WCB ENGINEERING BULLETIN

Vol.30 No3

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

SEPTEMBER 2021

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 Western Cape News Bulletin

Membership Fees:
I would like to thank all members who have paid their fees for 2021 thus far this year.
However, a number of payments have been received which do not have clear information on who has made the payment! – **While the invoice clearly states to please use the invoice number as a reference**! This is not a good state of affairs as such a payment cannot be credited to whoever made the payment. So, PLEASE let us know should you be aware of your company making a payment and you suspect an incorrect reference has been used. THANK YOU!

In this Bulletin, we have the normal Questions and Answers for Factories and Mining GCC examinations.
A short article on the current issues on the ECSA front. Please take the time to read through these documents.
We are putting together another GCC Candidate Masterclass programme for end October. The flyer is included as well as a few tips on examinations.
Finally, there is part two of an article taken from the ICMEESA Archives – from The Certificated Engineer volume 39 – 1969.

Lastly, there is an email regarding a Green Building Market Assessment. Action required for a survey.

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

Chris Schnehage
chris@icmeewc.co.za

LOCAL BRANCH NEWS

Activities of the Western Cape Branch since the last Bulletin were as follows:

We have not had any specific Branch activity during the year so far due to the continued COVID Pandemic.

We appeal to members who have an interest to please suggest something and assist with arrangements.

Until next time, Ciao for now!

Chris Schnehage
Tel: 083 326 8023
Email: chris@icmeewc.co.za

OHSAct, Nov. 2013 (1) (Act)

1.1 Define the following terms as stipulated in Occupational Health and Safety Act:
1.1.1 Chief Executive Officer (CEO) [1]
1.1.2 Employee [2]
1.1.3 Sell [1]

Answer: See definitions

1.2 Every employee shall at work carry out any lawful order given to him, and obey the health and safety rules and procedures laid down by his employer in the interest of health or safety.
State TWO other general duties of employees at work. [2]

Answer: 14 (a) (b) (c) (d)

1.3 In terms of the Act, the chief executive officer is charged with certain duties:
1.3.1 Name these duties

Answer: 16(1)

1.3.2 May the CEO assign these duties on to other persons?
Motivate your answer. [4]

Answer: 16(2)

Plant Eng. Nov. 73 (4)

A centrifugal clutch has four blocks which slide radially in a spider, keyed to the driving shaft. When the clutch is at rest, each block is held 5 mm clear of the drum by means of a spring exerting in this position a pull of 200 N the mass centre of each block then being 200 mm from the axis of the clutch. The internal diameter of the drum is 500 mm and the mass of each block is 7 kg. The stiffness of each spring is 20 N per mm. The coefficient of friction is 0,3. Calculate the maximum power the clutch can transmit at 10 rps.

Suggested answer:

$r = 200 + 5 = 205\text{mm}$
$Fc = 7 \times (2\ 10)^2 \times 0{,}205 = 5665{,}15 \text{ N}$

Inward centrifugal force on each shoe exerted by the spring = Pc
Pc = F spring + F due to spring stiffness
Pc = 200 + (20 × 5) = 300 N

Fr = Fc + Pc = 5365,15 N

Total friction torque = Tμt = n R μ Fr
Tμt = 4 × 0,25 × 0,3 × 5365,15
Tμt = 1609,55 Nm

Power = 2 π × 10 × 1609,55 = 101,13 kW

Jorge Pereira GCC Preparation Classes (Pty) Ltd.
Part-time GCC Classes in Cape Town
For details contact Jorge Pereira at
082 896 8489 or jorgepereira43@yahoo.co.za

Plant Engineering: MINES mechanical question

Question (June 1991, Question 6)

A mono-rope conveyor system has a total length of 400 m between the tensioning pulley and the return pulley and is used to transport material to the working place.

The bundles of material have a mass of 100 kg and is transported to the top of a 5 in 1 incline, 410 m from the loading station. The bundles are conveyed at 20 m intervals at a velocity of 0,8 m/s.

The rolling resistance coefficient is 0,15 and the coefficient of friction between the driving wheel and rope is 0,065. The driving rope passes two turns round the driving sheave.

Determine the:
(i) tight side tension of the rope
(ii) minimum slack side tension of the rope
(iii) minimum initial tension in the rope
(iv) power to drive the loaded rope [10]

Proposed Solution:

The loads of 100kg are 20m apart. Thus, the load imposed on the load is $100 \times \frac{400}{20} = 2000\text{kg}$

This load imposes a tension at the top pulley of $T_p = H_p \left[1 + \frac{4y_b^2}{xb_b^2}\right]$ where Hp $= \frac{w_b^2 g}{2y_b}$

where $w = mass\ per\ m\ run = \frac{2000}{400} = 5\frac{kg}{m}, \quad and\ x_b = 402m\ and\ y_b = 80.4m$

The vertical velocity of the load $= 0.8 \sin 78.7° = 0.745\ m/s$

Power required to move only the load

$= F \times \quad = 2000 \times 9.81 \times 0.745 = 15.4kW$

Now $\frac{T_1}{T_2} = e^{\mu\sigma}$ *where* $\mu = 0.065$ *and* $\sigma = 4\pi$ *radians,*

$\therefore\ T_1 = T_2 e^{0.065\times4\times3.1416} = 1.22655T_2$

Also $T_1 - T_2$ = force used to move the load and overcome friction.

