Production Technology: Theory and Practice
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Lecture - 30
Lab - 07

(Video Starts: 00:13)

Hello and welcome to the course on manufacturing technology theory and practice. How a rack can be fabricated? You know what is a rack? Rack and pinion mechanism we have shown it to you. Here these teeth have to be cut. The difference between the cutting the teeth on the rack and the cutting teeth on the spur gear is that we do not have to find out the angles like in case of bevel gear. Here you have to only find out the pitch, given a module.

Pitch means the distance between the two teeth. The minimum distance. Now, for the calculation of the pitch, the formula is well known this will be module multiplied by π and suppose the module we have taken as 1.5 millimeter, in that case, we will be selecting the milling cutter as 1.5 module. Therefore, the pitch will be 1.5 multiplied by π which is 4.7 millimeter. That means one tooth has been fabricated and to go to the next position for cutting the next tooth we have to move to 4.7 millimeter.

That movement is done with the help of different knobs we have different handles. This is the handle which is used for the cross feed. This is the handle which is used for lifting up the machine up and down and here we can see a handle. That handle is used for the longitudinal feed. In all 3 axes X, X here if we say the Y here if we consider and the Z is along the vertical axis.

This is for the vertical, vertically moving the table up and down. This is the longitudinal feed given by that handle and this is the handle which will give you the cross feed. Cross feed to cover the entire depth for the entire width of the teeth. Mr. Srinivasalu will demonstrate you how the inner teeth on the rack can be fabricated for that we have the blank here.

For that purpose, in fact, there could be two blanks simultaneously clamped and with the cross feed both the gears can be cut on the two different blanks. That is just to increase the productivity. So, at a time there will be two complete racks produced and a particular milling cutter has been selected with a certain module which we have selected as 1.5. This is a milling cutter with the 1.5 modules selected for this particular rack. Mr. Srinivasalu will demonstrate how the rack can be fabricated, can be cut.

We can see digital display here; this will be digitally displayed that is the pitch. Reading will be digitally displayed and no need to see here if the list of given according to the pitch. Meaning that when the handles will be rotated X, Y, Z as I shown it to you, you can see the value there in the display and then you can be ensured that the required value is set.

Now this is fixed at a certain position, let us say 0 positions. And that can be seen in the display as we have told you that display will actually show you what will be the longitudinal feed given what is the feed given axially and how much movement has been done upwards and downwards. All these 3 axes X, Y, Z are displayed in there that you can see. We can set the values now let us say this is the X axis, X axis is 0. It is the depth, that is the Z axis.

This is the cross feed given. You can see these values in the display as well that how much it has been given. Now the machine is on and as you can see the milling cutter rotates and it will be given a cross feed so that the entire length of the tooth can be machined. Making sure that the workpiece is tightened in the fixture. So, the entire length is being fabricated.

Now, we will be giving the pitch because we have to get the next get ready for the next tooth. For that we will be giving the pitch and you can see the X axis is being changed. It has to be 4.7, π multiplied by module which will be 4.7, 4.7 mm has been moved for the next tooth and the next tooth can be similarly cut as the first one. So, two teeth have been cut on that rack. And here the calculation is very simple you have to simply calculate the pitch.

And the pitch can be calculated as π multiplied by module and the module you have selected as 1.5. That makes the pitch 4.7 mm. And each time after you cut one tooth, you have to move to X

axis. Along the X axis, according to the value that you have got, that is 4.7 mm and the next tooth is ready for cut. Now we are going to demonstrate the operation on the vertical milling machine.

And as I told you already, the difference between vertical and horizontal milling machine is that the axis is vertical in case of vertical milling and vertical milling machine axis of the spindle. Here is the milling cutter and this kind of a milling cutter I have demonstrated earlier, these are the inserts. And these inserts are very expensive. Therefore, the material for the insert is the cutting tool material and this material which is used to make the mandrel to hold the inserts is different.

This material is different from the material used in the inserts. These inserts are the cutting tools. Now, this is the tool for the vertical milling machine and as you can see that the difference between the tools in the milling cutters in the vertical milling machine and the horizontal milling machine is also there. That means, in case of horizontal milling machine you have seen that there is a central hole in the milling cutter. And with the help of the key and the keyhole the milling cutter is inserted or fixed in the arbor.

