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NPTEL ONLINE CERTIFICATION COURSE
Course
On
Spur and Helical Gear Cutting
by
Prof. Asimava Roy Choudhury
Department of Mechanical Engineering
IIT Kharagpur
Lecture 20: Gear Hobbing- VI

Welcome viewers last, that means 20th lecture.

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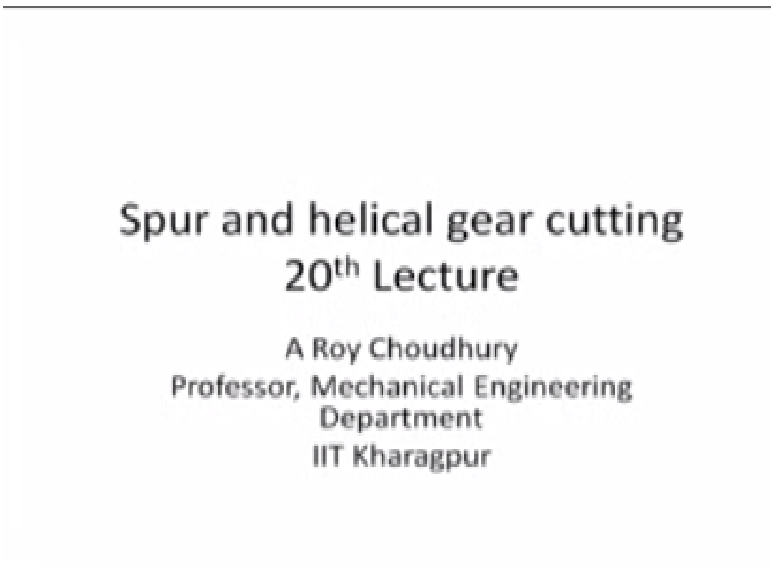

For the course spur and helical gear cutting, so let us move right on the subject because we have less time and more topics to cover.

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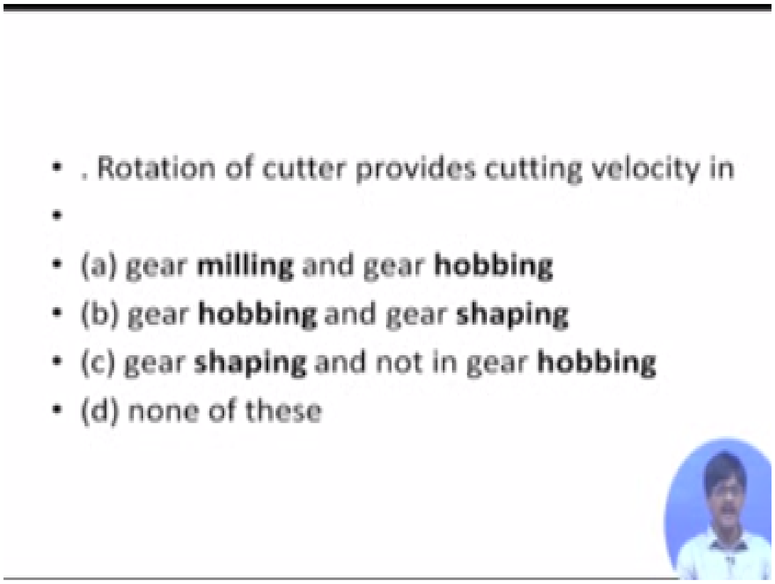

So as we discussed we will have a quick look at some multiple choice questions. So the first one rotation of cutter provides cutting velocity in, gear milling and gear hobbing, this seems to be correct you know. In gear milling the milling cutter rotates and develops cutting speed, gear hobbing also the gear hobs rotates and develop the cutting speed. Gear hobbing and gear shaping, rotation of gear cutter definitely takes place but it is for speed and it is not for the cutting velocity.

Development of cutting velocity in gear shaping is by reciprocation, so b is not correct. C gear shaping and not in gear hobbing, so gear shaping obviously is eliminated already and therefore c is also not correct and therefore we have to be correct, gear milling and gear hobbing.

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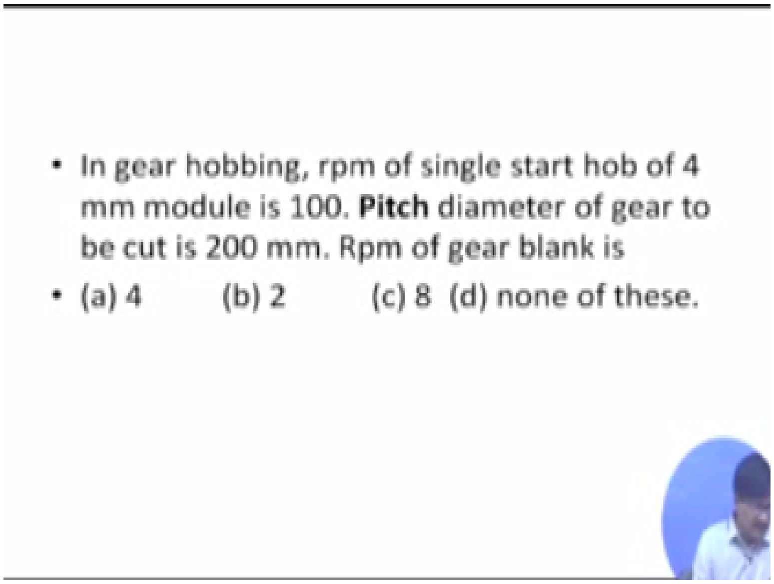

In gear hobbing rpm of single start hob of 4mm module is 100. Pitch diameter of gear to be cut is 200mm. rpm of gear blank has to be found out. So what do we have here, starting let us write down, so first write down, the rpm of single start hob.

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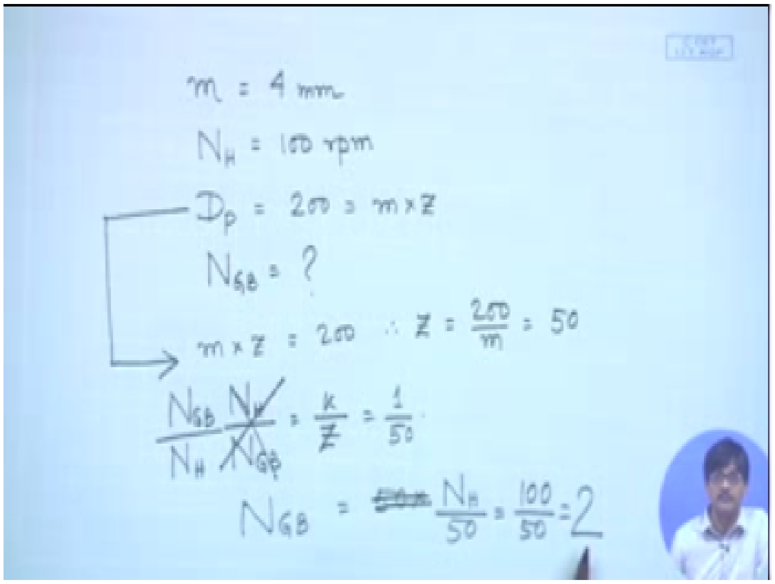

So module = 4mm okay, N_H = 100rpm. Which diameter of gear to be cut, here nothing has been mentioned so we will assume it is sphere gear. Which diameter of gear to be cut are 200, so Dp = 200, so this must be equal to module x z okay. We have to find out rpm of gear blank. This is the statement of the problem. So once we utilize this particular relation we get m x z = 200. Therefore z = 200/m, m has been provided to be 4mm and therefore we have 50.

