Manufacturing Processes II
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Lecture No.23B
Use of Attachments in Machine Tools

Good afternoon, dear friends, you are welcome to our course Manufacturing Processes II.

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The module that is containing General Purpose Machine Tools and today's lecture topic is Use of various Attachments used in Machine Tools.

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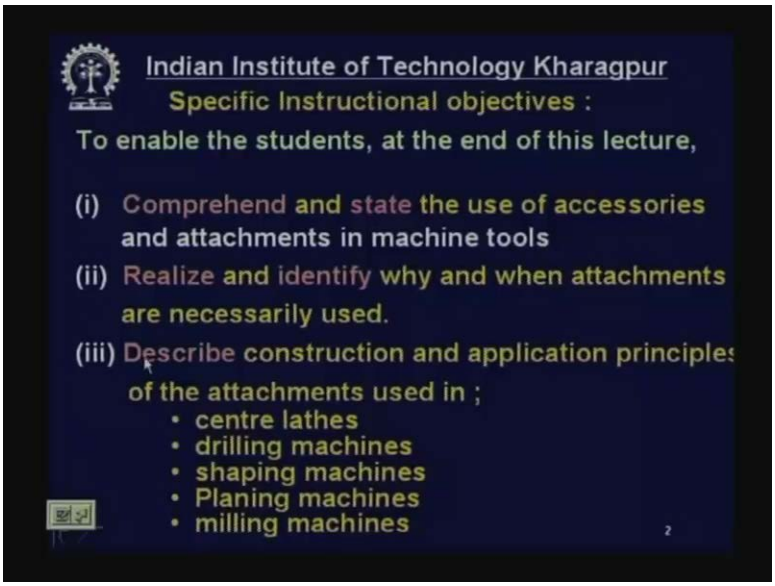

Now what are the objectives today? This lesson will enable the students (i) Comprehend and state the use of accessories and attachments in machine tools (ii) Realize and identify why and when attachments should be used or necessarily used and (iii) Describe construction and application principles of the various attachments used in central lathes, drilling machines, shaping machines, planing machines and milling machines which are most conventional general purpose non-automatic machine tools.

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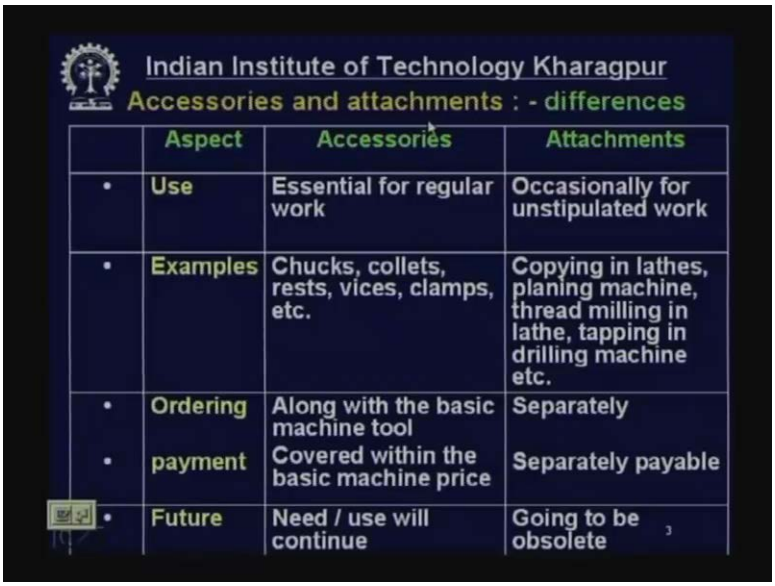

Now let us have a quick glance into Accessories and attachments. Accessories and attachments both are used in machine tools, but there are differences, what are the

differences which the accessories and attachments? In respect of use, accessories remember these are essentially used for regular work. You know each machine tool is specified for a range of activities is called stipulated work. And for conducting the stipulated activities, some devices extra devices are to be incorporated in the machine tool but the attachments which are very occasional used and beyond the stipulation range.

You want to suppose a lathe has got some stipulation. You want to do something which cannot be or should not be done in lathe, but we shall do it in a lathe deliberately with the help of an attachment is very occasional. Examples of accessories which are inabilitable for regular work; Chucks, collets, steady and follower rests, different types of vices, clamps and other things in different machine tools. What about in case of attachments? Say copying in lathes, planning machine, now you are doing copying lathe, milling machine, planing machine with the help of certain attachments as and when required thread milling. So you are doing milling in lathe. Tapping in drilling machine; So, these are various attachments which are very occasional used when you know almost compared ordering.

Now accessories are ordered along with the basic machine tools. So when you purchase the lathe suppose you always enlist the accessories say 4-jaw chuck, 3-jaw chuck, steady rest follower. Rest all these things should be enlisted along with the machine tool. But the attachment need not be attached associated with the machine tool. It can be purchased or ordered any moment you can do this and each has to be done separately. Payment: when you will pay the payment for the accessories are covered within the basic machine price. So, the total price covers the payment of the accessories, but in case of attachments they have to be ordered separately they have to be paid separately as and when required. What about the future? Accessories this a continuous need and use and this will continue whenever machine tools conventional machine tools or any machine tool will be used accessories are always have to be used say for chuck but the cop the attachments they are going to be gradually obsolete.

The reason is this unstipulated work or special work to be done in another machine tool why it is necessary? When it is necessary? When all types of machine tools are not available, only few one or two three machines to say shaping machine and lathe and drilling machine is available but you want to do tapping, then we have to take help of a tapping attachment in a lathe. You have to do milling say thread milling, long thread milling, you do not have such kind of machine. Then you have to use a attachment into a lathe and beside that this very quick and vast advance when is taking place in the area of machine tools, sophistication versatility automation and specially flexible automation like say cnc machining center as and when these machines are coming up the neat and use of attachments are gradually decreasing.

