IC Engines and Gas Turbines
Dr. Pranab K. Mondal
Department of Mechanical Engineering
Indian Institute of Technology Guwahati

Lecture – 16
Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems (Contd.)

We will continue our discussion on IC Engine. And, today we will continue our discussion on the Battery ignition system, and more specifically we will see that what are the procedure or rather what are the step by virtue of which we can have the potential which is the order of 10 kilo volt to 20 kilo volt to generate a spark in a spark in us, to break the resistance or a spark gap.

As I said that we are having 1 battery which is having you know battery of 12 volt to 24 volt, from that low voltage how we can generate high voltage which is of the order of kilovolt 10 kilovolt through this circuit. So now, I will write the stress by virtue of which we can have that you know higher development of the higher potential.

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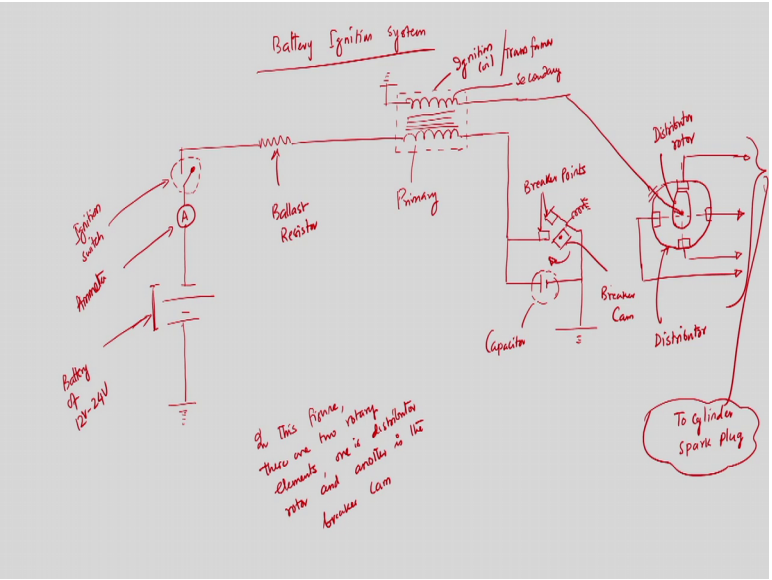

So, this is a schematic we have discussed about the function of each and every you know parts of the system. We have ignition switch and then we have register and ignition coil and breaker points and distributor rotor.

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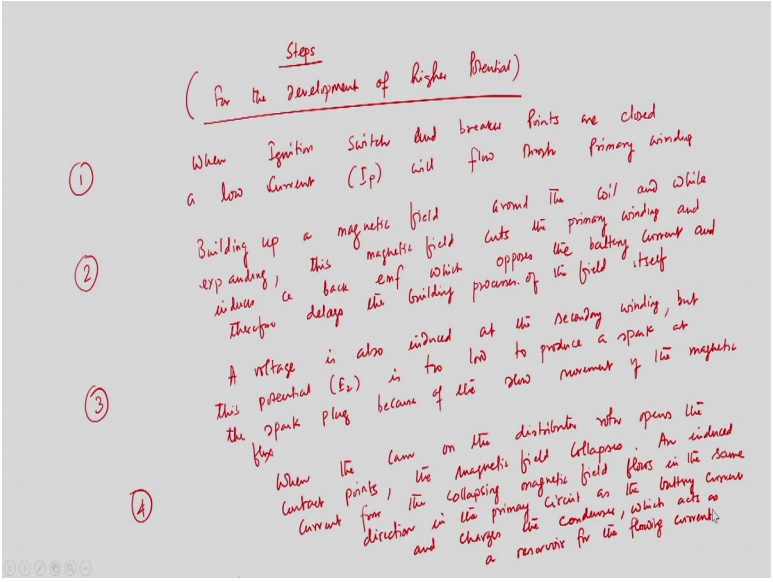

So, today we will discuss that what are the steps of you know, what are the steps of steps by virtue of which we can have higher steps for the development; for the development of higher potential. So, this is very important that from that circuit how we can have higher potential and that is what we will discuss today. So, first step is that is very important that when the ignition switch and breaker points are closed. So, when ignition switch that is we have level already and breaker point are closed.