Number of teeth is been cut is 50, that been so, we can say, we can establish our known relation N_H/N_{GB} must be = k/z okay. K is = 1, because you will find in the problem that have been stated single start of hob 1/50 okay. Once we know the distance this is 1/50 rpm of gear blank is this one okay and N_H has given to be 100, so we write N_{GB} = so this goes up, that goes that way 50 x just a moment, something as gone wrong, I have made a mistake please correct this.

I will give cross N_{GB}/ N_H= k/z okay so N_{GB} = N_H / 50 okay and k already it has already been assigned 1 and therefore it is 100/50 = 2. Kindly excuse me for this mistake, now that it has been corrected. The correct answer is gear blank rotation is 2rpm. So let us have a look at the problem, yes. b is correct rpm of gear blank is 2.

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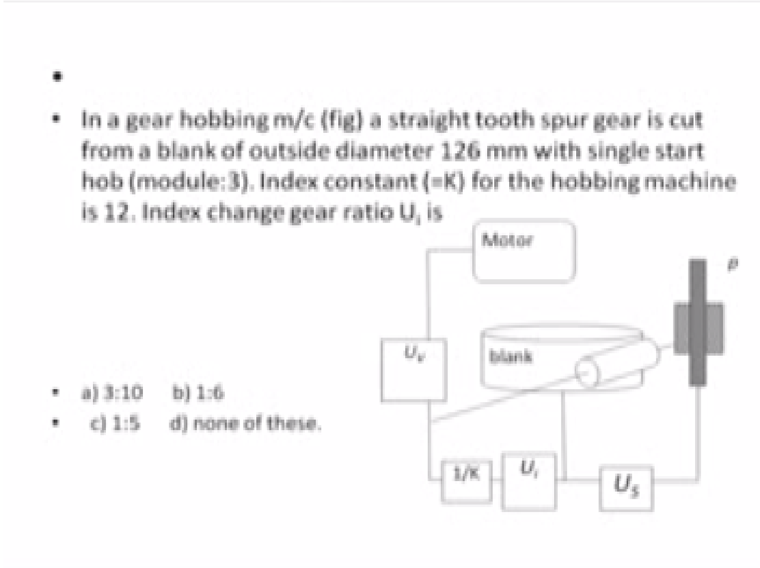

In a gear hobbing machine figure a straight spur gear is cut from a blank of outside diameter 126 with single start of hob modules 3. Index constant for the hobbing machine is 12 now you might say this index constant it has been shown clearly in the figure what sort of gear ratio it is importing into the figure. 1/k is the gear ratio; this index constant is bringing in okay and index change gear ratio Ui is therefore, 4 options are given. So let us work it out what is the statement of the problem, first of all.

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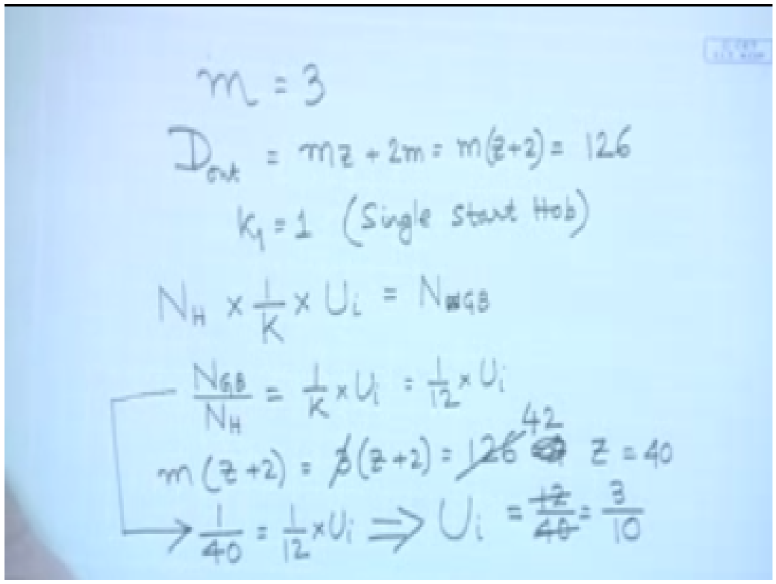

Module = 3, what sort of gear are we cutting, straight spur gear, so there is nothing to worry about, if we are cutting the straight tools D_{out} = we used our previous expression m x z+ 2m = m x z+ 2, this has been provided it is 126. K = 1 single start hob and oh I am sorry there are 2 k now. So let us call this k_1 = single start hob. Now what is the statement of the problem? The figure provides us a k value.

Let us look at the figure, this one yeah this ratio is 1/k and therefore it is given that there is a gear box with 1/12 gear, in that case what is Ui. So let us work it out this way, starting from the hob rotation N_H x the 1st gear box 1/k x U_i which we are trying to solve must be = N_{GB} this is the relation that we have. Therefore we can say N_{GB}/ N_H we will bring this one to this place, this is = 1/k x U_i= 1/12 x U_i. What is N_{GB}/ N_H = N_{GB}/ N_H must be = k/z I mean k_1/ z k_1 = 1 and number of teeth which has been cut can be solved from here.

N x z+ 2 let us quickly do that m (z + 2) I mean = 3, 3 x z+ 2 = 126, 3 cancels with this one, 42, so if z+ 2 = 42, we have z = 40 and therefore we come back to this expression and we write, what do we write. This is = k/z therefore this is 1/40 = 1/12 x U_i which gives us U_i = 12/40 which means 3/10. So the answer is U_i should be 3/10. Let us have a look here, yes option A is correct others are not.