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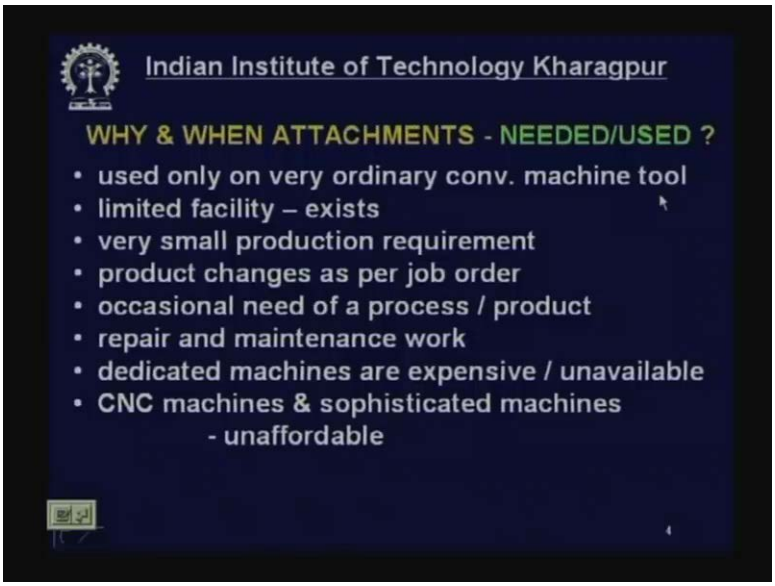

Now why and when attachments should be used? These will be gradually eliminated or obsolete. But even now another few decades this will continue in some areas. What are those areas? When and why attachment should be needed and to be used? Look, this should be used only on very ordinary conventional machine tools say central lathe ordinary column drilling machine, ordinary shaping machine. Ordinary non-conventional general purpose non-automatic milling machine and so on. Limited facility exists if you have a normal facility to conduct all types of machine tools to conduct any kind of work then you need not go for any attachment.

If tapping is required do in a tapping machine, in you need a copying, you do in a copying machine and so on. Only when facilities do not exist you have only few machines but you have to do different type of work, then you have to take help of attachments very small production requirement. Now the production requirement is only for piece production or job order production. It is not for mass production or lot production one or two pieces occasionally maybe once in a month or once in three days which has to be done. Product changes as per job order the job product is not predictable any moment any kind of job may come and you should pauses few attachments which as when required they mounted in the appropriate machine tool and get the small work done.

Occasional need of a process or product: So it is not a regular process and normally such kind of you know slow, inaccurate activities are done under repair and maintenance work where it is very much less manufactured. Dedicated machines are unique expensive or unavailable, where dedicated special purpose or single purpose machine tools are very expensive and because of that not available then we can go for at use of attachments in very conventional machine tools. Another thing, this computer numerical control machines which are very flexibly automatic, which has got wide versatility and flexibility and sophisticated machines. If they are available then there is no question, there is no

need of any attachment and when we cannot afford it, we can go for attachment, we cannot afford it we can afford it we should not.

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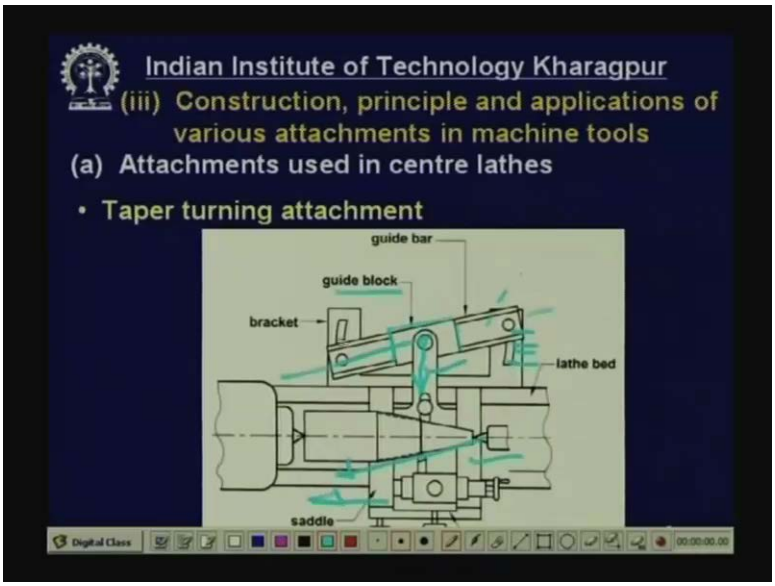

Now let us have some examples: say construction principle and applications of various attachments in machine tools. Now there are many types of attachments possible but we shall discuss few common type are being used for last few years and decades. Now first is see this taper turning attachment which is used in as attachment in centre lathe. Now center lathe is a very common general purpose non automatic machine tool and this kind of machine tool is used where attachments specially attachments are mounted to get specific work. Now, how is it done? Remember taper turning in a lathe taper turning is a very regular work, which are normally done by offsetting the tailstock, by offsetting by swiveling the compound slide, by taking a horn tool or by combining longitudinal feed and cross feed.

