Heat effect on the efficiency of otte cycle

Amer Hussein Ali
Faculty of Education
Tripoli University

Mohmamed Ahmed Alazoumi
Faculty of Science
Azzaytuna University

الملخص

دورة اوتو (OTTO) هي طريقة هامة لدوران محركات الاحتراق الداخلي ،حيث انه على مدار العشرين عاما الماضية قد اعتاد العلماء في مناطق متعددة على استخدام نظرية الديناميكيا الحرارية للفترات الزمنية المحدودة والتحكم المحدود ، مقدمين مجموعة متنوعة من الدورات الغير رجعية، و دارسين بذلك لكفاءة المقياس الحرارى الخاص بدورة (OTTO) والحصول على نتائج عديدة.

و تناقش هذه الدراسة قانون حركة المكبس وتهتم بدراسة الهياكل الزمنية و الفواقد الناتجة من الاحتكاك،وكذلك تأثير الفقد الحرارى، وتحتوى على كم من القيم النظرية والعملية . حيث ان هذه النتائج أقرب بكثير إلى الواقع من الحالة المثالية التى فى دورة (OTTO) و بالرغم من ذلك، ونظرا لاستحالة التقاسم الفعلي ، فلا تزال هناك فجوة بين هذه الدراسات والوضع الحقيقي.

كما اختبرت هذه الدراسة التأثير اللارجعى لعملية العزل على كفاءة دورة (OTTO)، حيث ان دورة (OTTO) تتكون من أربعة أنماط معدلة من حيث حماية الاحتقان ، والتسخين على نفس الحجم و الحماية من التمدد والانبعاثات الحرارية بنفس الكم من الطاقة

Abstract

Otto cycle is an important means of rotating an internal fire engine. Over the past 20 years, scientists at home and abroad have used thermodynamic theory of limited time and control, introduced a variety of irreversible cycles, studied the efficiency of Otto's thermometer and obtained numerous results. The law of piston motion is discussed in this article which looks at time structures and friction losses, and the study discusses the effects of heat loss. These results are much closer to reality than the epitome of the Otto cycle and have a number of theoretical and applied values. However, due to the impossibility of the

participatory process, there is still a gap between these studies and the real situation. This document examines the irreversible effect of the isolation process on the efficiency of the Otto cycle. The Otto cycle, suitable for the Otto cycle, consists of four modified forms of congestion protection, heating at the same volume, expansion protection and thermal emissions with the same energy.

Introduction

German inventor. In his early years of business, after reading in the newspapers in 1861 about the invention of the gas engine by the French Renault (E. Lenoir, 1822-1900), the idea of an internal fire and four strokes by French engineer AB Ro Rochas (1815-1893) was used to make compressed engines, which were patented in several countries between 1862 and 1864. In 1864, he founded Langen

(1833 -1895) in collaboration with German engineer E. Langen (1833-1895) to produce an engine, which was later developed to win a gold medal at the International Fair in Paris in 1867. In 1872, the German Gas Engine Company was formed.

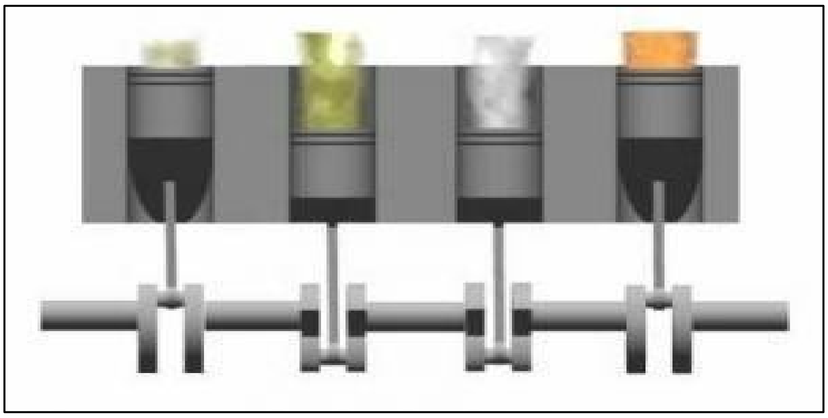

Figure 1 Four stroke engine

In 1877, an improved gas engine was patented, making it more useful for gas engines. The development of his gas engine formed the basis for the recent invention of the gas engine by German inventor G. Daimler (1834-1900).