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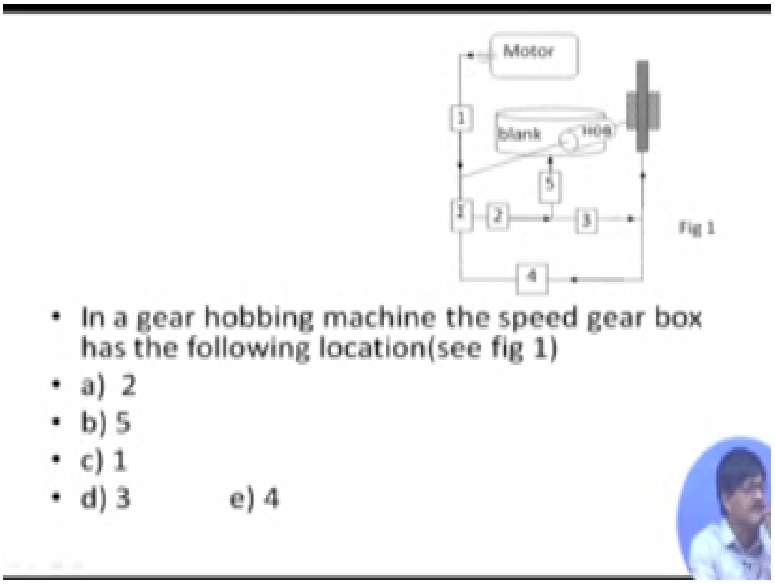

Next in the gear hobbing machine the speed gear box has the following location. Gear hobbing machine the speed gear box has the following location where is the speed gear box. Now this has been hammered into you so many times over several lectures all of you must be knowing speed gear box is located here. Therefore, one is the, C is the correct answer.

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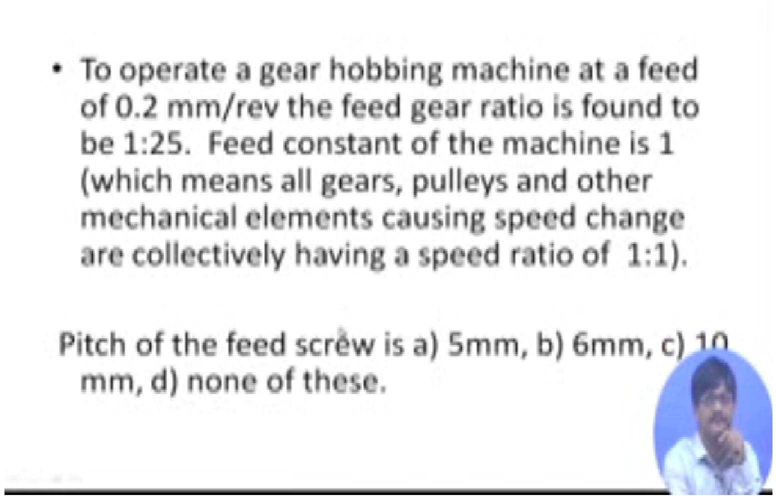

To operate a gear hobbing machine at a feed of 0.2mm is the feed gear box is found to be 1:25. So the speed gear box value is given, feed constant of the machine is 1 which means all gears, pulleys and other mechanical elements causing speed change are collectively having no effect on the speed in that case the pitch of the feed screw is 5mm, 6mm, 10mm none of these. So let us quickly draw this particular figure.

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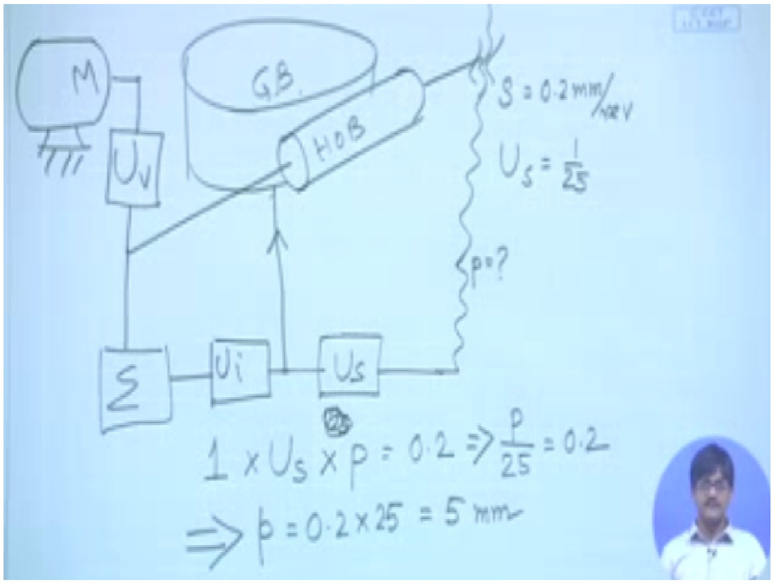

This is the hob, this is the jar and the speed is obtained by the position of the UV here, this is the motor sorry, but anyway this part is not essential, motor yeah, hob, gear blank, so tact a power from here, this is our differential, this must be Ui, this is the connection to the work piece and this is our Us, UIs feeds vertical screw with the help of which the hob comes down. So what is given to us let us make a statement of the problem.

The statement of the problem is this feed is given to be 0.2mm per revolution of work piece. What is the feed gear box ratio equal to Us let us write here, Us is given to be 1/25 okay. And therefore, we have to find out the pitch of this leave screw, this is the problem. So we quickly make the relation, we establish the relation gear box by the time the gear box sorry, gear blank rotates once, this movement should be 0.2. And therefore, we write, you know the equation this way one rotation of the gear blank multiplied by Us, multiplied by the pitch must be equal to 0.2.

Therefore, Us=1/25, therefore we write P/25=0.2 which obviously gives us the answer P must be equal to 0.2x25 = 5mm okay, 5mm pitch of the screw must be 5mm.

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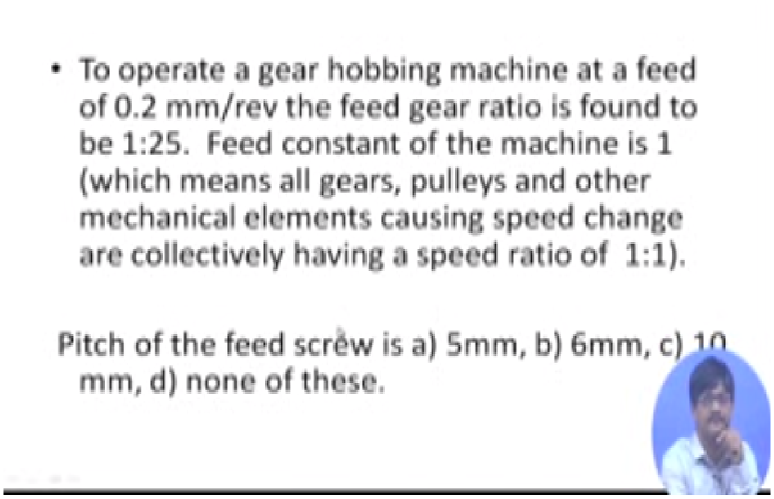

Coming back here A is the correct answer.