We can do that but one attachment called taper turning attachment if available and mounted, this will help lot in getting taper turning like this over wide range of length and angle. How does it work? You see this cross slide is first dealing from this saddle; this is a saddle it is dealing, so this will move automatically of its own. Now this is connected with a slight. This is called guide block. This is pitted, this will be slide along a bar this is called guide bar .Now when this saddle will be moving in this direction. This will follow this path. As a result, the cross slide will move inside along with longitudinal feed. So now on this cross slide, there is a compound slide on that there is tool post on the cutting tool is mounted. So when this cross slide will be moving along this path, the cutting tool also moves along this path. This is how the taper turning attachment is chosen. Now this is a graduation, you know here and here. So you can set this bar at any particular angle desired.

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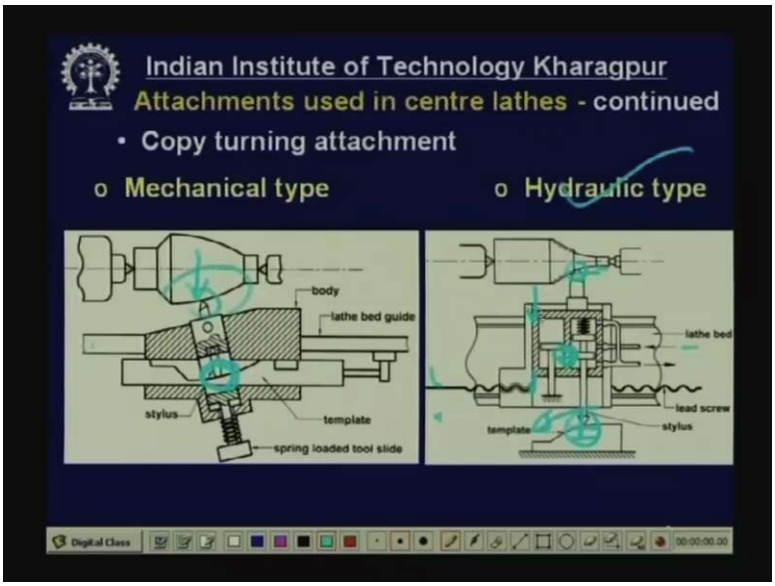

Next is copy turning attachment used in centre lathe: Copy turning attachment: now this can be mechanical type or it can be hydraulic type. Now this shows the mechanical type. Now what is there? This is the job to be produced. You see the product which has got a profile, a profile ended with flat end and taper. Now what you do? You have to produce first a template, a rod or a plate of this shape. This part will be replicated on to the product through the cutting tool. Now this block this is the attachment, this attachment is mounted on the saddle. But this template is fixed with the lathe bed at a point. So when this block moves in this direction, this template does not move. This cross slide which is holding the tool moves in a transverse direction through this guide.

Now when this template you see when this saddle moves in this direction then, this stylus follows this path and is origin contact because this is a spring load because of the spring all is pushed in this direction. As a result, this stylus this stylus here is always in contact with this one and so this will follow this path. So this cross slide will follow this path. It will move in this direction as well as in this direction resulting that along with the stylus the cutting tool will also follow this path, and then this will go right here this will also right here. Then this will go straight this will also go straight. Like this, the entire thing will be copied but it has got certain limitation this is not very popular this mechanical copying. The reason is the cutting force that comes on to the cutting tool is cutting coming straight to the stylus at the contact point. As a result, there will be lot of vibration, wear and tear strike slip motion. So, this stylus and template will be damaged and quality of the product will be affected. So it should be attempted such that this contact force will be independent and much less compared to the cutting force, this has been accomplished in hydraulic copying. Here you see the hydraulic copying:

Now here also, this is the template which has got a profile like this suppose, this is the profile which has to be produced here on to the job. Now the cutting there is a cylinder this is a cylinder on which, this is also a slide the cutting tool is fixed, this cross slide

which has got two cylinders, one is the valve other, one is the cylinder and this is a spool which spool is the stylus here always in contact with the template under the action of the spring. Now when this high pressure oil is coming through this and this enters, this tends to enter into this and there are two forces here not shown over here. There are two forces. So, this oil cannot enter into this chamber, nor into this chamber, but when the stylus because this whole saddle this saddle is moving in this direction continuously will be with the help of this lead screw.

Now when this will so long remain on the flat surface there will be no movement in the stylus and these two forces will not open and cutting tool will also follow straight path, but when this will fall way cut path or stip then this port will open. When this port will open the high pressure oil will reach here alright and pressure will be exhorted on the cylinder and the cylinder will be moving down against the piston which is fixed. Now when this cylinder along with the cutting tool moved downward along with the slight downward movement say delta y of the tool this cylinder also gradually moves downward delta y and then first of all, this port was opened. This port was opened here because of the movement of the stylus. Now after this stylus moves because of this pressure oil coming into the chamber, the cylinder will come down. As a result, the port that was the amount of port that was open now this will be closed.

So, this movement amount of movement of the tool that is delta x will be exactly equal to the amount of downward movement delta x or delta y of the stylus. So, this will be nullified immediately, but this is continuously drooping. So, again the port will open again the cylinder will move down along with the cutting tool. So this move like this, so this kind of movement will continue. So, this will move down then horizontal then vertical and like this or this is y direction and this is x direction but this roughness of the surface are very very small. So this will be almost linear on the naked eye. This is hydraulic and the advantage is that the cutting force developed in the cutting tool will not be transferred to this stylus. Here the contact force is very very small and independent of the cutting force.