Otto's cycle is also known as the four-stroke cycle, a kind of warm internal fire cycle cycle, which is a warm-blooded cycle of moderate heat. One Otto cycle circuit consists of four valves: the suction process, the compression process, the expansion operation process and the extraction process, and then the piston goes down to allow the mixture of fuel and air to enter the cylinder with one or more valves, closing the air port. The piston rises to compress the compressed gas, then heats the mixture with a spark plug as it approaches the edge of compression stroke, and the pressure exerted by the blast forces the piston to go down, complete the blowing, and finally release the hot gas through the valve. Discharge.(Woodbank Communications Ltd, Retrieved 2011,4-11)

System mechanism

Crank connecting rod mechanism

The crank connector is an integral part of the engine movement to achieve a working cycle and complete power conversion. It consists of a body group, a connecting piston group and a crankshaft fly wheel. During drilling, the piston is placed under gas pressure to make a direct movement in the cylinder, which rotates using the power that comes from a rod connected with the crankshaft. In air space, pressure and discharge movement, the plane wheel releases energy and converts the rotational movement of the crankshaft into the direct movement of the piston.

The gas distribution mechanism

The gas distribution mechanism main usage is to help in closing and opening the valves of air and exhaust instantaneously depending on the movement of the engine, so whether the combustible blend or air enters the cylinder and the depleted gas get away through the cylinder exhaust system. Most of the gas distribution mechanisms are equipped with overhead gas distribution mechanisms, which are generally composed of a gas gate group, a gas gate transmission group and a gas gate drive group.

Fuel supply system

The function of the fuel engine fuel system is to produce a certain amount and filter gas mixture according to the needs of the engine, which is supplied to the cylinder and will be burned.(Kaplan and Glass,1995)

The extracted gas is carried to the air with the assistance of the cylinder. The most utilization of this fuel supply system is to supply gas diesel and air to the cylinder. At the same time, it forms a gaseous blend within the fire chamber and deplete the escaping gasses.

Lubrication system

Its main function is to bring a certain amount of clean lubrication to the surface of the moving part evenly, in order to achieve friction of liquid, decrease the resistance of the friction and decrease the wears on parts of the machine.

The surface of the part is also cleaned and cooled. The lubrication system usually consists of a lubricant channel, some valves, an oil pump, and an oil filter.

Cooling system

The main function of this system is to distribute a percentage of the heat that the thermal parts hold in time to make sure that the engine is running at a proper temperature the water cooled engine typically be made of a cooling water sleeve, water drive, fan, water reservoir and a regulator etc. (Dinçer and Zamfirescu,2014,266)

Ignition system

The combustible blend in a gasoline motor is ignited by an electric spark prepared with a start cap on the barrel head of the gasoline motor, the head of which expands into the combustion chamber. All equipment capable of generating electrical sparks between spark plug electrodes on time is called ignition system, which is usually composed of batteries, generators, substables, ignition coils and spark plugs.

Starting system

In arrange for the motor to move from stationary to operational, the motor crankshaft must to begin with be pivoted by outside powers so that the cylinders move back and forth and the combustion of the combustible blend within the barrel extends to work cylinder down to pivot the crankshaft. The engine can run by itself and the obligation cycle can be carried out consequently. So, beneath the impact of the outside constrain, the crankshaft started to begin the engine and amid the full handle did not start to do anything called beginning the motor. The unit required to perform the primary handle is called the engine starting system. The gasoline engine be made up of two upper channels and five systems, namely crank connection, gas distribution system, fuel supply system, lubrication system, cooling system, ignition system and first system, and diesel engine for the above processes and four main systems, namely crank connection system, and Gas distribution machine, fuel supply system, lubrication system, cooling system and first system, diesel engine is integrated and does not require a heating system In arrange for the motor to move from stationary to operational, the motor crankshaft must to begin with be pivoted outside powers so that the cylinders move back and forth and the combustion of the combustible blend within the barrel extends to work cylinder.