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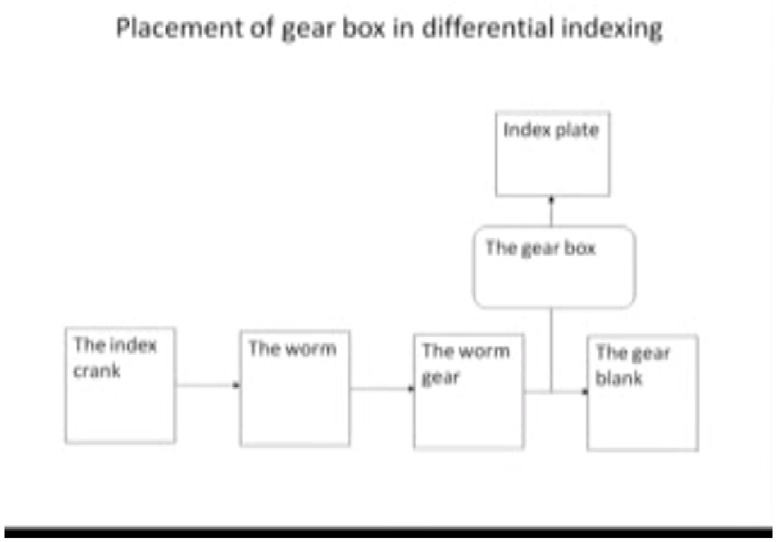

Now let us quickly discuss the positions of the gear box in case of milling, now that we have become conversant about the positions of the gear boxes in different cases of hobbing and shaping. What do we exactly mean by this, we mean that in hobbing and shaping we had come across different, you know laws of rules that help which we were establishing the uniqueness of the positions or locations of the gear boxes in the kinematic structure.

That is UV has to be at a particular location, Us has to be at a particular location. Now once you have gained that experience I want you people to go back to the case of differential indexing and establish a rule sorry, establish some simple logic that help which you can point out the correct location of the gear box which is used in differential indexing. Let me quickly re introduce the idea that we had discussed that length during those lectures.

We had an index crank the crank was rotated, we had a worm which should rotated by this crank this worm and relation with the worm gear and that worm gear had upon a shaft with gear blank and here there was a pipe rotation of the power a gear box where has placed and it was feeding the index plate which was rotating and ultimately that decided the differential movement to be provided to the worm. If you allow me to draw the figure it will look like this.
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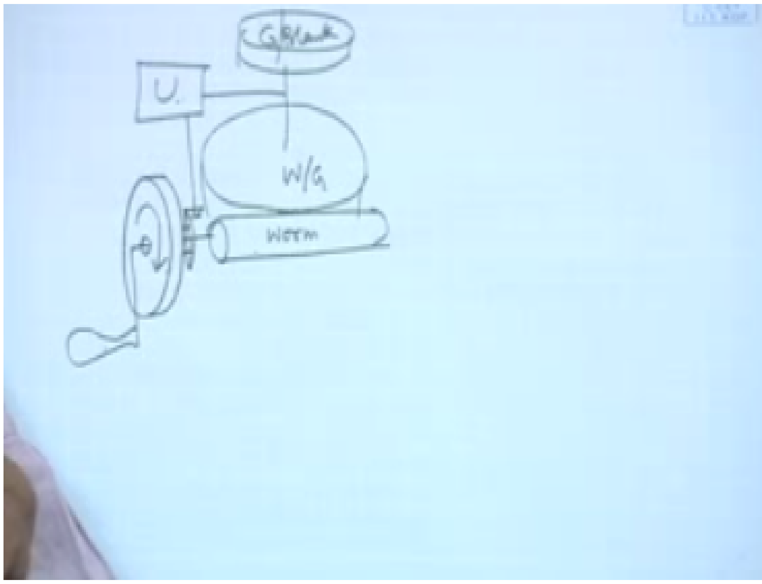

This was index plate through this passed the crank with this crank went to the worm this worm was connected to the worm here, worm gear had on one side your job on the other side it had a gear box U, which ultimately give its power through you know bevel gears to this plate this is what we had. Index crank, worm, worm gear, gear blank, gear box and this gear box which controlling the power to the index plate which will now rotate it.

Now the question is why we decided to place the gear box here out of whole possible places. Now coming back to the slides have a look at this that is in this figure we see can be have the slide please on the computer screen okay. This is the index crank.

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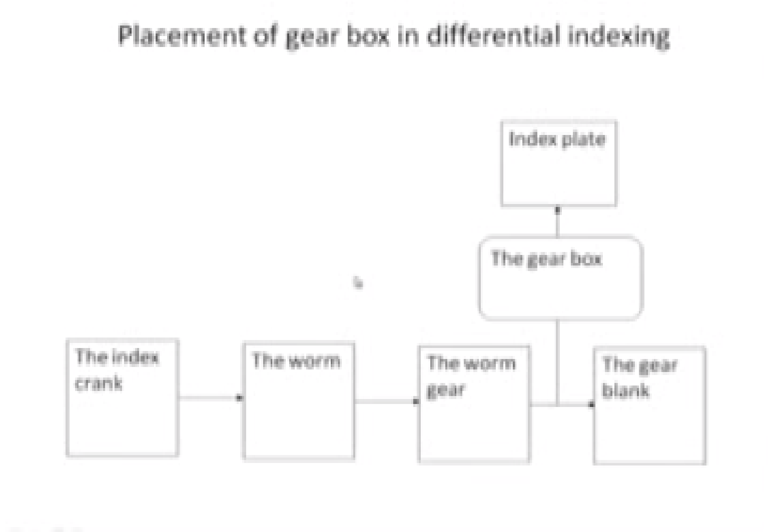

Yes of the worm here and this is the, you know the depiction of the polation of the gear box okay in this particular schematic view oaky. So the gear blank from this point we had taken a pipe rotation. Now let us take another possibility.

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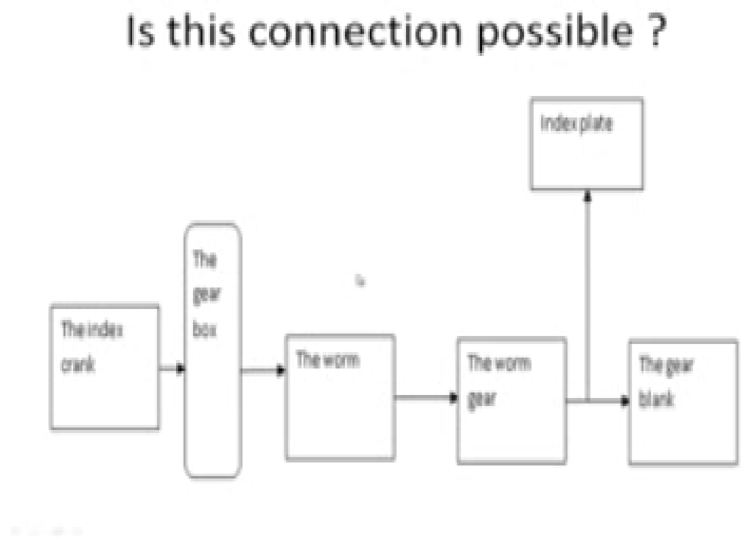

Why not this so from the logic that you had learnt about while locating different gear boxes at different places I would likely to judge whether a gear box can be placed just after the index crank okay, you place it just after the index crank o that the worm gets a different rotation from what it was suppose to get and the worm gave her some rotation etc, etc. what problem would it give raise to? So let us have a discussion so we are placing it here.