Thus $1.22655T_2 - T_2 = \frac{15400}{0,8}$ + force to overcome friction.

Now the rolling resistance can be considered to be $0.15(T_1 - T_2)$

So $0.22655\ T_2 = 19250 + 0.034\ T_2$

$\therefore\ T_2 = 100kN$ from which $T_1 = 122.655$ and $T_1 - T_2 = 22.655kN$

(i) To the tight side tension the tension required to support the load must be added so total tight tension of $T_1 = 122.655 + 40 =$ **162.655 *kN***

(ii) minimum slack side tension of the rope, Thus $T_2 =$ **100 *kN***

(iii) minimum initial tension in the rope $= \frac{T_1 + T_2}{2} = \frac{162.655 + 100}{2} =$ **131.31 *kN***

(iv) power to drive the loaded rope $= (T_1 - T_2)v_r = 22{,}655 \times 0.8 =$ **18.12 *kW***

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A Legal Knowledge: MINES question

Question (June 2021, Question 3):

The mine is busy installing scraper and mono winches. What safety measures must the employer include during installation of scraper and mono winches to ensure persons are not injured? [10]

Proposed answer

8.4 Scraper Winch and Mono-Rope Installation

(2)(g) a written procedure is prepared and implemented for the installation of the winch system, covering at least-

(i) the requirements of scraper and mono-winch foundations and installations;

(ii) the crossover and anti-fouling arrangements of ropes from two or more winches;

(iii) illumination of the moving parts of any winch so that they can be identified by persons;

(iv) appropriate sheave and return pulley anchor and rigging arrangements, including the use of safety slings;

(v) measures to ensure that winch ropes are used within the design capacity;

(vi) winch starter box location to ensure ease of operation by the operator; and

(vii) the moving and transport of winches from one location to another

ECSA update.

For all our members who are Registered with ECSA as Pr Cert Eng's - please note that we do try to keep updating members with what is on the go.

The are two items that I want to mention and discuss in this article.

Firstly is the matter Identification of Engineering Work (IDoWE).

This item should be of interest to ALL engineers - in particular the Certificated Engineer - as in the near future we are all going to have to do some fancy footwork to be able to practice as Engineers.

I suggest that you read the Gazetted publication of IDoEW by clicking on the link below. It would be best to download the document so that you can read it at your leisure!

IDoEW_Gazette

The ECSA is putting together a number of "Consulting" Sessions in the next few months. I attended the one held recently for Voluntary Associations. The work "Consulting" was questioned as the Gazette on IDoEW has already been published.

The answer to this is that ECSA is consulting with Engineers around the Country how the IDoEW process is going to be implemented.

As part of the Gazette, ECSA has also published an Overarching Code of Practice which is on the next link. Again, I recommend that all members and fellow engineers download the document and study it.

IDoEW_Overarching_COP

The ECSA want to put the code into place within the next few years.

So - members, *et al*, pay heed as this one is on the horizon for implementation.

The second matter I wish to bring to your attention is the following:

As a matter of course, the ECSA, through it's various sub-committees, revise all the codes and policies - and one that is being revised right now is the ***R-05-PCE : Discipline Specific Training Guideline and Requirements for Candidate Certificated Engineers***. The single code has been split into 4 (four) Policies as follows:

R-05-MW-PCE: Sub-Discipline Specific Training Guideline and Requirements for Candidate Certificated Engineers (Mines and Works).

R-05-FE-PCE: Sub-Discipline Specific Training Guideline and Requirements for Candidate Certificated Engineers (Factories).

R-05-MM-PCE: Sub-Discipline Specific Training Guideline and Requirements for Candidate Certificated Engineers (Mine Managers).

R-05-ME-PCE: Sub-Discipline Specific Training Guideline and Requirements for Candidate Certificated Engineers (Marine).

As the first two are applicable to Certificated Electrical and Mechanical Engineers, I would appreciate it if members could peruse the two policies and submit comments on the forms provided on the ECSA Website.

The following link will make it easier.
ECSA Policy Update

Thank you for participating.

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The Institution is in the process of organising another **GCC Candidate Masterclass**.
This set of sessions will be held making use of the virtual platform Zoom and will take place from 25 to 29 October 2021.

The flyer is posted here for information. Please inform anyone you may know who is writing the GCC examination in November 2021.

A few study tips for Candidates to think about at this stage of preparation.