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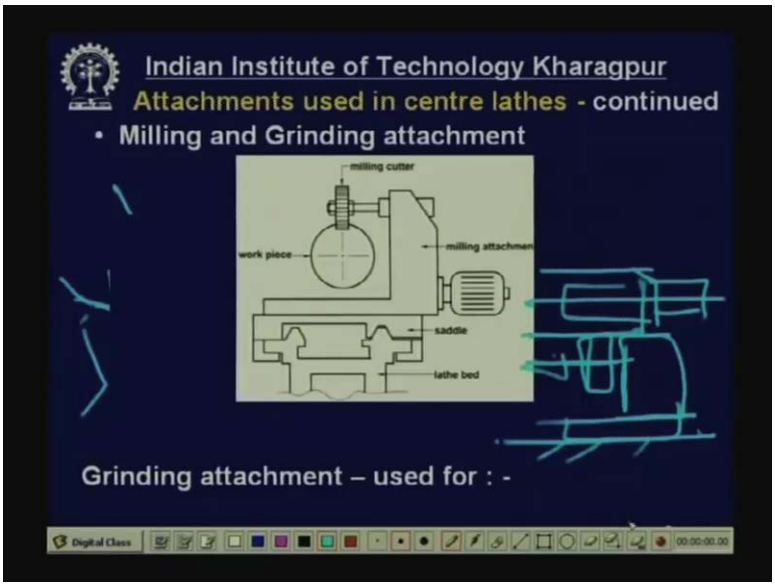

Now another attachment frequently used in lathe center lathes. What is called milling and grinding attachment? Milling operation in lathe, grinding operation in lathe center lathe. Now how is it accomplished? Now if it is a milling, this shows a milling attachment .This is a grinding attachment, this is the lathe bed alright. This is the saddle. This is the saddle, on the saddle these bracket or this attachment this is the attachment this entire body is the attachment, mounted on the saddle of the lathe bed and then on this attachment what are there? There is a motor for power. There is gear box inside and then this is transmitted to this spindle. On the spindle, there is a milling cutter alright and this is a job say cross section of the job a rod which is supported in between the center such chuck in a lathe perpendicular to this axis and now the when this saddle will move along the bed along the bed, then this cutter will also move and produce a slot like this, so this will produce a slot suppose this is the rod and this will produce a slot here like this a slot will be produced.

Now we can use different types of milling cutters and by different types of milling cutter we can get different type of work. So, this can be you know a slitting cutter a side cutter a stip. cutter or ah now you can produce splines also so spline grooves we can cut the tooth of gears if we use form tool. If we use a form tool or milling cutter then we can machine this material in between the tooth of gear so lot of work can be done milling work can be done in this process. Sometime this attachment is also provided with provided with some attachment further attachment where a vertical spindle may be there and you can put end mill type of cutter for cutting slots and similar work. Now this is the milling attachment, which can be you know used for many many purposes. This is a very versatile very common grinding attachment. Now mind that, this cutter can be a form cutter.

If we can just like I told you that it can produce each get it can produce thread also say in the lead screw, a thread has to be produced. This grooves have to be cut so that, this cut can be cut by this attachment and this is called long thread milling. Now grinding attachment; yes. Now if we want to finish this thread, if we want to finish this slot surface

finish and accuracy then instead of this milling cutter we have to mount a grinding wheel, but in that case the spindle or the speed of the spindle has to be high and gear box is not necessary. Here you can put a pulley, from pulley to pulley at high speed and spindle rotate at high speed you can mount a grinding wheel. So, the grinding wheel can be used for you finishing accuracy and surface finish or slots, splines gear tooth and then thread screw threads and so on. Various things can be done and another advantage of this cylinder the grinding that the grinding attachment can also be used for cylindrical grinding you know external cylindrical grinding and internal cylindrical grinding.

Now suppose there is a rod. This has to be finished okay this has to be finished this turned and then you put a grinding wheel and there is an attachment which will mounted on the saddle and saddle resting on the bed. So, the grinding wheel will finish it. Now we can mount the internal grinding wheel to finish the bores, so which is very very useful device very often used. Now attachments used in centre lathes continuing milling. This is over, now next is Spherical turning attachment.

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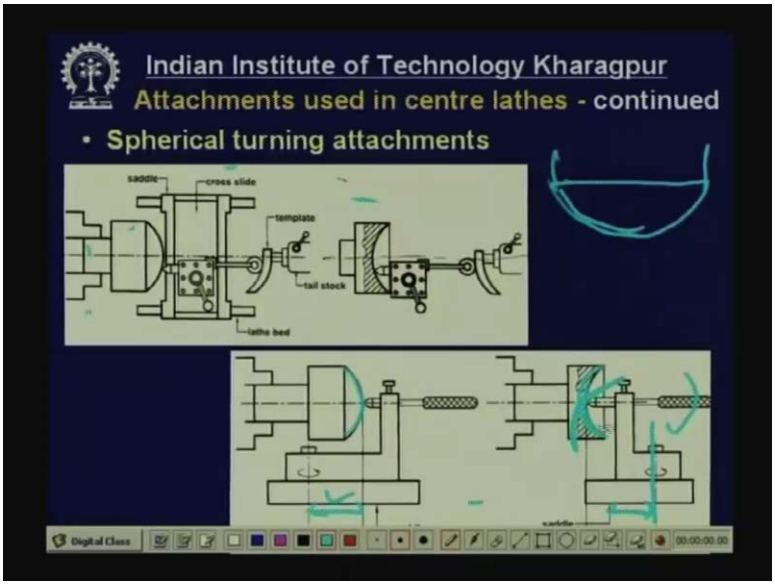

Now spherical; not a complete sphere but a part of a sphere surface has to be produced. Say for example here this is the job. It has got a spherical surface. This is external spherical or convex type spherical surface. How this will be done? The cutting tool is mounted on the tool post, tool post is mounted on the cross slide directly, but the cross slide is driven by may be driven by the cross feed screw manually or automatically. But the saddle is dealing from the screw what will happen this cross feed movement will be automatic? The cross feed will be given either automatically or manually but the longitudinal feed of the saddle along with this whole thing the cross slide etcetera on the cutting tool will be automatic. Now how this will be done? Here is a template. This template will be fitted into the tailstock alright and this tool post hole in the tool on one side there will be an extended rod holding a roller.