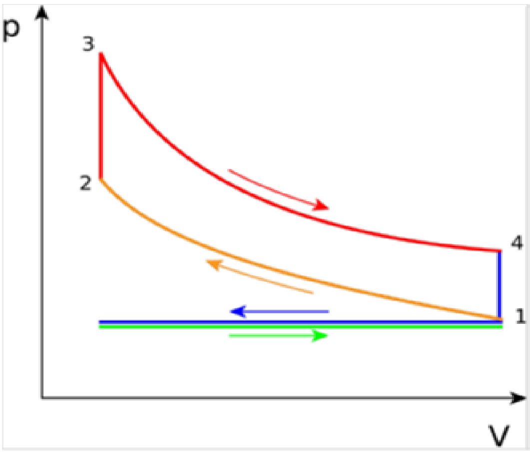

Figure 2: The pressure-Volume Diagram of an ideal Otto Cycle process.

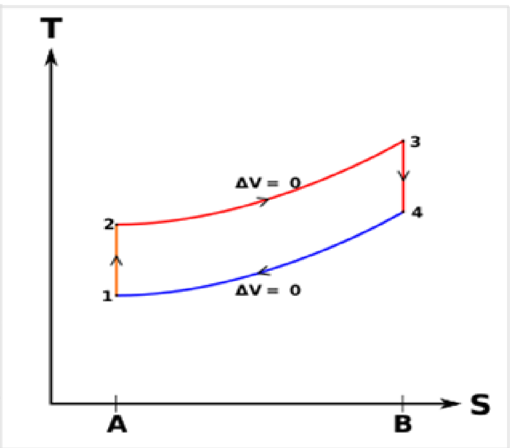

Figure 3: The Temperature- Entropy diagram of an Ideal Otto Cycle Process.

The Ideal Otto Cycle:

Figure 2 shows the PV chart (pressure-volume chart) of the Otto circle that peaked. This chart shows how to begin to progress in knowledge of weight and volume (gasoline and air fuel) through hydrocarbon combustion, causing piston activity to supply and transport the vehicle's engine. Cylinder developments (extended volume chamber), caused by the dissipation of thermal energy from combustion are performed and are generated in gas and piston work. The engine room is compact (low volume) as the cylinder works on the air, by differentiation. (Gupta,2006)

(**P:** Pressure, **V:** Volume, **T:** Temperature, **S:** Entropy, **V_c:** Clearance Volume, **$V_{s.}$:** Stroke Volume)

From 1 to 2: Compression by isentropic:

During the air travel, the air valve is open and the exhaust valve is closed. As the piston moves from top to bottom, the piston top gradually increases in size and the pressure in the cylinder decreases. As the pressure in the cylinder gradually decreases below the atmospheric pressure, a vacuum is created in the cylinder.

At this point, the combustible mixture is sucked directly into the cylinder from the air valve. As can also be seen from the schematic, when the piston is down, in this isentropic handle, the entropy remains consistent ($S_1 = S_2$), and that's clarified within the PV and TS diagrams.

From 2 to 3: Consistent Volume Heat Addition:

Process 2 to 3 is an isochoric handle (heat expansion) where the volume remains consistent. The piston here sits for a moment in the top dead center. Heat is provided from an outside heat source at steady volume ($V_2 = V_3$). Temperature reduces from T_2 to T_3, P_2 to P_3 and the entropy decreases from S_2 to S_3. (See above graphs PV and TS).

From 3 to 4: expansion isentropic:

In this process, the air experiences variable development (reversible adiabatic). The cylinder is moved from the top the bottom dead center .The pressures here are declining from V_3 to V_4, from T_3 to T_4, and entropy is constant ($S_3 = S_4$). (Refer to above P-V and T-S).