1. Always do your best to remain calm and not to panic while in the exam room. When you panic, your mind will not function properly.
2. When doing your revisions, start with the subject matter that you are good at and comfortable with and finish with the one's you are not too happy with. Use the same approach in the examination. This will boost your confidence.
3. On the legal side of things, try to apply the Regulations to actual situations to understand them better. Especially safety procedures when carrying out high risk work.
4. Prepare by using past examination papers, as this will give you an idea of the expected content and format. Further, you may get a question similar to ones you have studied.
5. Try to find a buddy or partner to study with. It is always better to bounce ideas and problems with someone else who is in the same situation as yourself.
6. Reach out to other persons who can assist you in your preparation.

Good luck in your endeavours!

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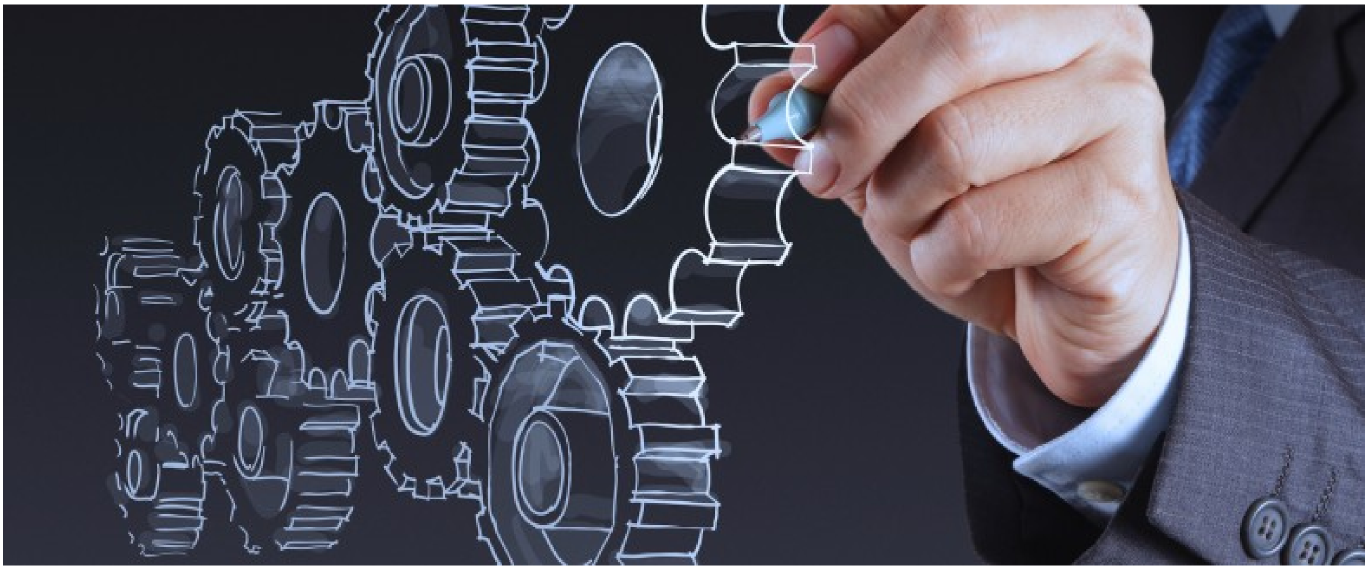
The Institution of Certificated Mechanical and Electrical Engineers, South Africa



LIMITATION
Online seats are limited (100) and preference will be given to candidates writing their exams in November 2021.

RSVP

Click here for registration form or contact the Secretary
info@icmeesa.org.za

LOCATION: Will be a virtual presentations using ZOOM platform.

First National Bank
Eastgate Branch
Branch Code: 257705
Account No: 50390026406
Ref: Use your Identity Number
Amount: R650

https://forms.gle/LHEpn2ZHiW71Ep3y6

Government Certificate of Competency Pre-Examination Candidate Masterclass 25-29 October 2021

TRAINING SCHEDULE

- **Monday 25/10/2021 18:00 to 19:00**
  Mechanical Exam Question (Willem van der Westhuizen)
- **Tuesday 26/10/2021 18:00 to 19:00**
  Electrical Exam Question (Greg Clack)
- **Wednesday 27/10/2021 18:00 to 19:00**
  Mechanical Exam Question (Willem van der Westhuizen)
- **Thursday 28/10/2021 18:00 to 19:00**
  Electrical Exam Question (Greg Clack)
- **Friday 29/10/2021 10:00 to 11:30**
  Legal Matters (Greg Clack) &
  Department of Labour and Employment presentation

73 Fifth Avenue, Northmead, Benoni
Tel No: 0878222229 Mobile No: 0847758888
E Mail: info@icmeesa.org.za

WWW.ICMEESA.ORG.ZA

ELECTRICITY GENERATION AND THE GAS TURBINE Continued…
(PART TWO)

GAS TURBINE GENERATORS

The injection of specialized gas turbine peak load plant into an expanding electrical system not only firms up the suppl in a manner unapproached by any other means reducing the capital cost per kW of the system as a whole but it also increases the load factor on existing base load plant improving overall efficiency with further benefit to the system. In order to provide maximum insurance, the peak load station is best placed as close as possible to the consumer, saving not only the capital cost of expensive base load generating plant and transmission equipment but also distribution losses which may amount to 10 per cent of the peak load generated.