So when you pull this you know, move this cross slide towards the operator in this direction, then this roller will move in this direction alright and this cutting tool will also move in this direction. So you get the entire surface. Now if we want say concave surface, then what will you do? Then you have to use this kind of template. Other thing is more or less same almost same. You know this will be mounted on the cross slide, the cross slide will be mounted in the saddle, saddle will be free or dealing from the lead screw or feed rod.

So if the longitudinal feed can be automatic because of movement of the roller that now how this is a system where this spherical turning is accomplished convex and concave by templates you known conjugate templates, but this is a tedious job. So, every time for we have to change it and this is not easy but this can be done without any template is another method. Suppose you want to produce this surface now here is the saddle mounted on the lathe bed and there is a one bracket which is fixed, not fixed mounted on this saddle by a pin. So this block can be rotated about this pin and like this rotated with the help of this handle.

Now when you move this handle, this locus of the tip of the tool will be you know a curve, circular arc and then because of the rotation because of the rotation of the job, this will be replicated this side also and then you get the entire cylin the spherical surface here. Now if it is concave then what has to be done? Then this Ri, this radius Ri this distance can be change. Now remember these distance is very important. These distance these distance means the radius of curvature of this sphere. So, by adjusting varying this length, we can get spherical surface of different radius. Now come to internal concave surface, then the hinge point will be this side and this is the radial distance and you rotate in this direction. So that, this will follow this path curve curved path and you get the entire internal spherical surface.

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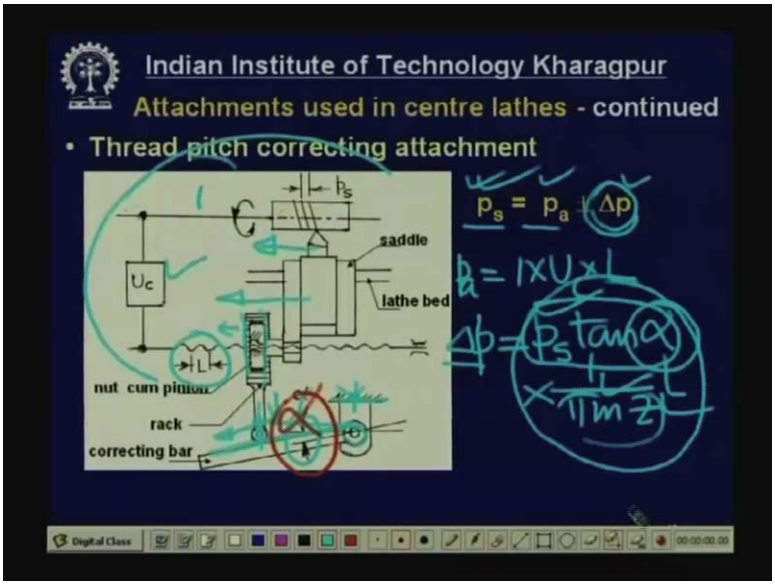

Now next attach. Now still we are continuing attachments used in the centre lathes. Now we can observe that so many types attachments can be used in centre lathe centre lathes are as such very very versatile. So versatile that this is called father machine or mother machine in which any type of work can be accomplished. At the top of that by using, so many types of attachments you can get this processing capability further enhanced. Now this is an example. What is this? Now suppose is a thread cutting operation, this is the job to be rotated as set in the rpm and then the lead screw as also to be rotated and with a particular transmission ratio depending upon the number of teeth to be the pitch of the job to be cut and lead of the lead screw. So according to this ratio, this ratio has to be fixed by gears and these two motions will be synchronized. So when the job will rotate the screw will rotate. When the screw will rotate, there is a nut this is a nut, this nut is a part of the saddle.

So, when this nut will move in this direction and the saddle will also move in this direction and you get this tool movement. So this linear movement feed movement and the rotation together produced the desired thread of a definite pitch. Now the problem is sometime because of some say error, say transmission system or kinematic system, the actual pitch on the job we get say P a which is different from what is expected P s is a stipulated say 2 millimeter but because of the errors inside the kinematic systems, you are getting slightly less say 2.1 or slightly high or slightly less say 1.9 millimeter pitch that is what is the error? So it is plus minus 0.1 millimeter error.

Now what will we do? This difference, so this is the desired stipulated. This is actual and this is the error. Now if this error be compensated by differential mechanism or kinematic systems, then we can get very accurate thread in spite of having some error into the kinematic systems of the machine tool. Now how this will be accomplished. See, now this equation you look into this equation P s is P a. What is P a? P a is equal to job rotation, one rotation multiplied by the transmission ratio U c multiplied by L lead of the screw. So this is P a alright. Now what is delta p? delta p is very interesting may be plus minus. This is when the saddle moves in this direction along with the entire system that there is a this is the nut, this nut has got internal thread. This nut is basically gear or pinion and this pinion is against a rack vertical rack and a rack is in contact with a bar hinged at a fix point on the lathe bed.

Now when this will travel in this direction, this will follow this path. As a result this rack will come down how much, suppose when this one the total travel is equal to say P s the actual desired pitch then this distance. Then what is the amount of downward movement of the rack. This will be equal to tangent of alpha. What is alpha? This angle inclination of the bar. Now because of this movement how much will be the rotation of this pinion that will be this will be divided by pi mz, what is the perimeter? So is a perimeter of the pinion. So this will be the amount of rotation of the pinion because of linear movement of the rack this much because of this rotation of the pinion, there will be some movement along the effectively on the lead screw. So this will be multiplied by L. So this is the total amount of movement of this nut because of rotation of the pinion by some linear movement of the rack due to its movement along an inclined path.