Then low voltage current, low current a low voltage current I p we will flow through the primary windings; will flow through primary circuit or primary coil whatever it can give primary windings right. So, if I go back to my previous slide, then where schematic is shown, then if I if when the ignition switch and breaker points are closed.

Then a current inflow a low voltage current I p and that you know through the primary winding. So, we are having one primary and secondary winding in the ignition coil. So, this is primary and this is secondary. So, primary winding and secondary winding we have you know ignition coil. So, when we ignition switch and breaker points are closed a low voltage current will flow through the primary winding.

And that is a first step that is what we are writing. Second number 2 so we have understood that when the ignition switch and breaker points are closed a low current will pass through flow through the primary winding. Second is when the low current is flowing through the primary winding it building up a magnetic field around the coil so,

this process building up a magnetic field around the coil. And while expanding this magnetic field, while expanding this magnetic field cuts the primary winding.

While expanding this magnetic field cuts the primary winding and induces a back emf and induces a back emf electro motive force which opposes; which opposes the primary, which opposes the battery current and therefore, delays the building process. Which opposes the battery current, which opposes the battery current and therefore, delays the building processes.

And therefore, delays the building processes so, this is the you know second step. So, when an ignition switch and breaker points are closed a local low voltage current will pass through the primary winding. While it is passing through the primary winding it builds up a magnetic field, around the coil and while expanding this magnetic field, this magnetic field cuts the primary winding and induces a back emf which also opposes in opposes the battery current and therefore, delays are building process.

Number 3 is very important, is very important. So, development of the building process of which delays the building processes of the field itself; of the field itself fine. A voltage is also induced, a voltage is also induced, a voltage is also induced at the secondary winding, at the secondary winding. But the potential while it is happening a voltage will be develop a voltage will develop also in the secondary winding, but the magnitude is too low, but the potential, but this potential it is too low to produce a spark.

Usually low to produce a spark at the spark plug. So, a voltage induced at the secondary winding, but the potential is usually low to produce a spark at the spark plug. So, what is an spark plug because, of the relatively slow movement of the magnetic flux, because of the slow movement of the magnetic flux right. Then 4 very important; now when the cam on the distributor rotor when the cam this is the process. So, voltage will definitely voltage will induce definitely, but the magnitude is very low to produce a spark, because of the strong magnetic flux. So, when the cam on that distributor shaft, on the distributor shaft or rotor you know opens the contact points, opens the contact point.

The magnetic field that magnetic field that developed, the magnetic field I know magnetic field around the collapses. Magnetic field collapses and an induced field, an induced current; an induced current from the collapses magnetic field from the

collapsing magnetic field; from the collapsing magnetic field flows in the same direction; in the same direction in the primary circuit, in the primary circuit as the battery current..

So, when distributed rotor opens up the contact points a magnetic field collapses. Because of these collapses are in magnetic collapsing the magnetic field an induced current also flows in the same direction as the battery current you know does in the primary circuit fine. So now, a primary circuit not only that and charges the condenser and charges the condenser. Because breaker points are closed, so, it charges the condenser it charges the condenser which acts as a reserved for the; charges the condenser which acts as a reservoir for the flowing current, for the flowing current.

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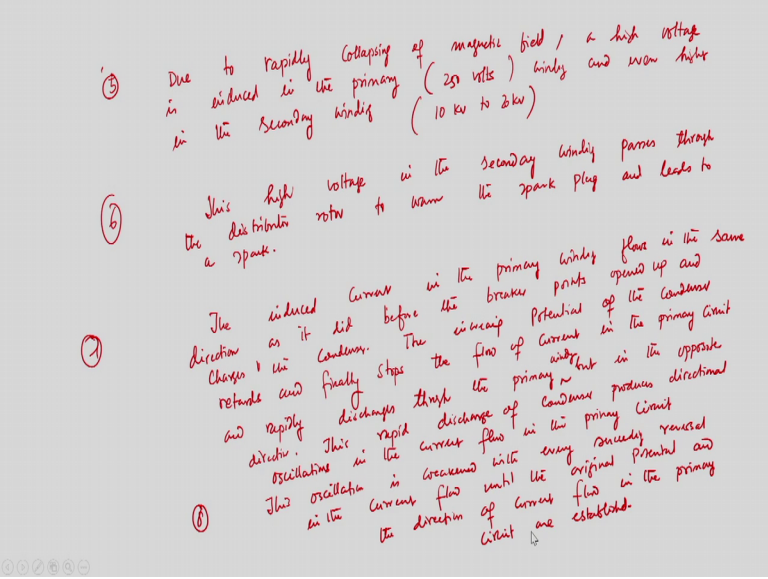