The location of gas turbo generators in a power consuming area remote from the main base load generating stations makes them potentially viable as synchronous power factor compensators at a utilization considered high enough to warrant hydrogen cooled alternators. The elimination of wattless current is of importance in connection with the supergrid where the reactance of the line causes difficulty at light loads when generation is not a problem, moreover the electrical stiffening enables the system to cope with load and fault transients which can upset industrial units placed at the end of long supply lines.

The marginal use to which peak load plant is subject requires that in addition to being cheap in first cost it should occupy the smallest area possible with the minimum of ancillary services, such as cooling water. While it needs to be fully operative on demand it should not require the constant attention of a permanent staff because it may need to be sited in isolation from the main generating centre. The simpler and more straightforward the design of the plant the more likely it will be able to satisfy this criteria and the original 17½ MW automatically controlled gas turbo generator manufactured for the Central Electricity Generating Board meets this specification in all respects. This engine succeeded in establishing a permanent place for the gas turbine in the more progressive electrical utilities (Fig. 11).

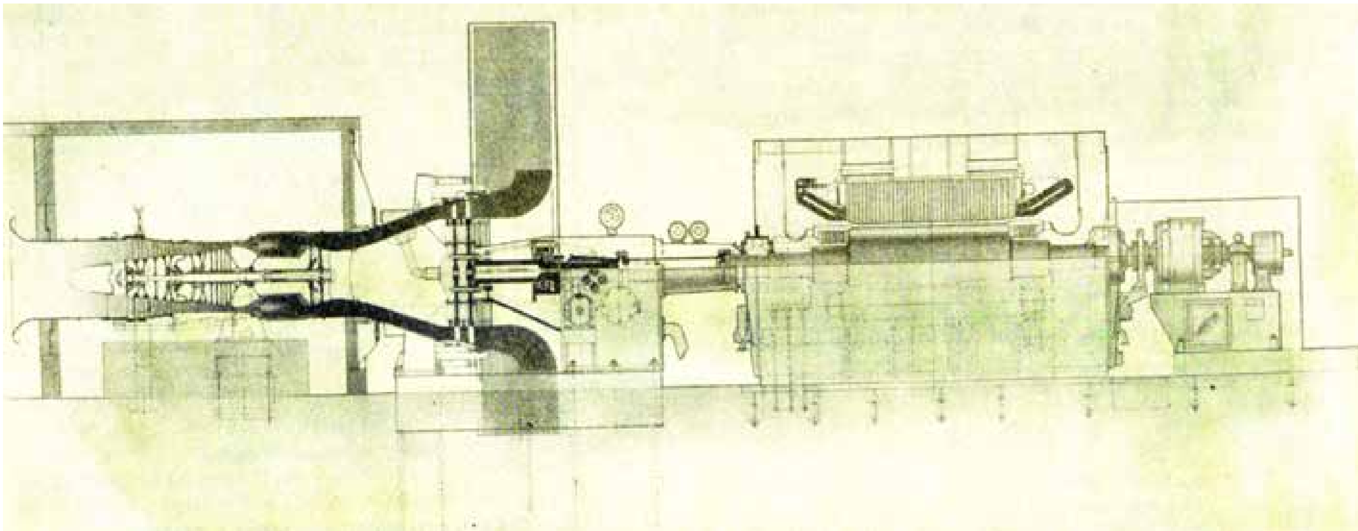


Fig. 11
17½ MW turbo generator

The most difficult and costly parts to produce in these high performance gas turbines are those associated with the compression and heating of the working. fluid. The. arguments in favour of standardizing basically identical components, even for such widely different usages as marine engines and electrical generators, are formidable. The aero jet engine, which had already proved to be far more reliable than its piston engine counterpart, provided the basic design philosophy for a compact unit to meet these requirements.
The necessity for maintaining a high availability of both civil and military aeroplanes had forced the

manufacturers to supply engines requiring the minimum of attention in service with facilities for the rapid replacement of the power unit for scheduled maintenance at a centralized and fully equipped repair base. Perhaps the most important contribution the aero engineer has been able to make in the field of industrial gas turbines is the concept of the standardized removeable gas generator.

The gas generator or hot end of the engine is constructed as a separate entity complete with its own auxiliaries. Basically identical units connected by gas ducting only to specially designed free power turbines for a variety of widely differing applications ensure the minimum outage of the main plant during inspection and repair (Fig. 12).

The problems involved in producing even the most ambitious power turbine are negligible compared to the effort required to develop a reliable and efficient gas generator. By compounding multiples of these standardized units with a range of power turbines, engines of compact configuration can now be produced to develop powers so far in excess of those attainable hitherto that one can say a new type of prime mover has been introduced. Having once established a suitable gas generator every effort should be directed towards its perfection, resisting temptation to diversify engineering effort to produce similar designs of slightly different form to suit a particular requirement. It is usually far more rewarding to develop an established design than to start from the beginning on an entirely new project.