Here it is a spindle and there is a chuck. For that, this is inserted here and fixed in the spindle of the milling cutter as you can see that this is the extension of that spindle on which the milling cutter is actually mounted. This will be the equivalent to the gearbox in the turning lathe and this will provide the rotational movement to the milling cutter as well as the axial feed or the feed in the Z direction of the milling cutter. Here is the handle which is used for making the Z axis movement, that is for giving the depth of cut.

Here is the blank, we are going to show you the fabrication of a flat surface, how the flat surface can be made using the milling cutter and on the vertical milling machine; this is the vise on which the job is fixed and the entire vise is fixed on the milling cutter machine with the T slots that the table has. Now, Mr. Srinivaslu is going to show you how this flat surface can be machined. Well now the machine is going to be operated and the spindle is rotating along with the milling cutter.

This is for giving the depth of cut, right now the milling cutter is going to just touch the workpiece from where we are giving the depth of cut. X, Y and Z axes are being displayed like in the previous case. And you can see in the display that the X, Y, Z axes X, Y, Z movement that was movement along the X, Y, Z axes, they are actually displayed. The depth of cut is set. And then the feed is given. Here automatic feed is given to the workpiece and the flat surface is generated.

Once again, the rotation of the milling cutter, you can see that milling cutter is on the spindle. And the workpiece is mounted on the table of the milling cutter with the help of the vise. On the vise the longitudinal feed is given to the workpiece and the workpiece is being machined. The material is being removed from the workpiece surface and the flat surface is being generated. Here by the feed we mean the feed per tooth in the case of the milling operations.

And let me remind you that the feed per tooth is the f. This is given by the V_f that is the feed velocity of the table divided by the number of rotation of the milling cutter N and the Z is the number of teeth in the milling cutter; $\left(\frac{V_f}{NZ}\right)$. This defines the feed per tooth f. Whereas, if you remember in case of turning the feed is simply given as the linear movement of the tool along the axis parallel to the axis of the workpiece in one revolution of the spindle or the workpiece.

Linear movement of the tool in one revolution of the workpiece was feed in case of turning, in case of milling it is feed per tooth, because milling cutter may have 6, 12, 18 different number of teeth. Therefore, feed has to be defined as the feed per tooth. Now you can see from the machining zone that the flat surface is almost generated. From the display you can see how the X axis value is changing because the table is moving along the X axis, it is the longitudinal feed given to the workpiece and the entire flat surface is generated.

Next, we are going to demonstrate you the drilling and fitting followed by the shaping operations. And how the surface can be fabricated in case of drilling in case of shaping and how the fitting works can be done. Before that we would like to show you the tools, some of them we

have shown it to you earlier during the discussion on the bevel gear cutting and the spur gear cutting. Today we are going to show you some more tools which are used for drilling and fitting operations.

We have already told you the digital micrometer, inside micrometer, outside micrometer, the bevel protractor. These are the tools which are used to measure the diameter of a shaft or the diameter of a hole with this. The diameter of the shaft with the help of the outside micrometer, this is the digital micrometer where you do not have to read the scale, you can read, it can be displayed here. This is the bevel protractor which is used for measuring the angles.

Similarly, we have also shown you the digital vernier caliper where the reading will be displayed on this display board. And here we have the vernier with the dial gauge. Instead of reading the main scale and the vernier scale as in case of the vernier caliper, you can get that value of the diameter of the shaft. Let us say if you are measuring the diameter here or here or here. This can be displayed in the dial gauge or in this display board.

Now, apart from the diameter of the shaft, you can also measure the internal diameter with the help of these Jaws. These jaws are used for measuring the diameter of the shaft whereas these jaws are used for measuring the diameter of the hole. This is the stainless steel scale that also we have shown here shown yesterday in the earlier classes. These are all the gauges. You can see that here we have the thread gauge.

Here you can see the jaws and these jaws are used to see which one is fitting with the one that you are measuring and here it will be reading the value. you can find out the pitch of the thread. These are for the fine pitch. These are for the bigger pitch. Similarly, you can find out what is the radius? Here you can see the different radius, there all these values are written and this is the outer diameter or the radius you can find out the radius by these gauges.

Here you can see that these are the wire gauges. Wire is passed through this and here the value of each of them will be written on this disk. Accordingly, you can determine what is the diameter of the wire. Which is passing through one of these slots, here also you can find out you can measure

the radius the same way that we have done it here. For this, this is for the bigger radius these are for the smaller radius.

