Electrical Measurement and Electronic Instruments
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Lecture - 06
Demonstration of Moving Iron Instruments

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Hello and welcome, so as I promised that in this video, we will open a Moving Iron Instrument and see how it exactly works and we will see in much more detail about its construction and different features.

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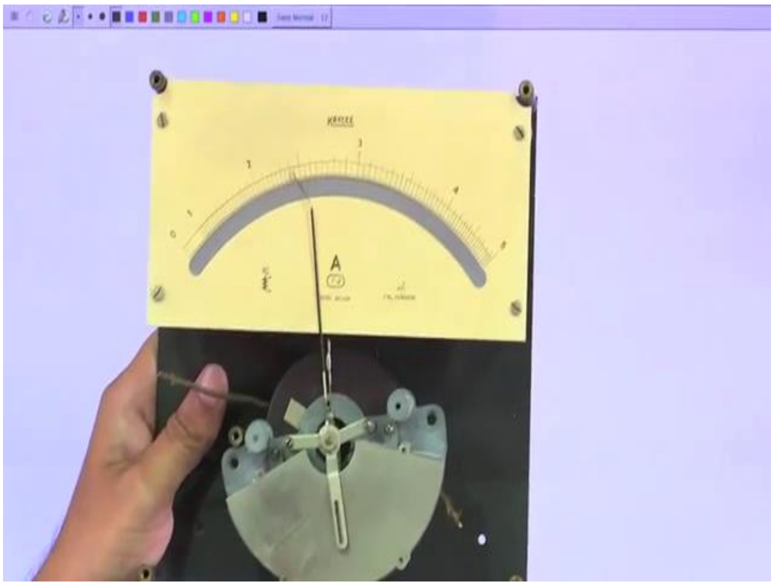

So, before we continue, a small note for you is that this particular video is not that important for exams and similar things, but this is interesting. So, if you are happy with theories if you are; if you are a theoretician, no problem you can skip this video and if you want to learn about the manufacturing details of an instrument, I will try to explain things here.

So, the instrument that I am holding in my hand is moving iron instrument. Now, so you can see this is the scale, this is the pointer and before I open it further, we need to discuss some theoretical things before we can proceed further. So, let us go back to our computer screen.

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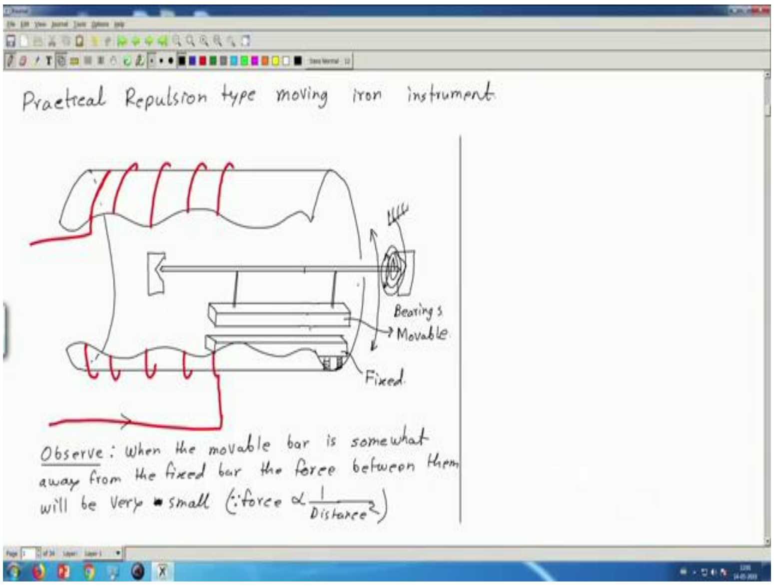

So, we will talk about a practical repulsion type instrument. This we will of course, have a coil. But before I draw the coil let me draw another thing, say I have spindle or axis like this and they it can rotate around a pair of bearings, so these are bearings.

So, this spindle or the axis can rotate like this. Now, I will have I will connect up a piece of iron bar. So, let this be a iron bar ok and I will connect it to this spindle to this axis like this. So, now, this iron bar can also rotate around this bearing, along with this spindle, so this can also rotate this entire thing can rotate like this. So, maybe I can give you a small demonstration like this over camera piece.

So, this is like this, say this is this pen is an axis which can rotate and to it I have attached an iron bar which is this pen, this blue pin is an iron bar and this yellow pain is an axis, so it can rotate like this. So, you see this blue pen which you think as the iron bar can rotate around this yellow pen which is the axis or this fender. Now, this entire thing I will put inside a coil ok, so now I will have a coil. So, this entire thing will be inside this coil, but let me cut open this coil so that we can see through this coil slightly.