From 4 to 1: Heat Rejection and Constant Volume:

The piston rest for a moment at BDC and heat is constantly rejected ($V_4 = V_1$). And the pressure increases from P_4 to P_1, the temperature increases from T_4 to T_1, and entropy fall down from S_4 to S_1. (Mike Busch,26)

Thermal efficiency (air-standard efficiency) of Otto Cycle:

At process 3 to 4: Heat Supplied = m CV (T3-T2) At process 4 to 1: Heat Rejected = m CV (T4-T1)

Where: (**m**: Mass, **CV:** Specific heat at constant volume)

$$\eta_{th} = \frac{m\,CV\,(T3-T2) - m\,CV\,(T4-T1)}{m\,CV\,(T3-T2)} \{1\}$$

$$\eta_{th} = 1 - \frac{(T4-T1)}{(T3-T2)} = \eta_{otto} \{2\}$$

The first law of thermodynamics for closed system undergoing a change of state in a closed system, mass is constant, then

$$\frac{dm}{dt} = 0 \{3\}$$

The system at cycle return to initial state so it's mean that the energy is stored and no change in: ∑ Energy Input = ∑ Energy Output at any cycle the cyclic Integral of heat is proportional to the cyclic integral work during every cycle (control mass)

J: being carried out $\boldsymbol{J \oint Q = \oint W}$ {4}

The factor of proportionality **(1Btu= 778.17.ft./b)**

And **Btu** is the international British thermal unit. The factor J is not necessary

$$\oint \delta Q = \oint \delta W$$

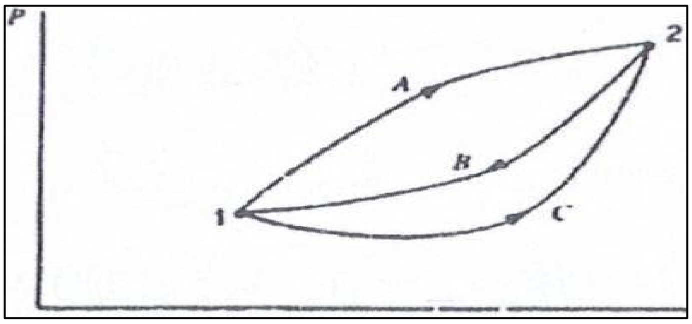

Figure 4: cycle A-B

This is the basic message of the first law of thermodynamics by adding energy (E), and the system passes through a closed cycle changing from state 1 to state 2 in operation A v and return from State 2 to State 1 in Operation B.(Moran and Shapiro,2008)

From the first law of thermodynamics and considering the cycle A-B

$$\int_1^2 \delta Q_A + \int_2^1 \delta Q_B = \int_1^2 \delta W_A + \int_2^1 \delta W_B \{5\}$$

Consider the cycle C-B

$$\int_1^2 \delta Q_C + \int_2^1 \delta Q_B = \int_1^2 \delta W_C + \int_2^1 \delta W_B \ , \{6\}$$

By subtracting,

$$\int_1^2 \delta Q_A - \int_1^2 \delta Q_c = \int_1^2 \delta W_A - \int_1^2 \delta W_c \{7\}$$

$$\int_1^2 (\delta Q - \delta W)_A = \int_1^2 (\delta Q - \delta W)_C \{8\}$$

$$\int (\delta Q - \delta W) \{9\}$$

Paths C and A are arbitrary, so the integrand is independent on the path, it depends only on the initial and final points, it is the energy E.