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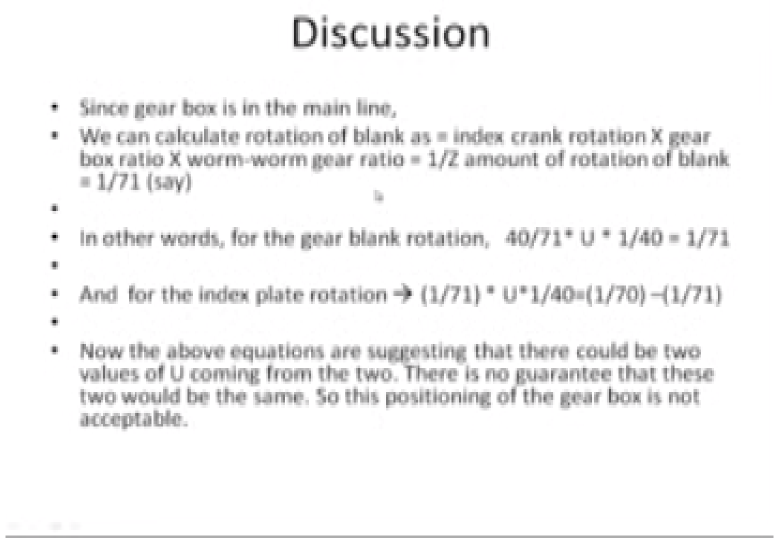

Will be place it here since the gear box is I the main line okay we can calculate rotation of the blank as equal to index crank rotation, so are going up to the blank so it is index crank rotation into gear box ratio I to worm- worm gear ratio equal to 1/z amount of rotation of blank okay. Now what does that mean? That means basically let us draw a figure once again that will help us.

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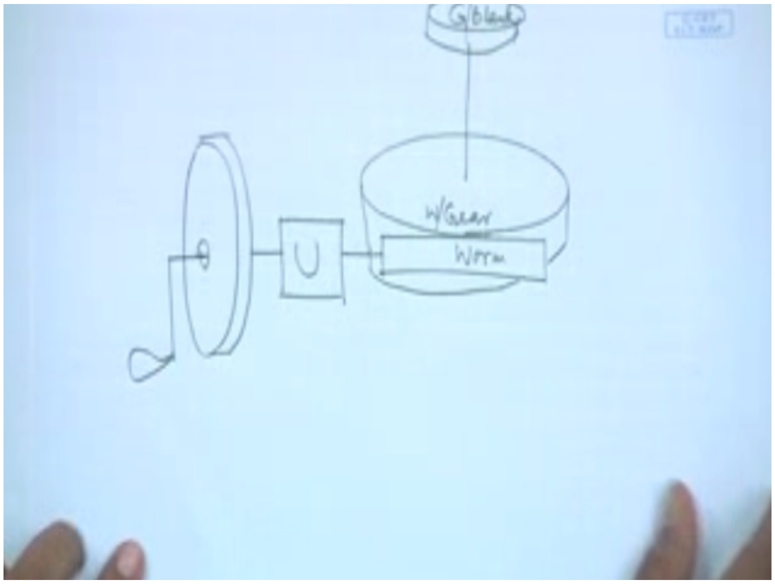

This is our index crank this is our index plate this is passing I have be are now proposing gear box here and worm here, worm here in contact with the, okay and this is our gear blank sorry this is our gear blank and simply tap this power and 1:1 we give this particular connection why not place it here it are you going to face any problem or just because we have studied with indifferent box it should be placed here. So for this one if you make calculation it will be crank rotation multiplied by gear ratio multiplied by 1/ 40 must be equal to gear blank rotation, and how much is the crank rotation?

You see index plat is rotating in such a way that you are getting 1 by ay it is suppose you are cutting 71 teeth, so this will be 40/ 71 okay.

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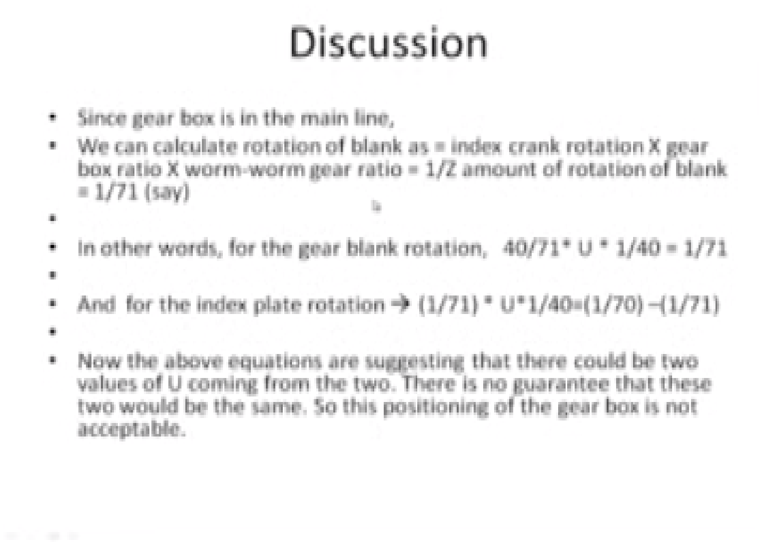

So coming back to this particular material which is written here we will say in other words blank rotation is 40/ 71 which is the crank rotation multiplied by the gear ratio multiplied by the worm and worm ratio must be equal to 1/71the blank rotation okay. Now place this we show what do we have after cancelling out we will have 71 cancelling out and what you call it 40 cancelling out and we will have u = 1, u = 71 will cancel out with 71 and 40 will cancel out with 40 and space thing is UV = 1 form the consideration of gear rotation.

What about the index plate rotation? Index plate rotation will be by the time the index the crank rotates 1/71, index plate rotation must be 1/71, 70 – 1/ 71 from this consideration we will get another value of U how mush ill that value been that value will be equal to 40/70. So from here u is coming to be 1 and here it is coming to be 40/70 therefore this particular solution cannot exist because from one condition that is the blank rotation we are getting u should be equal to 1 and from the index plate rotation we are getting u should be equal to 40/70. So this location of the gear box is not going to serve the purpose.

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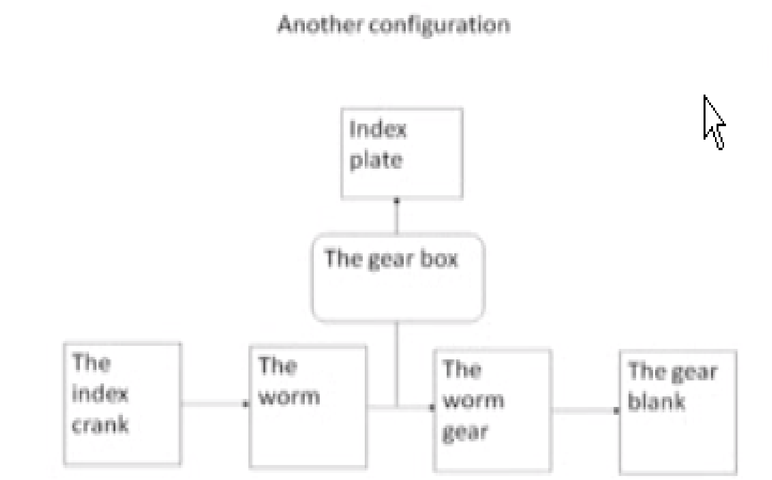

Let us take get another possible location of the gear box what about putting the gear box here a head of the worm here after the worm so if it is after the worm okay therefore worm gets the required amount of the rotation and we do the calculation now it will be index plate rotation multiplied by the worm rotation these tow re going to be the same and after that you will be have gear box that is going to give us the index plate rotation, so let us write down index crank rotation.