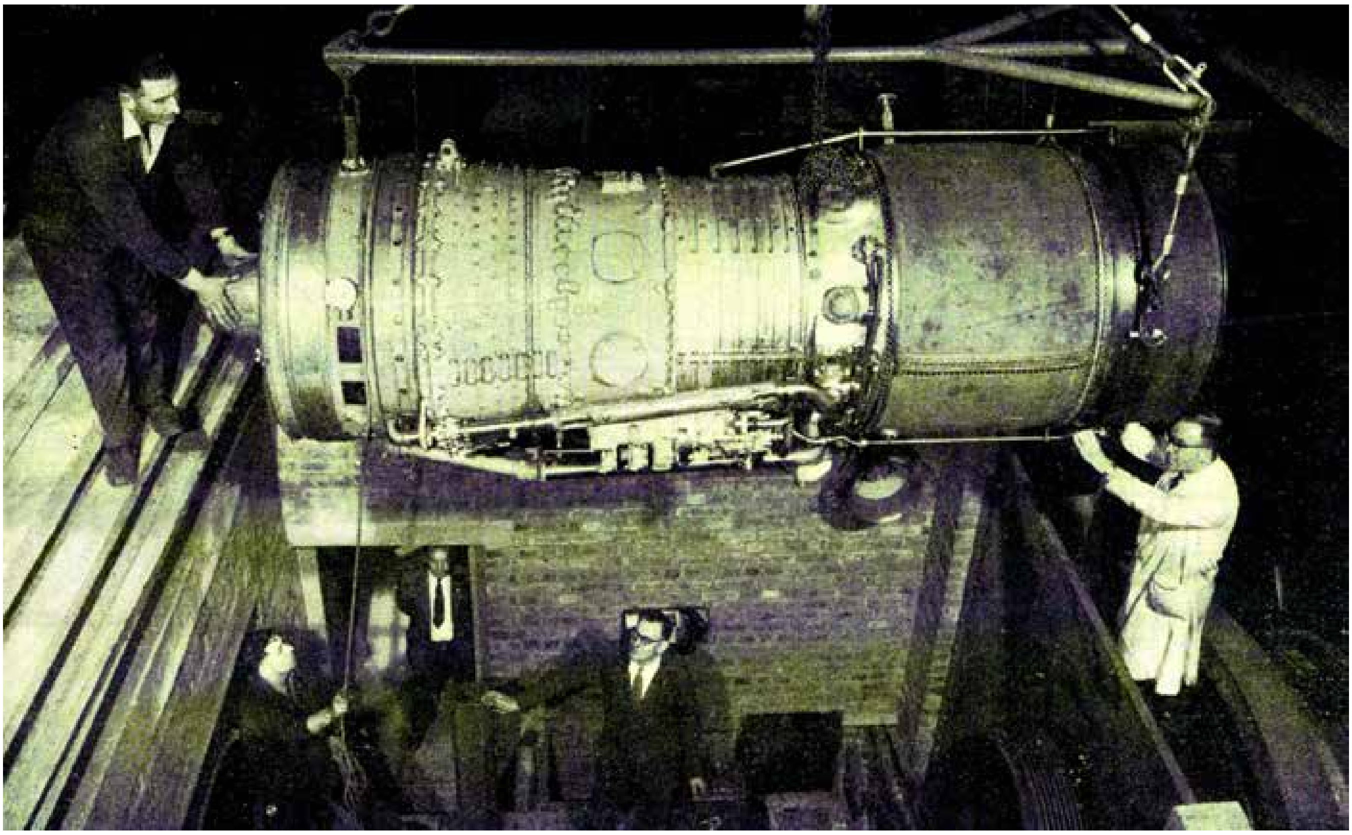


Fig. 12
Changing the gas generator

The Olympus is an efficient gas producer and has operated satisfactorily in an industrial capacity at ratings suitable for a full range of large marine and industrial gas turbines. This unit of 30,000 gas hp is a simple cycle high pressure ratio design with a five stage low pressure and a seven stage high pressure axial compressor each driven by its own single stage turbine. There is little doubt that the twin spool engine is the most suitable type of gas generator available. The machine is in effect a simple jet engine supercharged by a coaxial exhaust driven blower; the two systems being mechanically independent operate at optimum conditions, consequently the high overall pressure ratio is obtained without the need for blow off valves and the engine is extremely stable accepting rapid changes in load without stalling (Fig. 13). The unit weighing 53 000 lb has been developed from the aero-engine used in the Vulcan high altitude strategic bomber in service with the Royal Air Force and has a background of over a quarter of a million engine hours in flight.