And here we have the depth gauge and the depth gauge is so if you have to find out what is the distance between this surface and this surface. This is how you are measuring and you can read the scale there is a scale here. This scale will show you what is the size? What is the dimension? Similarly, this is the depth micrometer here it is more accurate. Again, if you have to find out the distance between this surface and this surface here putting it in one of the surfaces and putting this stylus up to the surface that you are measuring.

When it is touching exactly, you can see that this is touching and after that it will not go because here the mechanism is such that it will afterwards slip. Then you can read from the main scale here and from the vernier scale here what is the distance and that distance is the distance between these two surfaces. This is the depth micro meter that you can see that it has a vernier scale and it has a main scale and it has a circular scale.

From here you can find out what will be the actual distance between the two surfaces or what is the depth of a hole. For example, if there is a blind hole, what is the depth of that blind hole? That also can be found out from this depth micrometer. This is a tri square and this is taken for this is used for getting the 90^0 angle. If you have a slab for example, let us say this has to be checked whether it is at 90^0 or not?

You put that here and look at the light if the light is passing. That means, this is not exactly matching with this surface and this surface has to be further processed and so on. This is for quick checking that these two surfaces are exactly at 90^0 with the help of this tri square. This tri squares you must have used also for making drawings when you have to make the perpendicular lines or parallel lines, then the similar try squares are also used.

This is a combination set which is used for measuring the angle. These are the typical angles given. This is a kind of a gauge. And here it is 90^0 you can say and this angle at a certain angle is

given. Accordingly, if it is matching with that particular surface, you can be ensured that the relative angle between the two surfaces will be according to this angle which is given here.

This is a complete set that is why it is called the combination set. This we have already told you as the spirit level. This is the drill sleeve, this is the counter sink drill, this is the centre drill bit, this is a straight shank drill bit and this is the taper shank drill bit. About this drill sleeve and the drill bits I told you a few things last time that countersink drill is to make the countersinking process and you know that the counter sinking is used for special purpose bolts.

This is the center drill bit; center drilling is made to hold the shaft at the centers that also last time when we are making the lathe operation or when we are fabricating the part on the lathe machine, we have shown you how this center drill bit is used for making the center holes. This is the straight shank drill bit because the shank here as you can see is the straight. Therefore, it is called the straight shank drill bit and this shank is connected to the tool holde,r drill chuck or drill holder so that we have shown it already.

This is the taper shank drill bit where we have the tapers, which is the morse taper and it goes into the drill holder, the drill chuck which also has a morse taper inside. Those two surfaces that the inside surface of the drill chuck and the outer morse taper of the drill will match. The torque will be transmitted from the spindle to the drill through the friction between the two surfaces, the morse taper surfaces.

This is the adjustable spanner, the distance between the jaws which will hold the job or the screw head that can be adjusted by the screw. This you must have seen being used by the people who come for repairing the taps and for the household uses. Now, this as I said, is that drift or it is also the instrument which is used for removing the drill from the drill chuck, these are the Allen keys.

This I have already told you this is a dial gauge, this is the angle protractor. This is to measure the angles as well as the linear scale can be used. The linear scale that you have here that also can be used for measuring the length of a line or a surface. And this protector this can be used for

measuring the angle. This is for marking the blocks. Blocks are normally either painted or made in some marking on the surface and by chalk. And then on that this edge will be used can be used for making the line on making the centers for making a hole and so on.

This is a keyless drill chuck this has already been told to you that this is a collet chuck and it is equivalent to a mechanical pencil. This is the vernier height gauge, also has been told to you, for measuring the height that is the distance between two surfaces. Well, after that, we will demonstrate you some tools after the drilling. You have seen the drill and how a drill looks like, after the drilling operation it is normally the reamer which is used and the operation that is made is called the reaming operation.

Reaming operation is made not exactly to remove the material because most of the material will be removed by the drilling operation, but the reamers are used or the reaming operation is used to make the hole better in the sense that the accuracy of the hole to enhance the accuracy of the hole. So that is the basic purpose of the reaming when the tolerance is very close. The reaming operation has to be used because after the drilling normally the surface finish is not very good.

Because drills always have vibration, drilling machine will always have a vibration. Because of that the drilled hole diameter will be slightly more than the diameter of the drill that must have been told to you. So, after that to increase the accuracy of the hole, the reaming is used. So that the close tolerance can be obtained and this is the hand reamer where you are using a holder. This is kind of a wrench so it can be fixed in here and then it can be given the torque, so this is the hand reamer.