Now what we have to do? We know P a, we know P s alright. Now we have to determine delta p correctly. So P s is known, a module and z number of teeth of the pinion is known and only thing is according to P s and P a find out delta P and put delta p into this equation and find out alpha. So depending upon the error the amount of error, you fix this angle you fix this angle alpha. Now remember here I have shown that told you that the correction. If there may be any error, then may connection, but it can be used other was also. Suppose we want deliberately an unusual pitch suppose P s is equal to 2, this is known. This is available in the standard and available in the machine.

But we want two point one deliberately or 1.9, then what we shall do? Then also we can adjust this angle and utilize this attachment to get this either this or that. This kind of requirement comes when we like to produce say differential screws. A screw will have a portion and then another portion like this with the larger pitch, the smaller pitch. Suppose this is 1.9 and here is the pitch is 2, so what it the effective pitch or lead 0.1. So, if you rotate one complete then large lead screw will move only by small amounts of 0.1 millimeter. Say for an example in edm, ecm this kind of differential lead screw are used and for that purpose this kind of taper turn, this attachment can be used for getting differential screw.

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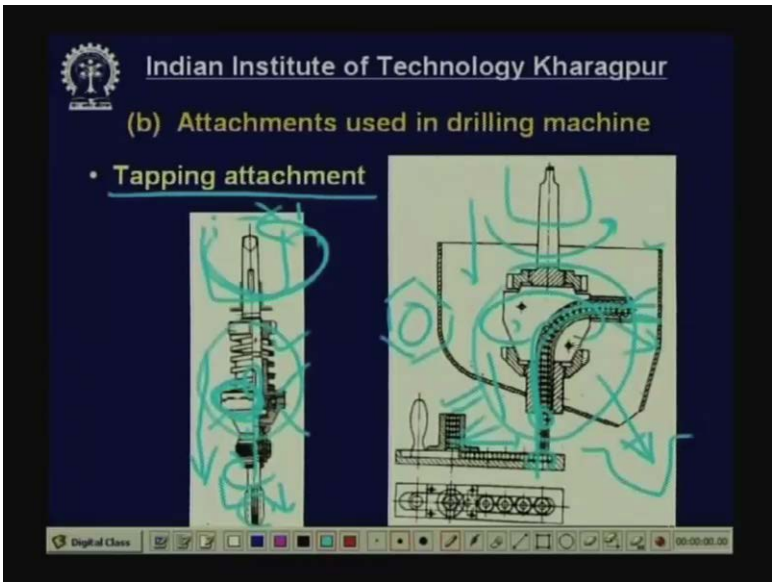

So these are things we described about the attachments used in drilling machines. Now come to used in lathe centre lathes. Now we shall discuss about the attachments used in lathe drilling machine. For example there can be different type of work. In drilling machine different type of work are done already mentioned in the previous lessons say boring, counter boring, counter sinking and all these operations. But here is one example of tapping attachment. What is tapping? Tapping means a tool which produces internal thread, say internal thread of nut like that. Now this one, this is the attachment which has got a taper shank just like a drill shank. This will be fitted into the spindle of ordinary drilling machine, ordinary drilling machine this one then there we have seen there is a

tool there is a one clutch and another clutch. This clutch is spring loaded and this is guided by this key but the lower clutch is free it freely rotate about the shaft about the shaft. Now when you want the downward cutting thread this has to be move down.

So this will rotate and move downward resulting thread cutting but problem arises during return because its stops and then returns by reverse rotation. So this will rotate in the opposite direction. Now this cannot come simultaneously and if these movements are not synchronized the threads will be spoiled. So what is done? After it reaches the end say blind hole or blind ah thread then their will be disengagement here because of some play or backlash into the clutches or clearance and the spring loaded springs this two will enable free return safe and free return of the tap during reverse rotation of the spindle.

Now here is another example little faster production .So these are all say nuts these are the all say blanks not blanks say rectangular sorry hexagonal shape without drill hole and these are magazine loaded and one by one is pushed. Now this attachment is fitted into the drill spindle. Now this will be this is rotating continuously, now this will be moved down. So this tap will get inside this nut okay, this blank and this will complete this one. After that when this will go up, this nut will go up along the tap and reach here and then another blank will come, another thread will come. So this will be accumulated like all these nuts will be accumulated after thread cutting. But because all these things are rotating at high speed because of the rotation at high speed and this suit is fixed by centrifugal force. This nut will be thrown out and all of them will be collected in to a main. So this is little faster production of nuts by threading by an attachment.

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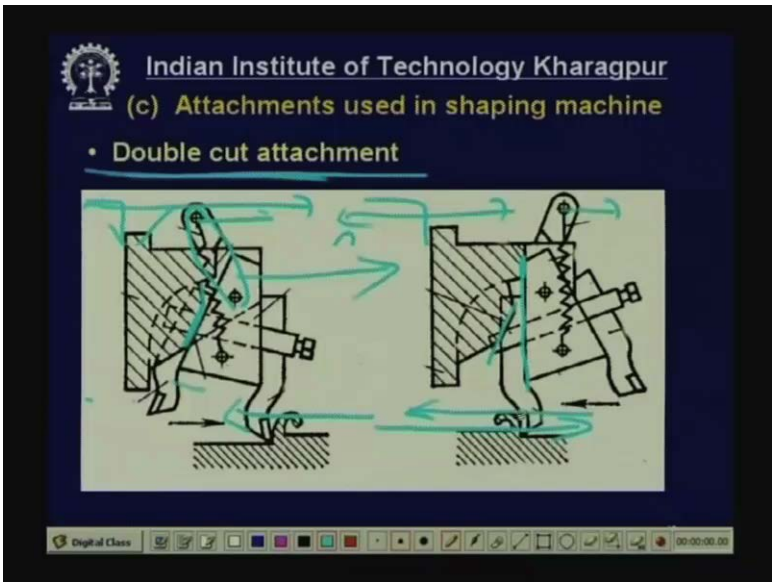