Now very importantly, number 4 number 5, number 5 due to rapidly collapsing due to rapidly collapsing of the magnetic field rapidly collapsing of the magnetic field, a high voltage is induced in the primary; a high voltage is induced in the primary, which is of the order of 25 2 5 about 250 volts. Primary winding and even higher in the even higher in the secondary windings; secondary winding even in the higher and the secondary winding, which is of the order of 10 kilovolt to 20 kilovolt.

So, due to rapid collapsing of the magnetic field a high voltage is induced in the primary as well as the secondary. But the strength of the voltage is of the order of 20 2 5 250 volts in the primary. While the voltage is even much much more higher and that is of the order of 10 kilovolt to 20 kilovolt in the secondary windings right.

This high voltage in the number 6; this high voltage in the secondary wind secondary winding, the high voltage in the secondary winding passes through the distributed rotor, passes through the distributor rotor to warm the spark plug; to warm the spark plug and ignites this and leads to a spark, leads to a spark. So, that is very important. Now this is the procedure by virtue of which we can have spark in the spark plug. So, this process you know repeats I mean the system is ready for another firing unit. Now the induced current in the primary flows in the same.

Now number 7 very important the induced current, this induced current the induced current in the primary, circuit flows in the same direction as it did before the breaker points opens, in the primaries in the primary winding primary windings flows in the same direction flows in the same direction, as it did before the breaker points open up; as it did before the breaker points opened up; breaker points opened up right, and because opened up and charges the condenser right.

So, this is that induced current the primary winding flows in the same direction, as it did before the breaker points opened up and charges the condenser. So, the increasing potential in the now, the increasing because it charges the condenser, the increasing potential; the increasing potential of the condenser, the increasing potential of the condenser of the condenser retards the retards and finally stops. Finally, stops the flow of current in the primary circuit. And, then definitely backfires and rapidly discharges again through the primary, rapidly discharges through the primary through the primary but in the opposite direction. Primary winding, but in the opposite direction.

That means, this induced current in the primary flows in the same direction as the battery current, as it did before the breaker points opened up and charges the condenser. So, while it is charging the condenser the increasing potential of the condenser retards and finally, stops the primary the flow of current into the primary circuit. And, rather rapidly discharges to the primary winding, but in the opposite direction in the opposite direction.

And the rapid discharge at the condenser produces this rapid, this rapid discharges this rapid discharge of the condenser, of condenser produces directional oscillation; directional oscillation in the oscillations in the current flow in the primary circuit in the current flow in the primary circuit, this very important.

So now, this oscillations 8 these oscillations, this oscillation is weakened with every succeeding with every succeeding reversal in the current flow, until the original potential and direction of current flow; until the original potential original potential and the direction of current flow and direction of current flow, direction of current flow in the primary circuit are established in the primary circuit are established right. So now, so this is happening now the system is ready for the system is ready for the another firing circuit.

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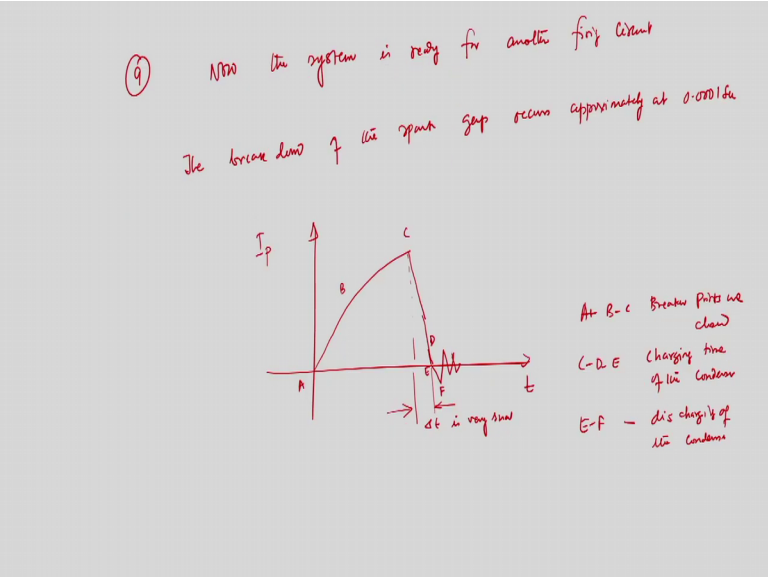