Thus, it can be written as $\Delta E = \delta Q - \Delta W$

By integration $E_2 - E_1 = Q_{1\to 2} - W_{1\to 2\{10\}}$

$$E = Internal\ Energy + Kinetic\ Energy + Potential\ Energy\{11\}$$

So,

$$E = U + K.E + P.E.\{12\}$$

$$\Delta E = \Delta U + \Delta(K.E) + \Delta(P.E.)\{13\}$$

The differential form of the first law: $\delta Q - \Delta W = \Delta U + \Delta(K.E) + \Delta(P.E.)\{14\}$

$\delta Q - \Delta W = dU + d(K.E) + d(P.E.)$ By integration, $\{15\}$

$$Q_{1\to 2} - W_{1\to 2} = (U_2 - U_1) + (K.E._2 - K.E._1) + mg(z_2 - z_1)\ \{16\}$$

By dividing the differential form by δt and considering the limit as $\delta t \to 0$, the rate form will be:

$$\dot{Q} - \dot{W} = \frac{dU}{dt} + \frac{d}{dt}(K.E.) + \frac{d}{dt}(P.E.)\{17\}$$

By dividing the general form by m, the unit mass form will be:

$$Q_{1\to 2} - W_{1\to 2} = u + K.E. + P.E.\{18\}$$

Where $u = \frac{U}{m}$ specific internal energy $\{19\}$

$K.e = \frac{K.E.}{m}$ Specific Kinetic energy $\{20\}$

$P.E = \frac{P.E.}{m}$ Specific Potential energy $\{21\}$

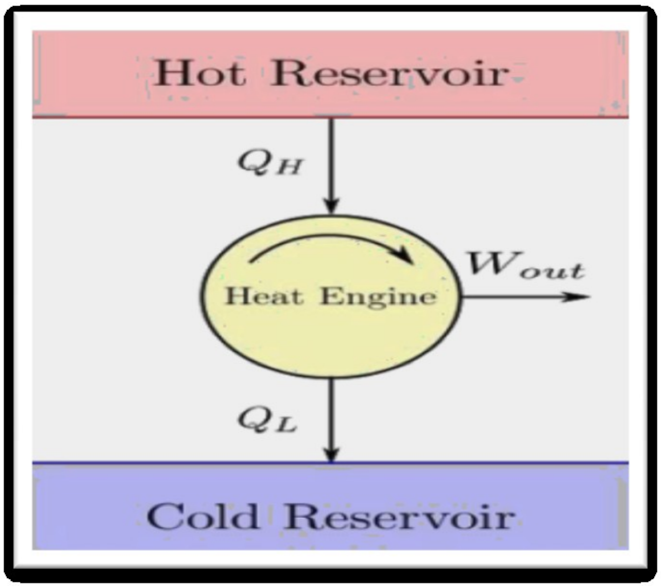

Figure 5 Heat Engine

Kelvin-Planck statement for Second law of thermodynamics:

The thermodynamics second law states that energy has the quality and quantity that arises in a particular way. The first Law does not give a look at the address of preparation and satisfaction and it doesnt guarantee that the operation will occur Later we need another common rule (second law) to see if the preparation can take place or not The treatment can occur when it hit both the primary and second thermodynamic laws The second law moreover states that vitality incorporates quality The security of vitality quality can be an critical concern for engineers It is additionally utilized within the choosen theoretical limits to implement common planning energies such as hot engine, refrigerants, etc.(Hern´andez and Angulo-Brown,1996,684)

Thermal Energy Reservoirs:

These are so-called bodies with enormous thermal energy capacity (mass x specific heat) that can conduct or store a limited amount of heat without changing the temperature. Lake air currents are an example of a two-stage system model that can be developed as a reservoir because it can absorb and dissipate large amounts of heat at a constant temperature, it is called a reservoir that provides energy as a source of heat storage tank and it is used in absorbing energy within the thermal sink so it is impossible to have a device or system in the cycle to receive a certain quantity of heat from a large temporary reservoir

(HTR) and create a net amount of work No heat effect = 100% . (Fig.5.)(Reynolds & Perkins,1977,249)

Clausius' statement of the second law of thermodynamics:

