specified by an occupational medicine practitioner, but not exceeding two years.

3.5

10(2)(a) If the employer ceases activities, the employer must hand over or forward by registered post all records to the relevant chief director: provincial operations.

EMAIL FROM ECSA

From: Sybil Dlamini <sybil@ecsa.co.za>
Sent: Tuesday, 13 December 2022 10:51
Subject: E- Bulletin

Dear Valued Stakeholder,

In the effort to ensure you are updated and kept abreast of developments that take place within the engineering sector in general and the Engineering Council of South Africa (ECSA) in particular, we have finalised the 3rd edition of the E-Bulletin.

In this edition, ECSA CEO; Dr Bridget Ssamula pens a holiday message to stakeholders, while the message seeks to wish all stakeholders a safe and happy holiday period, it more importantly highlights the changes as well as upcoming plans for the organisation. The ECSA AGM is also reflected in this edition with a specific emphasis on ECSA upholding the principles of good governance.

The third articles notes an achievement not only for ECSA and Eng. Refilwe Buthelezi but also for the entire engineering industry and South Africa, as Eng Buthelezi is voted in as President-Elect for the Federation of African Engineering Organisations.

And lastly, an update on the Identification of Engineering Work (IDoEW) Codes of Practise is provided.

Enjoy the read.

Kind regards,

E-Bulletin

****

MULTI-ROPE WINDING FROM DEEP LEVELS Part 01

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

ABSTRACT

A new type of drum winder, designed to meet the requirements of deep level mining with increased loading, is described in detail.

It is submitted that this multi-rope multi-layer drum winder provides in a double drum winder all the advantages of Koepe or friction winders which hitherto were unobtainable in drum winders.

By using multi-ropes attached to each conveyance smaller diameter ropes, sheaves, and drums can be used.

Methods of equalising tension in the multi-rope system and of protecting against faulty rope coiling or, at the very worst, a broken rope, are described. The merits of balance ropes on drum winders are discussed.

The full-scale tests which were conducted are described.

CONTENTS

1. INTRODUCTION

In South Africa the mining industry has many engineering problems to be considered and overcome. In this paper the author does not intend to touch on any others than those appertaining to hoisting from deep levels, a condition which requires much consideration, especially when designing a winding layout to operate from depth.

The engineer is constantly faced with the problem of hoisting more ore from greater depths and for this reason new methods have to be considered. Practice in the past throughout South Africa has been to install either the single cylindrical drum, double cylindrical drum, Whiting friction type or the conical drum, all of which re suitable for single rope operation except when operating in a shallow shaft, where twin ropes on the cylindrical drum could be used but with a single layer of rope only.

In recent years the demand for increased tonnage from greater depths has resulted in the engineer having to direct his attention to other methods, for the simple reason that it is no longer practicable to think of operating with single rope winding when handling these large tonnages, in which the payload is such a small portion of the total suspended load which includes conveyance, attachments, ore and rope.

The Koepe, which is a friction winding system, although not new, is now being considered as the solution of our problems, possibly because it has been the only known method of operating with multi-ropes. In a recent publication of an engineering journal it was stated in regard to drum winders that "one rope per drum and per conveyance is its limitation." With the introduction of the multi-rope drum winder described in this paper, this condition no longer applies.

2. DISADVANTAGES OF THE KOEPE SYSTEM

(1) Unless commissioned with only one conveyance and a counterweight, the Koepe system is unsuitable for multi-level operations.

(2) If fitted with two conveyances, which it undoubtedly would be for rock hoisting, it is then unsuitable for dual purpose winding, as it would be extremely difficult to arrange the mine in such a way as to have the correct relationship between the tipping point on the surface and the loading chute underground, with surface bank level and the loading point for persons underground. This would virtually mean a mine layout to suit the winding plant, whereas it is usual practice to install a winding plant to suit the mining operations.

(3) If flooding of shaft is encountered, the winding plant cannot be utilised when de-watering, as there are no facilities for clutching, and for the same reason an accident in either compartment of the shaft renders the equipment unserviceable. (See footnote).