Now shaping machine is much more primitive even more primitive than lathe central lathe and which is almost going to be obsolete but even then atleast earlier some attachments were used to enhance the processing capability of shaping machine. Some unstipulated work which are not supposed to be done in shaping machine, could be done

by some attachments. One example, first example is that double cut attachment. You remember that in shaping machine, this cutting tool cuts in the forwards stroke alright and in the return stroke it does not cut. That is called idle stroke. It is a waste of time and loss of productivity. So if it can cut in the forward stroke as well as in the return stroke then productivity will be double.

Keeping these views keeping this idea in mind attachment has been developed. Here you see that this is a rectangular piece which is hinged over here on a block, this block this block is rigidly fixed on the ram which ram reciprocation shaping machine. So this is connected with the ram. So this reciprocates; when it reciprocates in this moves forward this cutting tool removes the material like this and this one is arrested you can see clearly. This one is arrested along this surface of this block. So because the force is going there cutting force and this is the hinge it cannot rotate further because it is arrested here in the return stroke. When this will reach at the extreme end then this one will move forward this lever will move forward this spring loaded and then this will go in this direction and you see the orientation previously this surface was along this surface.

Now this here, it will contact here and this may be moving in this direction force is force will act in this direction but this will be arrested hinged over here arrested over here. So this cannot move so it is cutting in the both the strokes. So this way you can enhance the productivity, this was also attempted in planing machine but not that required not successful.

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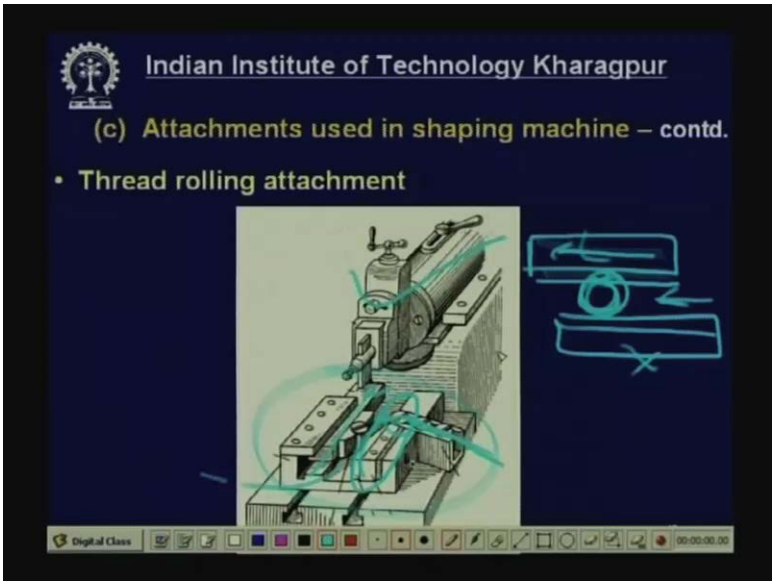

Thread rolling attachment used in shaping machine, now this threads screw threads can be produced in many methods say even casting, rolling, then rolling, casting, forging some in a very irregular type and by non conventional processes various methods in machining. Also there are different methods, you know single point chasing lathe, multi

point chasing or you can use die solid, die spring die and in different machine tools automatic stool cutting lathe.

There are many methods but if you do not have such machines, you should have only shaping machine. But we want to produce some fasteners and the threads then what will we do? You can put this attachment this attachment the center attachment on the shaping machine bed. Now here you remember that the thread rolling thread rolling is very common quick process of thread producing thread in fasteners it can be circular die, flat die, so this is a flat die. So this is one flat die is this one flat die which has got threads and this is the blank and this is another die. This is fixed which has got thread.

Now when it moves in this direction so this thread is produce into that, so this is a basic principle, so this is a fix die which is placed over here and this is the moving die. This is a moving die which is made to move with the help of being connected to the ram of the shaping machine and through this slot these screws or blanks of the screws are passed through and they get into this slot here and after this movement, the thread is produced and goes away through this path. So, this is a very this was a very common process but now a days it is no more used to that extent because thread rolling machines are available in plenty nowadays and way to widen the use as such.

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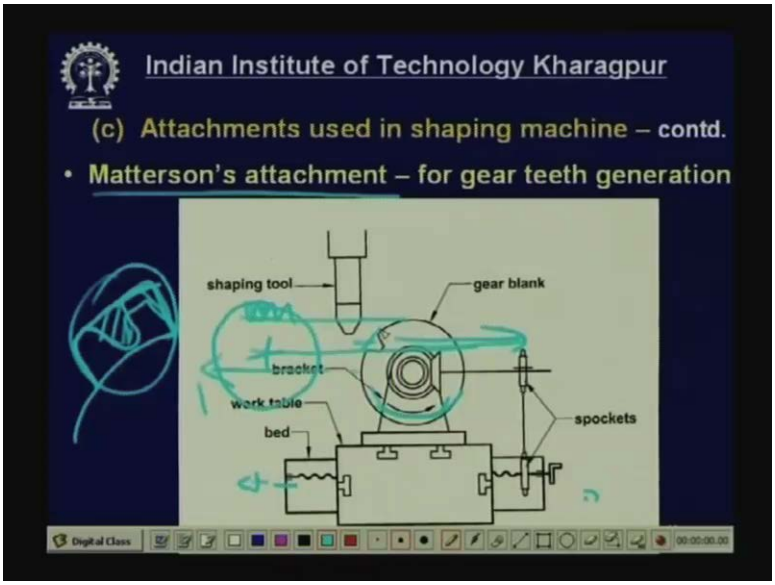