And we will show you the operation the hand reamer operation in the machine. Whereas this is the machine reamer so in of course the difference you understand that in machine reamer it has to be a morse taper shank, like in case of drilling that we have shown. And this if you remember I told you in case of drill this is called the tang. This is used to remove the reamer and machine reamer from the drill chuck by using the wedge shaped part that I have shown it to you. This is called the chisel.

This you must have seen with the carpenters. This is the scriber that I also told you to scribe to make a scratch line on the metallic surface and mark it. This is the C clamp C name came because of this shape. This is in the shape of the C. Within these two jaws this is fixed this is movable, you can actually fix whatever is being whatever is required. It can be a flat surface it can be a cylindrical surface whatever has to be fixed here. Within this space between the movable jaw and the fixed jaw, it can be fixed.

This is the scrapper, so this also you must have seen with the carpenters. Along with some kind of chisel like this these are also used for the fitting shaft. See that these are the center punch. Center punch is used to manually punch and mark the center where the drill has to be hole has to be drill. Because if you do not have a marking in that case, the drill may not actually go or say or start drilling according to the center that is desired.

Then we have different kinds of pliers and those pliers you must be familiar with because they are also used in the household purposes. These are the different kinds of pliers. They are very extensively used in the laboratories as well. Here there is a unique file that is not very popularly seen. This is the wooden file. This wooden file is mostly used for the wooden surfaces. And here if you can see that these teeth are quite pitch is quite rough in the sense that they are bigger.

If you see the direction of these teeth, then you can realize that as it goes in this way, then it can actually remove the material meaning that it can actually file the surface because, in that case the wood will be removed and when it is moving in this direction. It is not removing but it is actually smoothening the surface. Both directions when you are doing that, you are removing the surface and then you are smoothing the surface meaning those burrs which are present after you remove because it is a wooden surface.

Therefore, the burrs will be there. And those burrs can be removed and the surface can be smoothen, when the file will be in a pool in the other direction. This is a very useful file. These are different kinds of files here you can see these files are very fine files. And they are all therefore, called the needle files all of them are called needle files, this is the round shape, this is the flat shape as you can see, this also has a flat shape and this is a square shape.

All these files are used for manually filing the holes or the flat surface or the outer surface of a groove for example and so on. This is just to smoothen the surface that is to remove the bars and the scratches on the surface which are there. These are all the files from here to here, you can see that all these files are of different types. They are all used for the same purpose that is to smoothen the part that is to remove the burrs. Particularly you have seen the needle file, here you can see the double cut flat smooth file.

Double cut because here there are the directions of these teeth or so to say the teeth because teeth are here that is groups. These are in 2 directions one in this, another is along this direction 90^0 to the other one. Therefore, it is called a double cut flat smooth file. This is the knife edge file because of the shape of the file that name is given and you can see that this is in the shape of the knife. This is the triangular file you can see that the shape of the file is triangular.

And here also this is not double cut probably, no this is a single cut it is not a double cut. And this is the square file again because this section is the square cross section you can see that. This is a round file. Now this is mostly used for the filing the internal holes. And then the square file and the triangular file and the outer surfaces which will actually fit in when the triangular flat shape will fit in similarly, the square file for the square holes also where it will fit in or the outer surface that is required to be filed.

This file is called the half round file because of the shape here semi circular as you can see, and here these files you can see that they are of different sizes. And also they are of different grades in the sense that this one is for rough work. And here if you see that this is quite smooth in the sense that when you file with the rough file then the material removal will be much more than the material removal we will get from this file because this is a smoother file.

This is therefore called the smooth file. They are basically used for the finishing. And these files are basically used for the roughing. That is when the rough operation has to be performed. Rough file is required for removal of more material. Then this file is used for smoothening the surface it

is like in case of the rough cutting, the rough turning and the finished turning, rough milling and the finished milling, rough grinding finish grinding and so on.

Similarly, the filing also manually when you do that you can have a rough filing, filing of surface roughly and the final filing of the same surface. That will smoothen the circle that will increase the surface finish and the surface roughness will be reduced. Well, here are some more accessories you can see. This is the hand hacksaw It is handheld and the way that you drive it here like this and then the metal piece or the metal shaft or the prismatic piece can be cut or a slot can be made for example depending on the thickness of this blade.