It is unusual to create an instrument that can operate in a cycle and produce no other effect of exchanging body heat at a low temperature with a hyperthermic body. On the other hand, the refrigerator will only work if its compressor is powered by an external source of energy, Clausius and Kelvin Plank, the negative statements expressions of the second law and the negative design cannot be the second law, because the first law revolves around experimental perceptions. Interpretations of the second law are available in one clear language, It is similar to any device that violates this law. Kelvin's interpretation of Planck, Clausius' statement is also pernicious and vice versa.(Sieniutycz and Editors,2000)

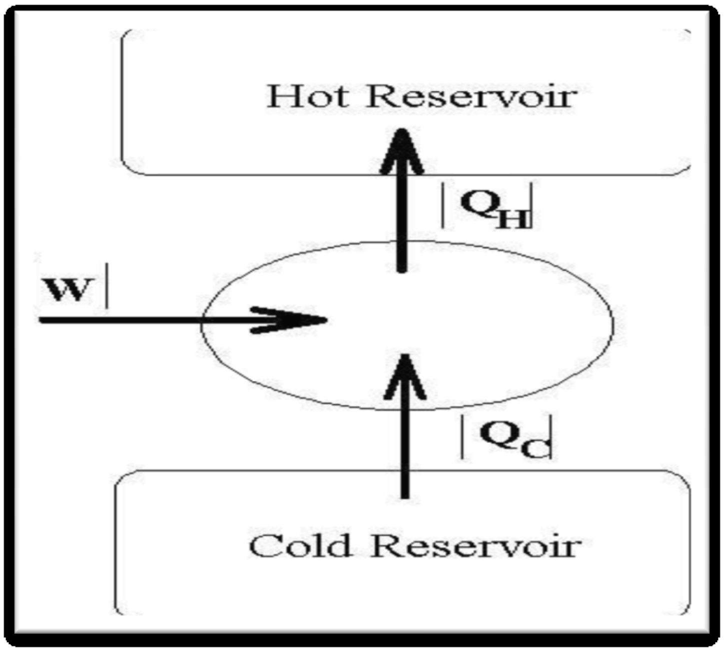

Figure 6 Heat Pump

It is inconceivable to develop a tool that works in a cycle and does not provide any other effects of impacts of heat trade from the low-temperature body (LTB) to the body at a better temperature.

The measure of performance is OP_{HP}

$$COP_{HP} = \frac{Desired\ 0/p}{Required\ 1/p} = \frac{\dot{Q_H}}{W_{in}} \{22\}$$

$$= \frac{\dot{Q_H}}{\dot{Q_H} - \dot{Q_L}} = \frac{1}{1 - \frac{\dot{Q_L}}{\dot{Q_H}}} \{23\}$$

$$\underline{COP_{HP} = COP_R + 1\ \{24\}}$$

Any tool that violates the first law of thermodynamics (through energy production) is referred to the first type (PMM1) motion machine, and the second type (PMM2) development machine is a tool that damages the second law.(V. Badescu and B. Andresen,1996,291)

Conclusion:

With consideration of the specific variable heat exchange of working fluids the Auto standard air cycle model was introduced. The characteristics of the cycle performance have been accurately explained in many examples. The results show that the effects of the specific heat exchange and variable heat problem of fluids working on cycle performance are subjective and must be taken into account in the analysis of the sharpening cycle. The results examined in this research may tell us the plan to sharpen internal combustion engines, that only air is known to be a liquid that acts as a total gas that contains specific heat and has a very special meaning. The ideal equation for a gas state is: (Chih,2004,95)

P V = RT

Air enters the cylinder at the first point and ends at the second point when the pressure stops. The pressure is considered equal without any rotation in the entropy. Heat addition starts at the second point and ends at the third point. At constant pressure, combustion of the fuel begins (fuel is applied to the flame and temperature of the gas) and / or heat is introduced into the liquid. Dilation starts at the third point and ends at the fourth point. Isotropic evolution without altered entropy is known. At the fourth point, the repulsion begins with the air temperature and ends at the base point. At constant pressure, the air cools and the temperature of the operating fluid decreases. It should be noted that at the first point air again enters the printing process and the cycle repeats.

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