is always justified in taking questions as they are given him. Viewing it in this light the reply would be, No.

The explanation of this is as follows: Under ordinary conditions we say that when a space is filled with steam, even if the pressure is only one pound above a vacuum, it is full, because nothing is there but steam, and yet when we bring the whole matter down to what is technically correct, a space is never full so long as it is possible to get anything more into it, therefore when steam is forced in until the pressure is thirty-five pounds by the gauge, it is not one-half full, neither is it full when the pressure rises to seventy pounds, for more can be forced into it, and it is difficult to locate the limit.

7. How do you find the ratio of expansion for a compound engine?

A. There are two ways of doing this, one of which is to determine the volume of the high pressure up to the point of cut off, also the total volume of the low pressure cylinder. Divide the latter by the former and the quotient is the ratio of expansion for the engine. The other is to multiply the ratio of expansion in the high pressure cylinder by the ratio in the low pressure, and the product will be the total ratio. There are many engineers in charge of fine plants that do not understand this, for it appears as if the ratios of the two cylinders should be added together instead of multiplied.

Take the case of an engine with a high pressure cylinder twenty inches and a low pressure forty inches in diameter, making the areas 1 to 4, and assuming that the cut off takes place at one-quarter stroke. This makes the ratio 4 for the high pressure cylinder, because at the end of the stroke the space filled by the steam is four times as large as at the point of cut off. When the exhaust valve opens and allows the steam to go to the low pressure cylinder, it fills it at an equal pressure up to one-quarter stroke, at which point the ratio is still 4, but when the low pressure piston has advanced to one-third stroke it is 8, at three-quarters stroke it is 12, and at the end of the stroke it is 16. As it is 4 for each cylinder, it is $4 \times 4 = 16$ for the combined or total ratio. In this case the effects of clearance are neglected, in order to make the illustration simple and comprehensive.

8. The areas of the pistons of a three cylinder triple expansion engine are 100, 300 and 900 square inches respectively. The ratio of expansion in the high pressure cylinder is 3. What is the ratio in the intermediate cylinder? What is it for the low pressure cylinder? What is the combined ratio?

A. As the ratio in the first cylinder is 3 and the second or intermediate cylinder is three times as large, the cut off would take place at one-third stroke, making the ratio 3. The low pressure cylinder is three times as large as the intermediate, therefore the ratio is three for this also, and the combined ratio is $3 \times 3 \times 3 = 27$.

Another way to explain this is to assume that the stroke of all pistons is thirty-six inches, thus locating the cut-off in the high pressure cylinder at $36 \div 3 = 12$ inches. The contents of it up to this point is $100 \times 12 = 1,200$ cubic inches. The contents of the low pressure cylinder is $900 \times 36 = 32,400$, and dividing one by the other shows that $32,400 \div 1,200 = 27$.

9. What is latent heat?

A. Heat that is not indicated by a thermometer. Heat is a form of motion, so that when water is heated to the boiling point the molecules of which it is composed are set in active motion. This is indicated by a thermometer, but when more heat is applied in order to increase the motion of the molecules and throw them further apart so as to form steam, it is not shown by a column of mercury, therefore it is said to be latent or hidden.

10. What is sensible heat?

A. Heat that is indicated by a thermometer, or that is sensible to the touch.

11. What is meant by the absolute zero of temperature?

A. It means a temperature so low that it is impossible for it to go lower. In other words, it means when the molecules are brought to a state of perfect rest. This has never been secured in practice, and is therefore a theoretical calculation only, but it is necessary for use in many engineering calculations. By the Fahrenheit scale it is 461, by Reaumer 229, and Centigrade 274 degrees below zero.

For the Fahrenheit scale, which is the one most commonly used in the United States, it is calculated as follows: It has been determined that a quantity of mercury will shrink about $\frac{1}{491}$ of its bulk for each degree that its temperature is lowered. Starting at the freezing point, which is 32 degrees, in order to reduce its bulk to nothing it must fall about 493 degrees, or to $493 - 32 = 461$ degrees below zero.

12. What is the total weight of a column of water whose cross-section is nine square inches, the height being one hundred feet and the temperature 62 degrees Fahrenheit?

A. 389.375 pounds. As the cross section of this column contains nine square inches and it is $100 \times 12 = 1,200$ inches high, it contains $9 \times 1,200 = 10,800$ cubic inches, or $10,800 \div 1,728 = 6.25$ cubic feet. At a temperature of 62 degrees, one cubic foot weighs 62 3 pounds, and the whole will weigh $6.25 \times 62.3 = 389.375$ pounds.