This is the double ended ring spanner, the ring type or this kind of a nut that can be tightened, nut which will be fixed here, which will fit here or here. There are different kinds of spanners depending on the size see, for example, this kind of thing that can be moved. It moves in one direction in another direction it does not, these are very helpful. And there is switchover, you can fix it and in another direction see it is not moving.

It is like in the case of the cycle, in the cycle also you can you know that in front, I mean when you are pedaling in the right-hand direction, front direction it is going and the back direction it does not move. The ratchet mechanism is also here you can see that and this is activated by this switch. Now this ratchet mechanism is not activated. Similarly, there are different kinds of the spanners which are used these are the double ended open spanner this I have already shown it to you. And here also you can see that these kinds of holders are used.

You can hold it here at this end and then you can similarly use it like in this case. There are special holders for this and those holders are used to hold it and it will be exactly the same. See this is the holder and it as a handle and this holder fits in here and then if you are doing that, this will actually give the torque to this. Then we have machine vise. You can see that this can be mounted on a machine bed and with the help of this screw it is knurled.

This distance can be changed and the part which has to be clamped accordingly the distance has to be maintained. This is puller, so particularly it is used very effectively used for taking out the

bearing when the dismantling of shaft to the bearing is required. This mechanism is very effective because otherwise if you hammer you can damage the bearing. Those bearings can be pulled from the shaft using this. This is called a puller.

Here if you see that this is a flat plate and on this plate the different kind of flat surfaces can be mounted. And if you see this, this is actually the V block and this block particularly it has a magnetic set. In this position on this ferromagnetic material plate this if you in this position this cannot be moved so because it is it has become magnetic this also ferromagnetic material. And in this position, the magnet is not there so you can move it along with this.

If you have to move from one position to another and then you fix it. You make sure that there is no relative movement between this block and the flat bed plate with respect to that it does not have any kind of magnetic action. It only has a V block and this V block can be used for putting the cylinder for measuring the non cylindricity for example. In that case you can make sure that the center is aligned the center of the cylinder which for which you are making the out of roundness that is aligned.

For doing that we use this kind of V blocks. We have a drilling machine we wanted to demonstrate. This is the radial drilling machine you must have seen in many other places also. It has the drill which is mounted here with the drill chuck this rotation is given to the drill as well as the feed in the X direction that is in the vertical direction is given to the feed. Here we have a collet chuck and this collet chuck can accommodate or fix the cylindrical shank drill that I have shown it to you earlier.

Here is a vise on the table on the machine table and this vise you can hold the jaw on the vise jaw will be fixed. And it will know that in case of drilling the jaw is fixed and the rotation as well as the thrust. Thrust is the downward movement of the tool or the drill when the drill penetrates the workpiece. Both of these movements are given to the tool in this case it is the drill and the workpiece is fixed on the table which is mounted on the vise tool vise.

Here when the machine is switched on, the spindle rotates that rotation can be changed depending on the required rotation of the drill you can determine the RPM of the machine how much you will be requiring. And then this we can give the Z axis movement that is the downward movements for the tool that is a drill to penetrate the workpiece and remove the material to make the blind hole or the drill hole as per the requirement in the workpiece which is mounted which is fixed on the machine table and the vise here.

We can switch on the machine and you can see that while the machine is switched on with a particular RPM, the spindle is rotating. This is the automatic feed given that feed means this is the downward movement of the drill. Now, before making that you can fix the value at which value it should actually move and then make that automatic. Now manually you can also move that in the axial radial direction as it is being shown to you right now.

And this handle make it is in a particular position and after that this can be a feed can be given either manually or automatically with the help of this handle. This is the handle which is used for moving the entire block along with the tool up and down you can see that there is a column and through the column or using the column along the column that whole entire head along with the drill chuck along with the drill, it is moving up and down can be moved up and down. This is another movement which can be given to the tool and this is the column.

The tool is moving that is why it is called the radial drilling machine. In normal drilling machine this kind of movement you will not find and this is done for using a very big job. When you have to drill hole in many places in different places in a bigger job let us say a very big plate. In that case the radial drilling machines are used so that the drill can be moved in various directions as have been shown to you.