So, let me open it up like this and, I am cutting it, so that we can see through it. So, this is a coil surrounding this arrangement, let me draw the turns also, so let this be returns and so on, I am not drawing it further, so this spindle is inside this coil. Now, I will have another iron bar which I will keep here, which I will draw here.

So, close to the first iron bar, but this one I will attach to this coil, so this is this will be attached or screwed to this cylindrical frame. So, this cannot move, so this is fixed and this one is movable. So, let me try to show you the arrangement, so we can now move to the overhead camera.

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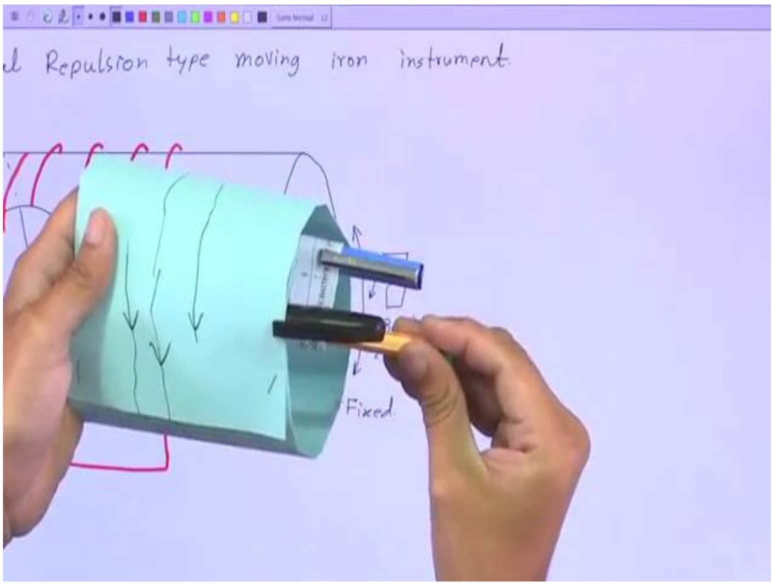

So, let this be the cylinder or the coil and let me attach iron bar to it like this, so the arrangement is like this. So, this paper is the coil, the cylindrical coil and there is this pen you can see this pen; this pen is attached to this cylinder, so this pen cannot move with respect to the cylinder.

So, this is like this and inside this I have this arrangement this spindle and the other iron bar and this one can rotate inside the coil, so this one can rotate. But this one cannot rotate ok, normally these two iron bars; that means, my blue and black pen they stay close to each other. Now, if I have current passing through this coil, say these are my turns, so let me draw some turns.

So, this is one turn, similarly this is another turn, if I have any current flowing through it. Then what will happen this iron bar will get magnetized, similarly the other iron bar which is inside both of them will get magnetized and as we have seen in our previous video, the similar poles will be close to each other.

So, if this side is North Pole then this side will also be North Pole; therefore, these two bars will repel each other, and this will turn away from each other. This black one cannot move, the blue one can move; therefore, the blue one turn away from the black one, so this is the arrangement. So, the same thing we have on screen here, this as soon as we excite this coil, if we have any current this fixed bar cannot move, but this movable bar will move away, turn away from this fixed bar. Now, we can connect springs like this, so that the spring tries to hold this movable bar at its normal position and some equilibrium will be established.

So, this is move practical repulsion type moving iron instrument. This is yet not the instrument that we will see now, but you should first understand the working principle of this instrument. Now, we will modify it further, so observe that, so here when the movable bar is slightly away, somewhat away.

That means, at a distance from the fixed bar, the force between them, the repulsion force will be very less, very weak, because force is inversely proportional to distance square. So, this bar therefore, cannot move very further, so the sensitivity of the instrument will be low, this will not turn much. Now, I will make another instrument for you. For that, so let us go to the overhead camera.