13. What is the difference between a continuous and an alternating current of electricity?

A. A continuous or constant current flows in one direction only, but an alternating current (as its name indicates) changes its direction, or alternates many times per second, the number depending upon the design of the generator that supplies the current.

14. When the reading of the voltmeter and the ammeter are given, how do you determine the electrical horse-power?

A. Multiply one by the other and divide by 746.

15. What is a volt?

A. It is the unit of pressure in electrical work, the same as the pound is for steam pressure. When the conductor cuts 100,000,000 lines of force per second, a pressure or potential of one volt is generated.

16. What is a kilowatt?

A. One thousand watts, and as 746 watts make one horse-power, a kilowatt is practically one and one-third horse power.

17. Explain briefly the theory of mechanical refrigeration.

A. Some liquid or gas, usually ammonia, is compressed by a mechanical device called a compressor, or by expansion caused by the application of heat, until a high pressure is secured, and the heat concentrated, after which it is removed by cold water in a condenser. Passing on through pipes until an expansion valve is reached it is allowed to expand into a much larger volume in pipes of greater diameter. As it does not contain heat enough to supply the increased volume, it attracts it from the surrounding air, in the direct expansion system, from the brine in the indirect system, thus producing a low temperature.

18. Why is ammonia used in this process?

A. Because it is readily obtained at a moderate price, it is quickly changed from a gas to a liquid, and its expansive properties are very great.

19. What is the latent heat of ice?

A. It is 142 heat units. It is so called because when ice is at a temperature of 32 degrees it requires the application of 142 heat units to melt one pound of it into water at 32 degrees, and when in the form of water as above stated, it is necessary to abstract 142 heat units in order to freeze it.

20. Why is salt water used in circulating pipes instead of fresh water?

A. Because it can be reduced to a lower temperature without freezing.

21. What is a gas engine?

A. It is an engine in which either natural or manufactured gas is burned in the cylinder in order to move the piston.

22. What is a gasolene engine?

A. An engine in which the gas formed from gasolene is burned in the cylinder.

23. How do you determine the mean effective pressure of a gas engine?

A. A diagram is taken and its mean effective pressure computed the same as for a steam engine, but the time during which this pressure is acting on the piston must be taken into account. If there is one explosion for four strokes, the pressure shown by the diagram must be divided by four to decide the mean effective pressure for the full piston speed, or the actual mean effective pressure for one stroke may be taken, and one-fourth of the piston speed taken when calculating the power developed by the engine.

24. What is meant by a two cycle engine.

A. It means an engine in which there is one explosion of gas for each two strokes made. The term "two stroke cycle" is much more comprehensive.

25. Why are heavier fly wheels used on gas engines than for steam engines of the same power?

A. It is necessary to do this in order to maintain steady speed. In some engines there is one explosion for two revolutions of the machine, thus making the impulses far apart, so that in the absence of heavy fly wheels or balance wheels, to absorb and give out the power developed, the speed would be very unsatisfactory. The same is true, in a less degree, of two cycle engines. The Tradesman.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

The Ontario Association of Stationary Engineers held their annual convention in London on May 28th, at which there was present a good representation of the certificate holders. The report of the registrar as to the membership showed 917 as the total number upon the books, of which 13 have died, 8 are blank numbers, and 154 have been cancelled, leaving 742 members on the books.

The financial statement of the treasurer showed an income, including the balance from last year, of $653.99, and an expenditure of $517.89, leaving a balance on hand of $136.10.

A full discussion of the license law and the prospect of having it passed, brought out the fact that many steam users who were at one time opposed to the measure, were now favourable to it, and a committee was appointed to further enlighten the steam users generally as to the working of the proposed act.

The election to fill the place of the retiring members of the board, resulted in the selection of Messrs. O. P. St. John, of Toronto, A. E. Eakins, of Toronto, A. M. Wickens, of Toronto, and Alex. Findlay, of London. The board then elected its officers by selecting O. P. St. John as president; Thos. Elliott, of Hamilton, as vice-president; J. G. Bain, 113 Yorkville avenue, Toronto, registrar, and A. M. Wickens, of Toronto, treasurer.

A lively election occurred for the next place of meeting, St. Thomas, Paris, Brantford and Berlin all being named, with the result that the ballot was in favor of Berlin. The usual complimentary votes to the officers were then passed, and the meeting closed in time for most of the delegates to catch the evening trains for their respective homes.