Air is drawn through guide vanes into the aluminium alloy low pressure compressor casing constructed in halves to facilitate assembly. The compressor rotor is supported at its forward end by a roller bearing and at the rear by a duplex ball locating bearing. The air is then directed through exit guide vanes into an intermediate casing housing the accessory drives and supporting adjacent compressor bearings through eight radially disposed hollow vanes encasing the drive shafts. The air flows from the Intermediate casing through guide vanes into the high pressure compressor. This steel casing is also machined in halves to facilitate assembly of the stator blades. All compressor blades and stators are in stainless steel, the rotor blades having fir tree roots in stainless steel discs.

The air which has been compressed to about ten atmospheres passes to the delivery casing and is diffused before entering the combustion system. The inner part of this fabricated steel casing supports the high pressure compressor rear thrust bearing by eight hollow vanes through which air is ducted for pressurizing the bearing seals and cooling the turbine. The atomizer bodies also located in this assembly are removeable for inspection.

The combustion system consists of a stainless steel outer casing constructed in halves and enclosing a group of eight interconnected and removable flame tubes manufactured in nimonic sheet and supported at the front end by the duplex burners which fire downstream and at the rear by the inner casing which also carries the front turbine bearing. Fuel is injected into each flame tube and the resultant mixture in the ratio of about sixty parts by weight of air to each part of fuel is ignited initially by two glow plugs located on either side of the outer casing, thenceforth the flame is self sustaining and the resultant high velocity gas is directed by convergent ducting into the turbines which drive the compressors.

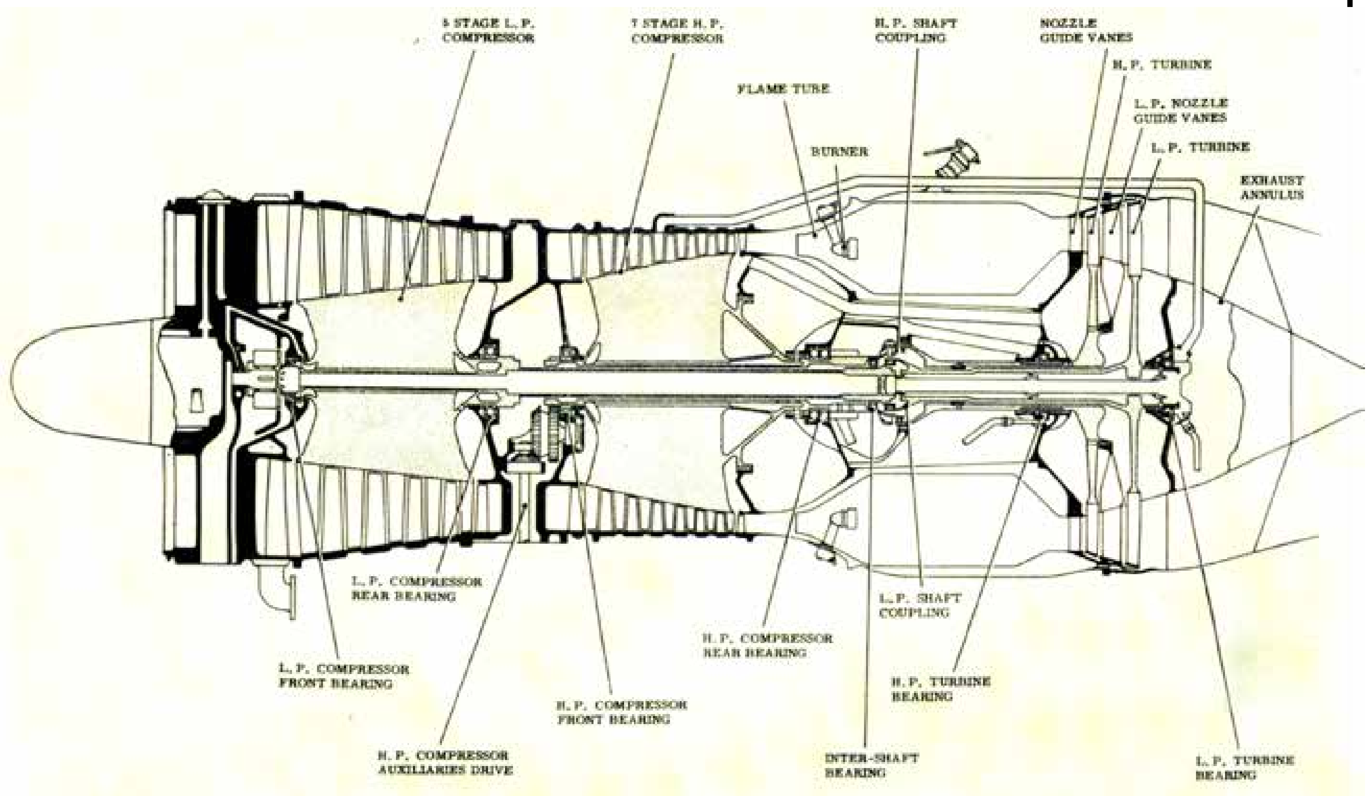


Fig. 13
Olympus gas generator.