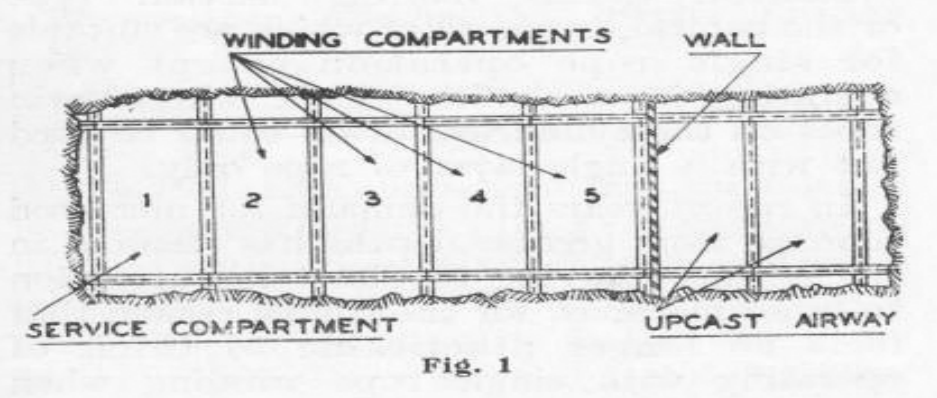


FIGURE 1

The flooding of shaft requires no explanation but to make quite clear what is meant when referring to the accident in a compartment, the author recalls an incident which actually occurred in a vertical shaft in the Orange Free State.

The shaft in question is rectangular in section having seven compartments, two of which are walled off to provide an upcast airway and are therefore inaccessible for any other purpose. The remaining five compartments, separated by steel dividers, provide four compartment for dual purpose winding and one service compartment; the latter is equipped for the installation and maintenance of pipes and cables.

In Fig. 1 the position of the service compartments can be seen. No. 1 compartment is serviced by a single drum winder whereas Nos. 2 and 3 are served by a double drum Ward Leonard and No 4 and 5 by a double drum A.C. winder. The accident referred to was caused by a diesel locomotive falling from the surface down No.3 compartment when the conveyance in that compartment was descending, resulting in the steel dividers between Nos. 2-3 and 3-4 compartments becoming distorted. Therefore Nos. 2, 3 and 4 compartments were rendered unserviceable and, as the conveyance in the service compartment was at the shaft bottom when the accident occurred and the damage to this compartment was unknown. this conveyance could not be raised. Fortunately, the winder serving Nos. 4 and 5 compartments was of the double drum type and could be unclutched. The rescue party were then able to descend in No.5 compartment with the single drum while the conveyance in No. 4 compartment was unclutched.

(4) The Koepe winding system as such cannot be used for sinking as it is a friction winder and requires a balance rope which cannot be installed until completion of sinking operations. This, in the author's opinion, is an important point to be remembered when considering deep shafts and the use of large buckets to speed up sinking operations. Under these conditions, the installation of a temporary winding plant to be used for sinking only can be most costly.

(5) In operation, the installation of new or the changing of old ropes is a problem, and requires an additional hoist for the purpose. The constant adjusting at capel ends to take care of rope stretch over a considerable period following the installation of new ropes, the anchoring of hauling ropes and the lifting and supporting of balance ropes prior to removing a skip bridle for inspection or repair, all cause considerable delay. These are difficulties which do not exist when operating a drum winder.

6) Except when operating a single conveyance with balance weight, the ropes cannot be cut for test -- therefore a greater factor of safety is demanded by the Department of Mines.

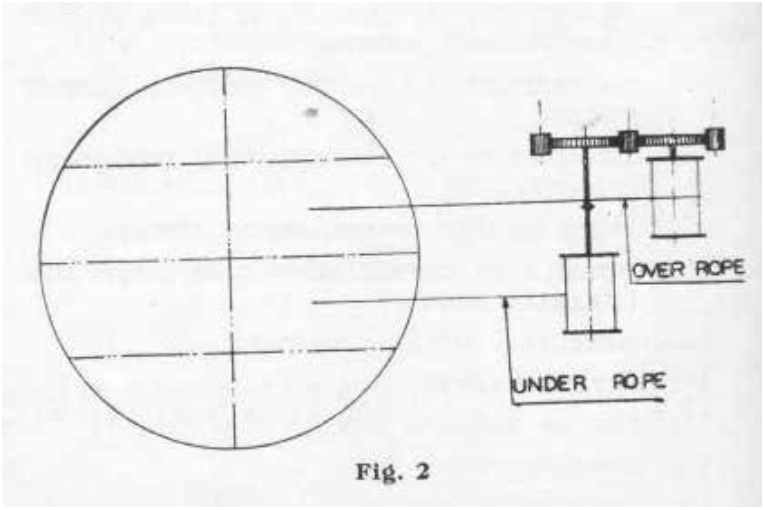


Fig. 2

FIGURE 2

(7) As the Koepe is a friction winding system, ropes cannot be lubricated and protected to the same extent as when operating with the drum winder; therefore it remains to be seen whether, without such protection, they will have a reasonable life when operating under the conditions prevailing in the gold mining industry.

(8) The shaft has to be increased in depth to provide facilities for the balance rope and tapered guides. This in turn increases the cost of installation and maintenance of spillage arrangements at the shaft bottom.

TO BE CONTINUED...