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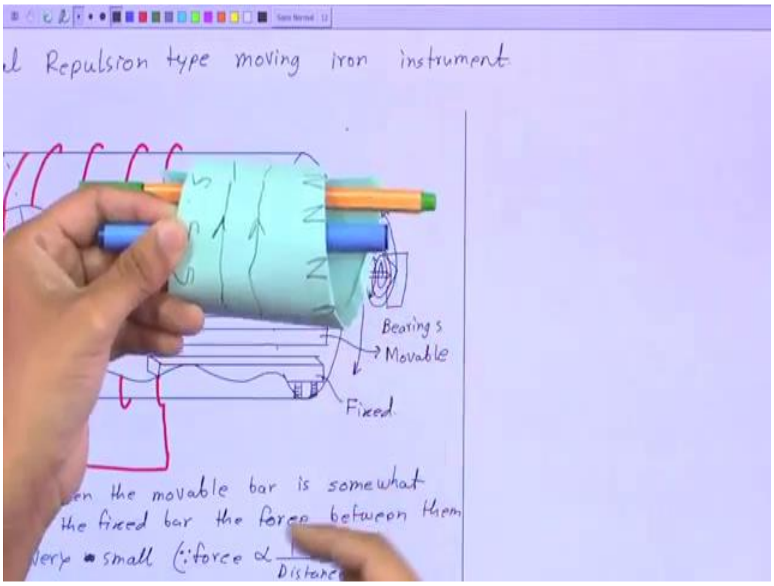

I will first take seat like this and then I will fold it like a trapezoid. So, you see this side the length is larger this side the length is smaller, now I will fold this within this page into a cylinder. So now, this looks like a cylinder, but you see its not of uniform or constant height, the height of this cylinder here is smaller, lower and here the height of the cylinder increases and here it has the maximum height. So, this is the arrangement. Now, I will have the coil or the turns on top of it, so let this be the coils.

So that means, the copper conductor, so this will carry current and inside this I will have this arrangement a spindle with a attached iron bar like this. Now, what will happen, see and this the cylinder is made up of a magnetic material, so this is a magnetic material it can be iron or steel not still I mean some it some magnetic material like iron.

Now, see when current flows like, this will get magnetized this itself will get magnetized and one side of it will be North Pole and other side will be South Pole, see this side is North Pole. So, this side this entire side is North Pole, so, I am writing N, N for north, so this side is magnetized as North Pole and this side say is magnetized as South Pole.

So, I am writing S, S for south, this side is N that side is S. Now, when I have this iron bar inside this, it will again be magnetized and if the right side is north then here also this should be north. So, this is north, right side is not left side is south and this is inside this. Now, if it is like this at some moment you see that this North Pole is closer to this North Pole compared to this and this and this North Pole.

So, this two North Pole have a larger distance between them compared to these two North Poles, because of this trapezoidal shape of this cylinder; therefore, this North Pole will be repelled like this. So, as current flows, the inner iron bar will rotate see the direction clear carefully like this, so this is the direction in which the inner bar will rotate, so this is the mechanism. And now, let us open our instrument slowly, so first I will pull this thing out.

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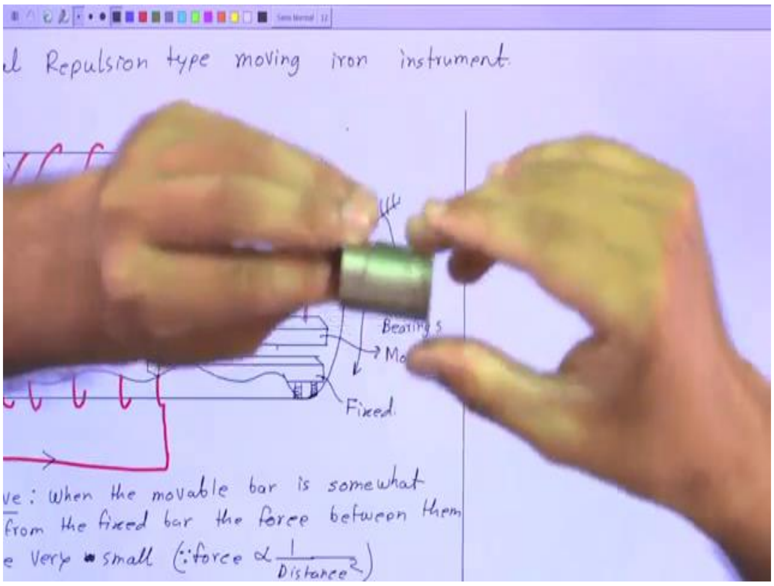

Then let me keep it aside, this is the coil, this is and some and this is owned on top of a plastic frame. So, these are the two ends of the coil, inside this coil I have a magnetic cylinder and look very carefully. Let me bring it close to you look very carefully there is this trapezoidal shape which we have just discussed.

So, maybe we can zoom into this, so look very carefully this trapezoidal shape is there, you can see it let me draw maybe some lines. So, that this boundaries are clear to you, see the trapezoidal part of this magnetic cylinder and this is inside this coil, this part was inside this coil and then after that we have this arrangement.