These are the handles which are used for selecting different directions different tool rotation or the rotation of the drill as you can see that now the rotation RPM has been changed. Then this is the high speed you can see that. As you can see like in case of turning lathe this is done by the changing the gears in the gear train which is in the headstock.

Here also in the headstock there are gear trains and depending on which position the handles are, there are different gears which are in mesh and based on that the particular RPM of the tool can be obtained. Either it is a very high speed or it is a slower speed depending on the speed, depending on the requirement what kind of job you are performing.

Just now, we have seen the radial drilling machine and I told you that the radial drilling machines are used for bigger parts, let us say if you have a bigger plate. I repeat and you have to drill many holes in various places then you have to have certain swing of the tool. Therefore, that radial drilling machines are used here if you see this is also a drilling machine this is a smaller version and here you can drill hole. Now, in case of radial drilling machine, I told you that the speed can be varied using the gear train which is there in the headstock.

Here for changing the speed there is a PIV drive. PIV drive stands for the positive infinite variable drive. And that drive I will show you the operation of this drive you must have seen in a theory book that in this the plate that is used these are conical and therefore their diameter varies from the center to the periphery infinitely.

Now from the motor main shaft the transmission goes in through the belt drive, you can see here there are V belts. And this V belt drive it drives this shaft on which the conical plates are located; those plates can come closer to each other and then the diameter will be varied we will show you right now. And therefore, from here to here, the transmission can be varied by using the distance from the center at which the belt is in contact with the disk.

And then accordingly the speed will be obtained; you can see that the motor is here so that input is given from here to this and from here it will come to the spindle. This is the output, Input coming from the motor which is the main drive of the machine from here to the belt to the conical pulleys. And from the conical pulleys the infinitely variable drive or the speed can be given to the output shaft where you have the spindle and where you have the tool mounted on the spindle.

Here you can see that this is small drill which is cylindrical shank drill which is mounted with the help of the chuck. And this is the collect chuck. Here if you can see that there is a hole here and through the hole you can see the tang. Well, this is the cylindrical shank drill is mounted on the spindle through a drill chuck which is the collet chuck and I showed it to you earlier the collet chuck with the morse taper surface.

The morse taper goes in the more internal morse taper of this chuck, drill chuck and here you can see that there is a hole through the hole you can see the end of the tang which is at the end of the tapered surface of this drill holder. I already told you that the tang is used to remove the drill from the drill chuck. You can take one wedge shaped part and then by pushing you can remove that the drill.

This is the tang which you are pressing so that it can be disengaged from the internal morse taper which is holding not only holding this tool, but it is also transmitting the torque that is more important. That transmission of the torque is only through the friction between the two surfaces, one surface is the conical surface of this shank and the other surface is the internal conical surface of this tool holder or the drill chuck.

If you want to put it just put it like this and it will be held between the two morse taper surfaces. Now to operate this machine you have to switch on first, so it is a start position. And you can see that as soon as you switch it on the power goes to the main drive and this shaft starts rotating. In it is turn that shaft transmits the power through the belt drive to the shaft here in between intermediate shaft and intermediate shaft has this conical pulley.

Now if you want to increase or decrease the speed you have to rotate this so what you are doing here by rotating this the speed is decreasing and why the speed is decreasing, you take a close shot of this disk and you can see that as we are doing this the belt is coming towards the periphery. And in that case the belt has come towards the periphery, that means the distance is more, diameter is more.

So, from the smaller one to the bigger one, the speed is reduced. And if we are increasing that towards this side, the speed is increasing because in that case the belt is going towards the center and the effective diameter is becoming less. Effective diameter is less meaning that from the bigger diameter to the smaller diameter the the power is being transmitted. Then accordingly this goes to the spindle and you can see that the drill is rotating. The rotation can be increased or it can be decreased.

Now you look at the spindle. See now the rotation is very less because we have increased the diameter and now, we are decreasing the diameter, you can see that they are now expanding and that is the maximum speed that you can create. Therefore, this is called the positive infinite variable drive PIV drive. And this PIV drive is very important because in this case any kind of speed that he required you can get without any steps, i.e. continuously.

And in case of gear drive you have seen that the speeds obtained are stepwise, so, you have a particular number of RPM, like in case of the turning lathe you have seen that there are fixed number of RPM and if you have to use an RPM in between, it is not possible. But in this case any RPM that is required you can get it with the help of the PIV drive which has been demonstrated. Thank you for your attention.

(Video Ends: 55:48)