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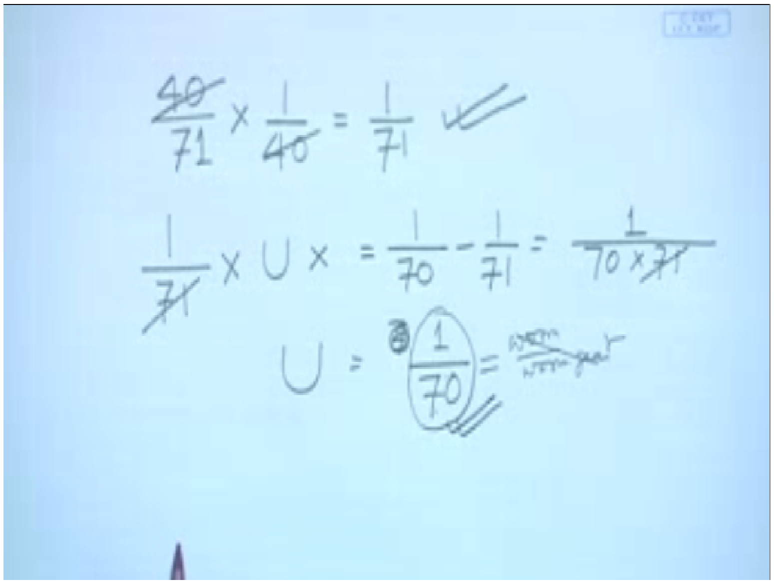

If you write down index crank rotation being 40/71 this multiplied by 1/40 should give us how does it give 1/71 that is what I write, so the straight connection okay if we look at this the straight connection this way index crank worm gear give blank this is working this actually no problem what about this one connection okay in this worm connection if we work this way by the time the crank is moving by 1/71 the gear box multiplied by this gives us the index plate rotation equal to 1/70 – 1/ 71 this is equal to 70 x 71 that is it one so we have 71 cancelling out and u comes out to be 1/70.

So this is going to work very well if you put U = 1/70 but herein lies that problem the problem is that why U I equal to 1/70 looks quite a simple ratio it is a difficult ratio to obtain, why because this particular ratio is more like the worm and worm gear ratio, worm and worm gear ratio. And that is why it will be very difficult to be obtained by ordinary spur gears.

When you are having a gear box what is the point putting a worm and worm gear ratio, because for every different gear teeth that you are cutting it is going to ask for a different worm and worm gears here. And that is going to be extremely expensive.

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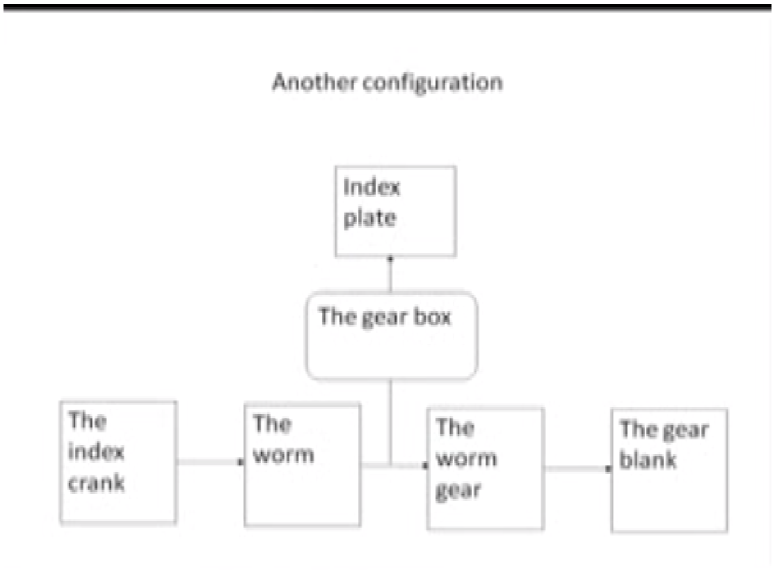

Therefore, in order to save money this particular configuration is an obvious rejection. This can obviously be rejected that is why we have the way this thing has evolved, that is why this was obviously not one of the preferred configurations.

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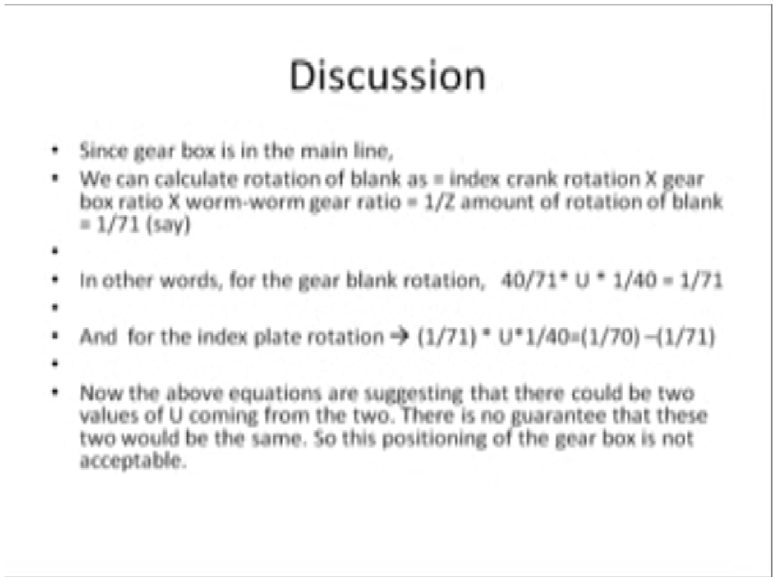

So what do we have now.