So now, 9 now the system is ready for the system is ready for the for another firing circuit, for another firing circuit very important. The enter break down process usually takes very small second of the order of 10 power minus 3 10 power minus 4 second. The breakdown of the spark gap; the breakdown of the spark gap usually occur approximately at 0.0001 second.

So now, what I said that when the back switches, when the if I now try to plot that when the ignition switch and the breaker points are closed, a low voltage current flows into the primary circuit. And, it will have a magnetic field and while expanding this magnetic field cuts the primary wind primary windings, as I said at a first step. So, when ignition switches are breaker points are closed a low voltage current will pass through the primary circuit and it develops a magnetic field.

Now when while expanding this magnetic field cuts the primary winding and it induces a back emf in it needs a back emf and the back emf will opposes the battery current to flow in the primary circuit and delays the building process. So, that is why if I have now plot the if I now plot that battery current I p primary windings, then this the it the process gets delayed then it is very important A B C breaker points. So, this is A, this point is B and this point is C and then irrapidly, irrapidly comes to 0 and then again a directional oscillation starts so, direction oscillation starts. So, this point is D, D then E, then F. So, this takes very small time delta was very small time to this delta t is very small, very small.

So, A B A B C is the breaker points are closed; breaker points are closed. That is a low voltage current is flowing to the primary circuit and it will develop a magnetic field. And, while expanding it develops while expanding the magnetic field it cuts the primary, it cuts the primary winding and induces back emf which opposes the current flow in the, which opposes the battery current to flow and therefore, delays a building process.

C D E C D E that is the charging time of the condenser, this is charging time of the condenser that is what we have discussed condenser and E F this is the discharging of the condenser, discharging of the condenser. So, this discharging and charging that is what discussed that it retards when it is charging that is condenser it potentially increase and eventually it retards and finally, stops the that is what we have discussed that finally, we have discussed that same direction and condenser retards it charges the condenser, the increasing potential of the condenser retards.

And finally, stops the flow of current the primary circuit and rapidly discharges to the primary winding, but in the opposite direction. And this leads to a directional oscillation and that is what is represented by this small you know spike in the current verses in this current versus you know time plot this is t, current verses time plot.

Now is a very small delta t; delta t that you know that is what I told you that a high voltage in the secondary winding processes through the discharger rapid collapsing of the magnetic field. A high voltage in this even develops and the high voltage in the secondary winding process through the distributed rotor and on the spark plug itself there is a spark. The induced current will be very small time that the breaker points are closed.

But when breaker points are opened breaker points are opened, the I p t will try to be 0 very small time this means that when breaker points are opened the current will be try to 0 within very small time that is why delta t is very small. And then, it will try to charge the condenser and when potential of the condenser will increase and again it will try to retards and finally, stops the current flow. And, it leads to a direction of oscillation that is represented by the small spike in the current verses time plot.

So, we have seen today that although we had a battery of 10 volt to 24 volt from that battery; from that battery rather source of electrical energy we had a source we had circuit and from that circuit we can produce high voltage in the primary that is of the order of 250 volts. But even more higher in the secondary that is of the order of 10 kilovolt, and that high voltage leads to that one of the spark and break the resistance of the spark gap and leads to a spark in the spark plug. So, this is a completely description of the battery ignition system by virtue of which during a low source of electrical energy we can produce high voltage and we can generate spark and we can ignite the combustion process in the spark ignition engine.

So, with this I stop here today and we will continue our discussion in the next class.

Thank you.