Precision cast stators direct the gas into the first stage wheel and through a second row of stators into the final stage. The close forged nimonic blades are held in the heat resistant steel turbine disc by fir tree fixings. Both discs are located on their respective shafts by means of Hirth couplings. The hollow shaft bolted to the second stage disc passes through the centre of the first stage turbine assembly and the forward end of each shaft is positively attached to its respective compressor thus balancing component thrusts. The turbine exhausts into an annular casing carrying the rear turbine bearing and the gas which is now reduced in temperature enters the interturbine duct to drive the free power work turbine.

The emphasis on a high power weight ratio for the aero-engine resulted in a jet engine of compact construction, all component parts, being no heavier than necessary to achieve satisfactory operation, are able to withstand severe thermal shocks with a minimum of distortion which is conducive to long life under a wide range of operating conditions. This characteristic has been retained in the industrial gas generator. The use of ball and roller bearings facilitates the rigid mounting of components under heavy load and high rotational speed. Experience has shown that, provided this type of bearing is adequately supported and correctly lubricated, a long life can be expected and the ease with which they are able to accept load within seconds of initial rotation makes them suitable for use in engines designed for rapid power loading from a cold start. The power demanded for starting the Olympus is exceptionally low as only the high pressure component has to be rotated by the 40 hp electric starting motor.

It was arranged to limit the maximum cycle temperature of the industrial engine to that proved to be satisfactory at the cruise rating of the aero jet. This ensures that the thermal stresses in the gas generator would not range beyond well established parameters. However, although the rotational speeds of the compressor assembly and the mean entry temperatures of the turbine of the industrial unit are comparable to those of the aero-engine at cruise conditions, the mass flow of air and the power output is much greater from the turbo generator. It is nearly proportional to the relative intake air densities on the ground and at say Mach 0.9 at an altitude of 60 000 ft and it was necessary to modify the design in certain detailed but important respects.

It follows that continuous duty at the industrial rating results in a greater difference in the mechanical loading of the main thrust bearings on the gas generator compared to operation at altitude than almost any other major component and the size and capacity of both the low pressure and high pressure compressor assembly thrust bearings have been increased accordingly (Fig. 14).

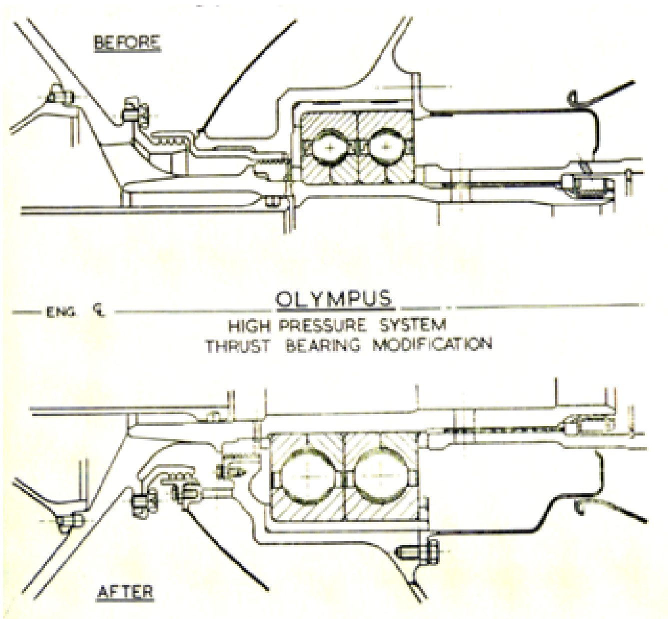


Fig. 14
Modified thrust bearing

The intensity of combustion again related to power output is about five times as great in the industrial engine compared to the aero jet at cruise conditions and this increase in the rate of heat released in the combustion system causes local hot spots in the flame tubes although the mean temperature is the same in both cases. The increased agitation of the burning gases results in local fatigue rupture of the metal in this region requiring modifications to redistribute the cooling air and to strengthen the flame tube structure. Similarly, tests carried out to achieve smokeless combustion necessitated modification to the burner system to compensate for the difference in viscosity between kerosene and diesel oil fuel. These were confined to the injection pressure, the angle of the burner spray and the swirl characteristics, requiring further detailed design changes to the combustion chamber to accommodate the new flame pattern.

The 17½ MW power turbine specifically designed for the Central Electricity Generating Board to be as simple and straightforward as possible is a two-stage 3000 rev/min axial flow type directly coupled to a 50 c/s air cooled alternator. The nimonic blades are held by fir tree roots in the rotor discs which are bolted and located to the mainshaft through Hirth couplings. The assembly is supported cantilever in two white metal bearings lubricated from a recirculating system and housed in a pedestal containing the accessory drives. The stator casing is centralized in relation to the rotor assembly by a support ring through radially secured mounting brackets and is assembled in sections for blade inspection. The rear flange is attached to an expansion joint on the exhaust volute in which the exhaust gases are expanded to a low velocity before passing to the final duct (Fig. 15).