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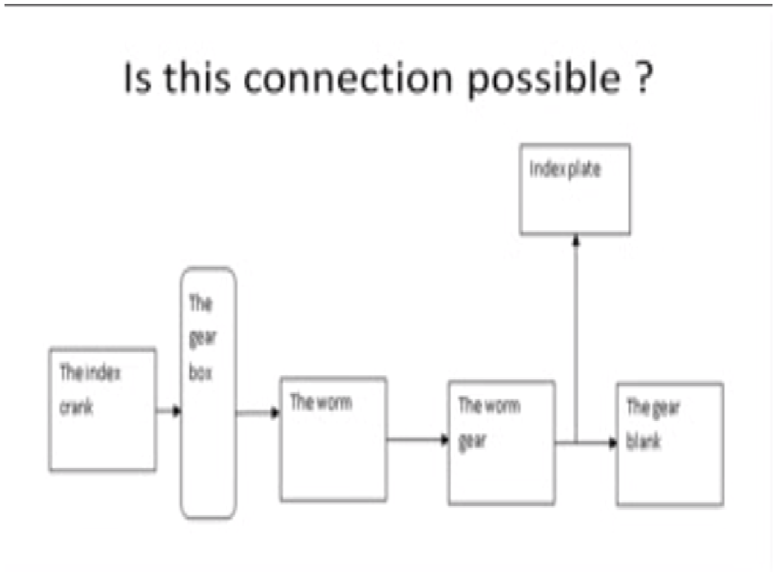

To start with.

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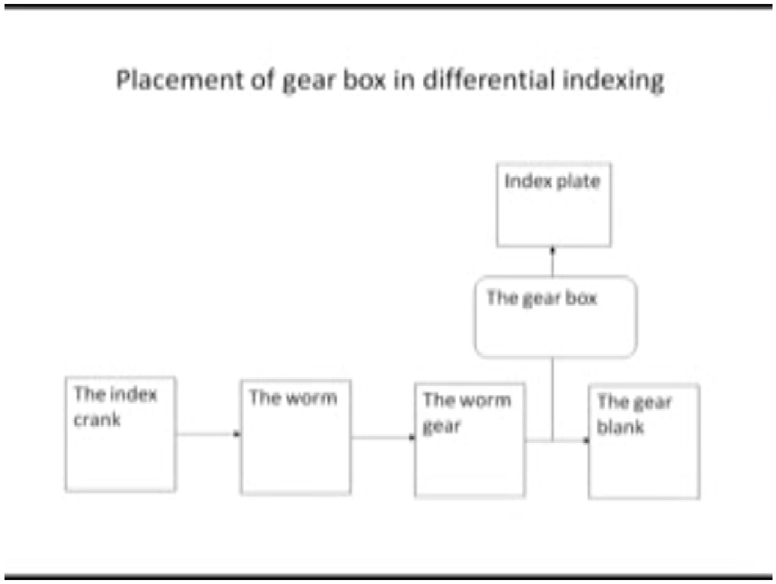

This one is what we have at present.

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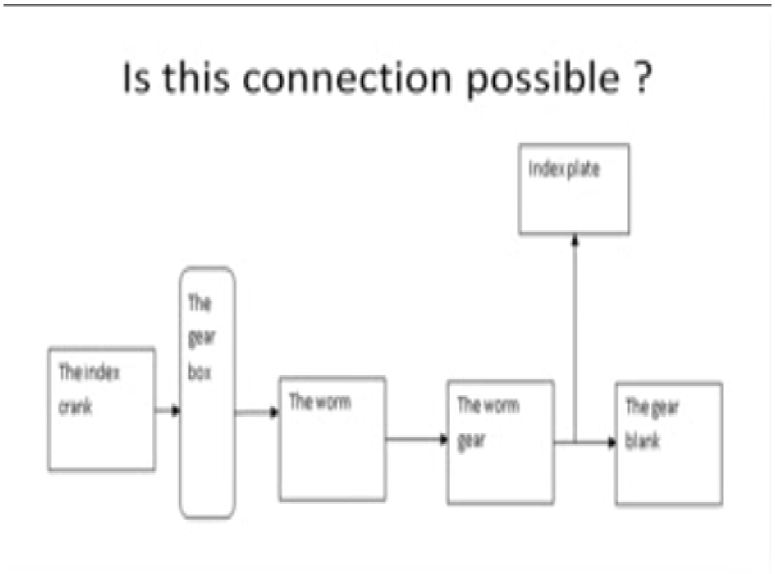

This one is what we decided that this gear box is not going to serve the two purpose of rotating the indexed plate properly and the indexed gear blank properly at the same time, because they have different requirements of the value of the gear box ratio, if it is placed here.

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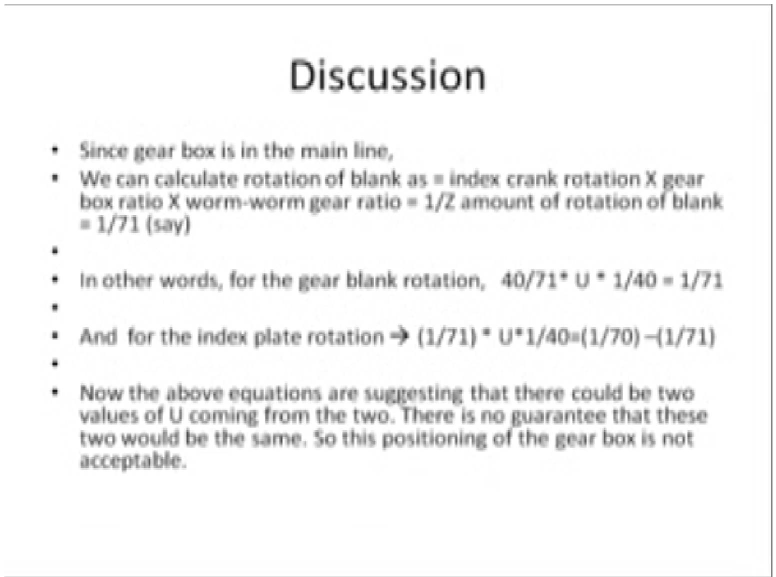

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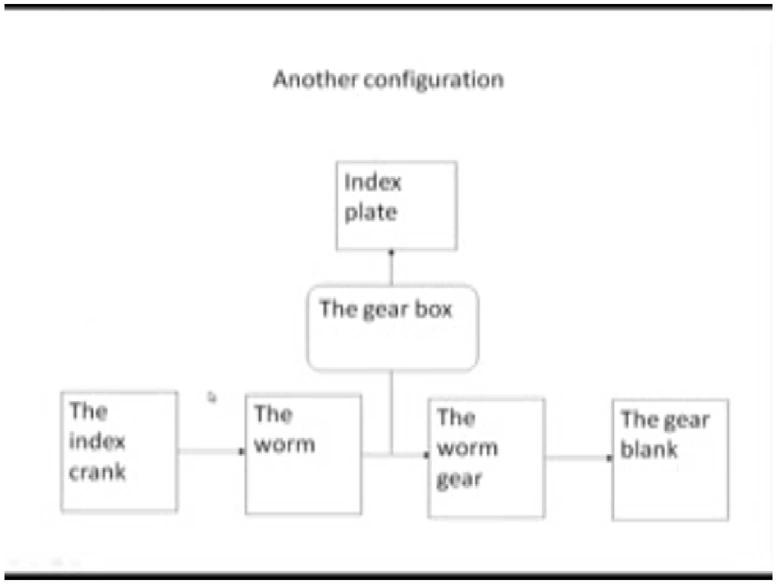

We also decided that this one is going to serve the purpose, but every time it is going to ask for one by number of teeth, and that is going to ask for different worm and worm gear ratios perhaps for every different number of TTO cutting and it is going to be extremely expensive.