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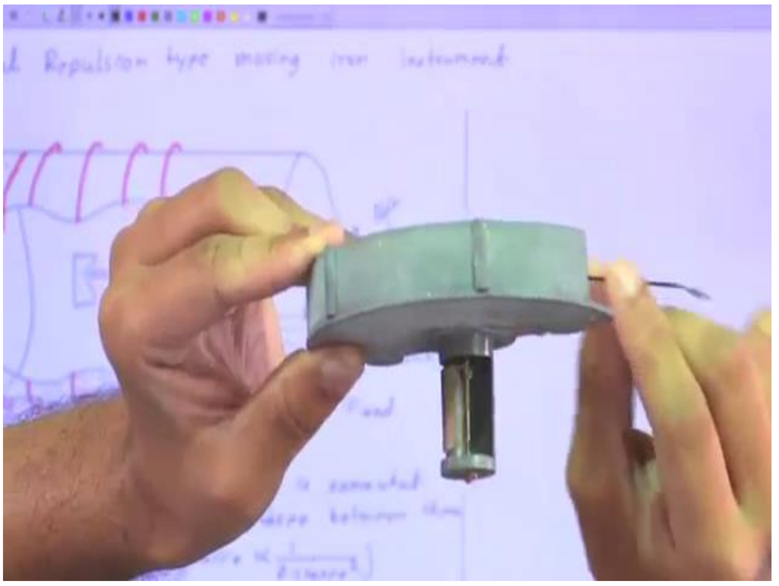

So, this was this thing was inside this coil, so let me take it out turn it over and see exactly what is there inside. So, you see there is a spindle around which iron bar is rotating. This is an iron bar, iron plate this is rotating, let me take it closer to you, so you see this iron bar is rotating around a spindle around an axis. And now, let me turn it over, this is the pointer which is connected to the internet to the movable iron bar and this pointer moves over the skin, so this is the entire arrangement.

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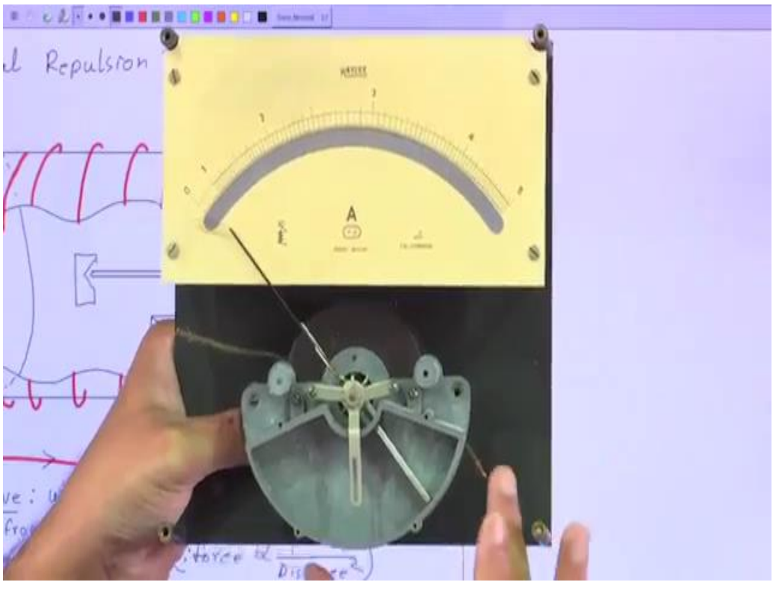

So, this is the main part of these are the main mechanism of this instrument. Let me talk about another important feature about this instrument, which is this damping mechanism. So, you see that behind this pointer we have this plate attached, so as this pointer moves this plate also moves inside this chamber, inside this semicircular chamber.

So, this as the pointer moves the plate inside also moves. Now if I move this pointer a bit, you see its oscillating for a long time, if I move it oscillates. So, this is not good because, if I say when I am measuring current, if I apply a current the pointer will move to a position and then due to inertia it can overshoot and then it will come back, and it can oscillate.

So, this pointer can oscillate and therefore, it will be very difficult to take reading the damping mechanism helps these pointer to settle down very quickly, how? I can close this chamber with this cover almost air tightly. So, now, this is an airtight chamber and if I now move this pointer you see its very difficult to move the pointer and it settles down very quickly (Refer Time: 22:47) if I can make it airtight it does not oscillate.

So, it is not moving as much as it was moving without this, say it's moving too much, although I cannot make it perfectly air tight like this, but if I can make it air tight enough then see its not moving that much. So, this is the damping mechanism which helps the pointer to settle down to its position quickly, so, that we can take readings very easily.

So, thank you for watching this demonstration, once again this demonstration is not that important for exams or for solving problems. If you are if you like theories more, then you can skip this video or forget this video. We will come back to theoretical aspects once again in our next video.

Thank you!