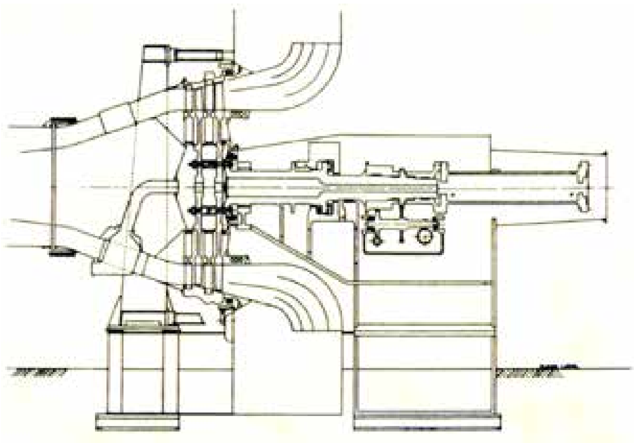


Fig. 15
25 000 h.p. free power turbine

All parts of the power turbine in direct contact with the hot gases are arranged to expand freely and to accept a high rate of change in temperature without loss of concentricity. The bearings are lubricated by the same system that serves the alternator providing jacking oil for both units. The power turbine and alternator rotor shafts are connected through a gear type coupling. In later versions it was required to operate the alternator disconnected for power factor correction and a fully automatic clutch was incorporated into the final drive from the power turbine. The device operates on torque reversal and with the generator stationary the clutch will engage as soon as torque is applied by the power turbine. When the generator is running as a synchronous condenser at mains frequency the clutch will engage as soon as the speed of the power turbine tends to overtake that of the alternator, similarly, as soon as the power turbine ceases to provide driving torque the clutch will disengage and release the generator from the power turbine. (Fig. 16).

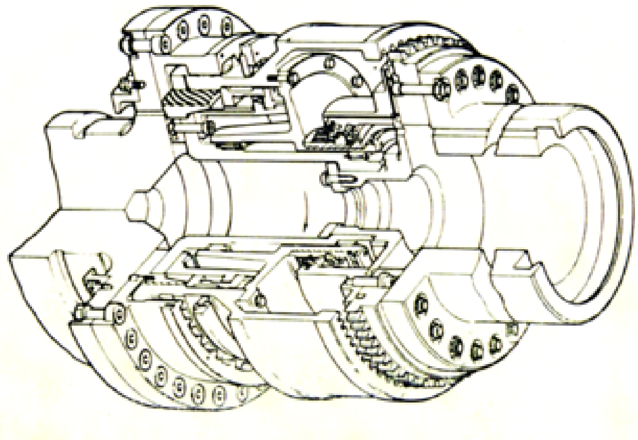


Fig. 16
Automatic self-shifting clutch.

The design life of these power turbines is comparable to that of the alternator and there should be no need to dismantle these components during the life of the set. A quick release coupling incorporated in the inter-turbine duct connecting the gas generator to the free power turbine facilitates the removal of the hot section of the engine for inspection and maintenance. Because there is no mechanical drive but only a gas duct between these two parts of the engine, no troublesome shaft alignment is required on reassembly.

To be Continued….

Email received regarding Green Building Market asessmewnt.

If interested, please take time to do the survey.
Thank you. Ed.

info@icmeesa.org.za

From: Swanepoel, Bernice <Bernice.Swanepoel@eu.jll.com>
Sent: Thursday, 30 September 2021 09:48
To: icmeesa@icmeesa.org.za
Cc: Rohr, Hildegard
Subject: Green Building Market Assessment - JLL for IFC

Good day,

By way of introduction, my name is Bernice Swanepoel and I am a manager in JLL's Strategic Consulting division. JLL has been engaged by the International Finance Corporation (IFC) to conduct a stakeholder assessment on the Green Building market in emerging economies. As a phase 1 of the study we are sampling stakeholders in South Africa who have knowledge of or are active in the Green Building market – engineers being key amongst them.

Our study is conducted through an online survey hosted on the Survey Monkey platform which takes respondents 5-10min to complete (please see link below to the relevant survey).
https://www.surveymonkey.com/r/QYVN9D9

This data collected in this study will be completely anonymous and will be used to inform a research publication which will be made publicly available by the IFC.

I would like to enquire if it would be possible for the Institution of Certificated Mechanical and Electrical Engineers to distribute the survey to your members? I would be happy to have a call at your earliest convenience to discuss any questions or concerns you might have regarding our request.

Looking forward to hearing from you.

Kind regards,

Bernice Swanepoel Ph.D
Manager - Strategic Consulting
Specialist Advisory
JLL
Office 303, 3rd Floor, The Firs
Cnr Biermann and Cradock Ave, Rosebank
South Africa, 2196
T +27 11 507 2200
M +27 82 698 2010
jll.co.za
africa.jll.com

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