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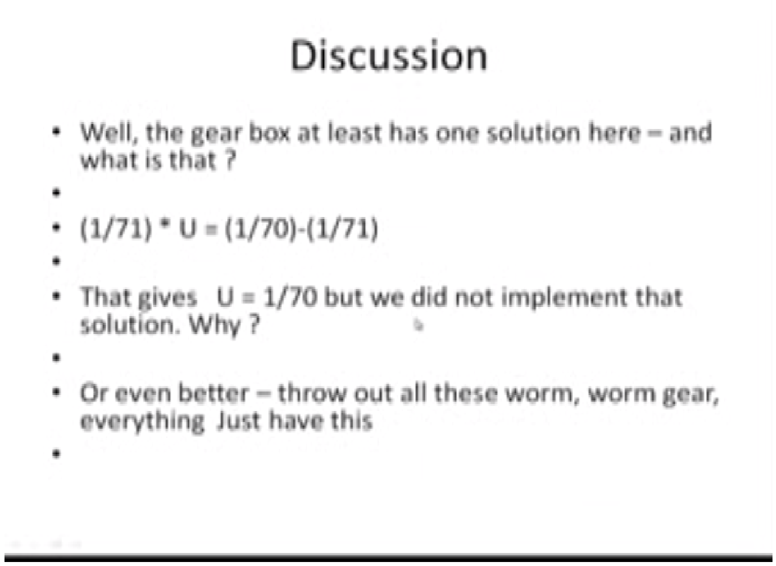

So this is what we have discussed just now U=1/70.

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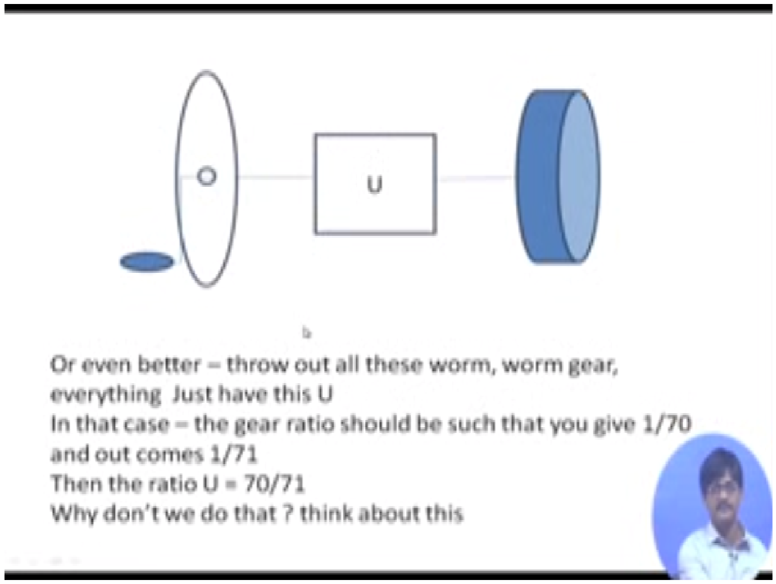

What if we throw out everything and simply you have a gear box in which this will be, you know the ratio of the number of available teeth, sorry number of available holes and the required number of teeth. That is of you are cutting 71 teeth and you are having 70 index plate number of holes, this ratio will be typically 70.71, why did not you go for that, remove everything in between and have that.

First of all it will not give us that magnification of the input rotation which was helping us in reducing the errors okay, secondly this would mean that we would have to have a series of gears of successive numbers 70.71 would be required, 80.81 would be required, 90/91, 86/87 a series of gears which will again make it extremely expensive.

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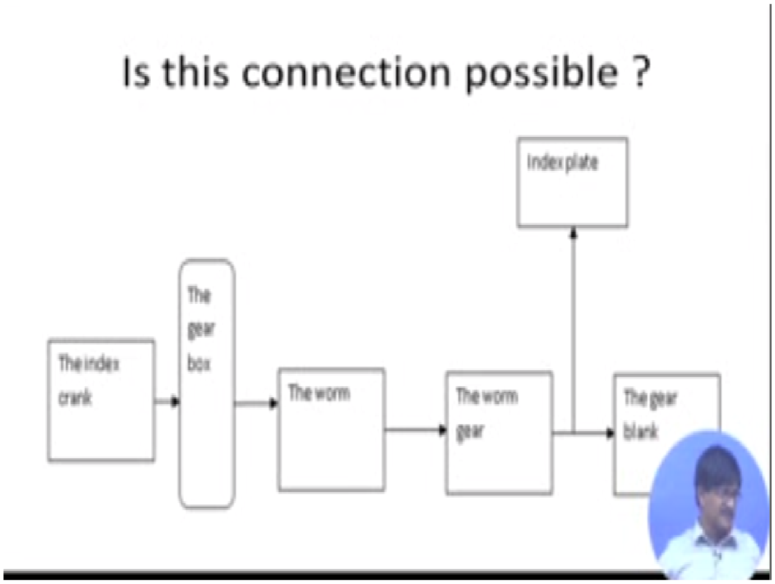

This is the reason why the unique position of the index.

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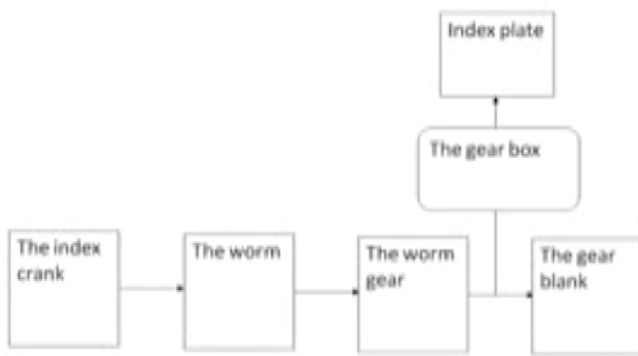
Placement of gear box in differential indexing



Sorry, of the gear ratio, gear box in case of differential indexing is this one none others okay. So to sum up the full lecture what we have covered is first of all in the first week we have covered the basics of gear, you know gear ratios and different what you call it introduction to different machine elements which will be required in case of gear cutting, like worm and worm gear, screw and nut, worm and sorry, rack pinion, spur gears, helical gears etc., everything we have discussed.

So in the first assignment we have had coverage of those, in the second week we have discussed about gear milling, helical milling, in simple indexing, differential indexing. In the third week we have discussed about and also we have discussed something about, you know testing of gears by gear to the Vernier Calipers. I have left out other methods of gear testing, because of dirt of time. We have covered in the third week the details about gear shaping process, gear shaping.

And we have also started a bit of gear hobbing in the third week itself and in the last week we have covered gear hobbing, then some discussing about helical teeth, some discussion about gear box locations in case of milling, and with that we come to the end of this course, I wish you best of luck in the performance, in the final exam and in the assignments all the best, thank you very much.