Another you know attachment used in shaping machine, this is called Matterson's attachment. Truly speaking, this is very old technique and being used very early not now a days because gear teeth cutting there are many processes. You know casting, forging, rolling, machining, grinding and what not? There are many methods. In machining say for milling, for forming basically by milling and by generation process by gear shaping, hobbling, then standalone method, rake type cutter and what not? This can be also produced by broaching very fast but all these machines should be available these are not are not very easy not very less cost or low cost.

Now if required this forming of the teeth of gear. Suppose one gear has broken in a machine, only two teeth and this is not available. So what we have to do on this? So one tooth broken, so what you do? You build a material but depose the material and then you finish it and remove this material this material and you get that tooth back. Now this kind of work can be done in this kind of shaping machine with the help of an attachment. Now this shaping producing tooth in gear tooth in shaping can be done in two ways forming and generation. You know the forming is neither accurate nor very reliable. But generation process is very reliable this Matterson attachment enables gear tooth cutting by generation method may be one or one piece at a one tooth gap at a time or one tooth at a time and then it has to be index. The gear blank has to be indexed, time to time slow process but this is very accurate and this is not that accurate really but much better than forming.

How it is done? This is the gear blank okay mounted on the center this is the bracket which is fixed on the table mounted on the bed of the shaping machine and this is the lead screw. So, this lead screw makes it move in this direction that is called feed or in this direction what we called it. Now the rotation of this gear blank and the lead screw are connected, that means when this table will move in this direction accomplished by rotation of the screw, then is a sprocket, this is a chain. So this shaft will also rotate. So, along with the travel of this table because of the rotation of the screw, this shaft this will also rotate and because of the wheel gears, this shaft will also rotate here.

So, this gear blank which was like this it was here at the beginning somewhere, now this will be moving in this direction gradually. That means the blank was here at certain height. This is the height of the tool and this is the height of the tooth and this is reciprocating perpendicular to the plane just like a shaping machine and this will gradually go in this direction while going in this direction this will rotate also. So this ratio and translation that will produce what is called rolling motion essential for generation and after time goes this blank come to this position this cutting tool will keep on removing material and produce a tooth gap like this. Then, this has to come back again bring it back, this will remain like that and then this will be rotate index. After indexing you just produce another tooth gap. So another tooth gap like this you can produce the entire thing.

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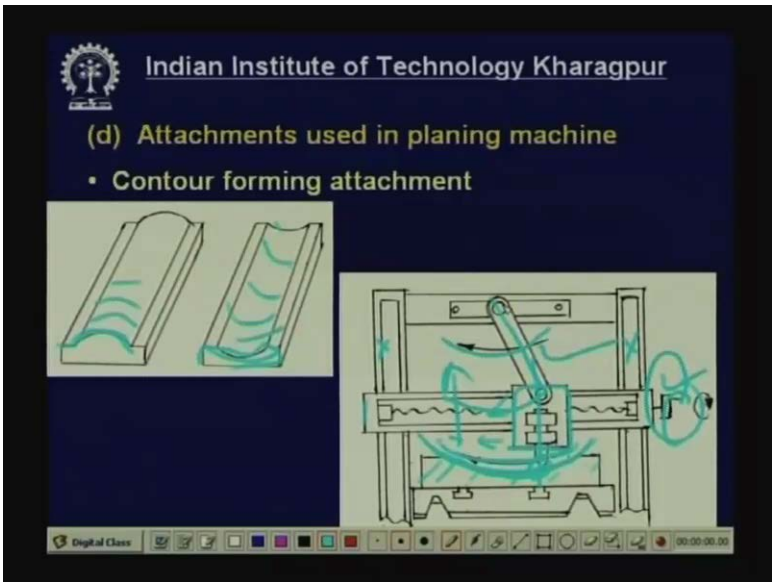

Now attachments used in planning machines: now friend do not think that the examples that I am giving these are the only possible attachments. There may be few more attachments also I am giving some common type. Now attachments used for planing machines. Contour forming attachment; now suppose this is big bars or plates or tables or say bed of some machines very large one may be 2, 3 meter long or say 1 meter wide and thick. Here we have to produce some contour. Just may be different type, say this is one type. So this one contour or it can be concave type. So, this kind of contours can be produced in planing machine. How is it done? This is the work piece, the cross section of the job.

Now here the tool is job is reciprocating perpendicular to the plane. So, the tool is relatively reciprocating. So it is cutting layer by layer now this tool has to move along this path along this profile desired. How it is accomplished, that first of all this cross rale is dealing from this vertical screws, that means it can move up and down freely and that is held in particular position by this screw as well as this bar this bracket bar hinge bar.

Now when you rotate this screw, this tool head along with the tool will move in this direction but it cannot go straight because this bar will swing in this direction. So, this will also move in this direction so tool will also move in this direction .So, even if you keep on rotating the screw, this tool path will also follow this path that is this path or this path. This is how these are copied in planing machine .It is not exactly copying but this is using a swing bar. Now this radius of curvature: this is the radius of curvature this length this length will decide this length will decide the radius of curvature. Now another example, attachments used in planing machine.

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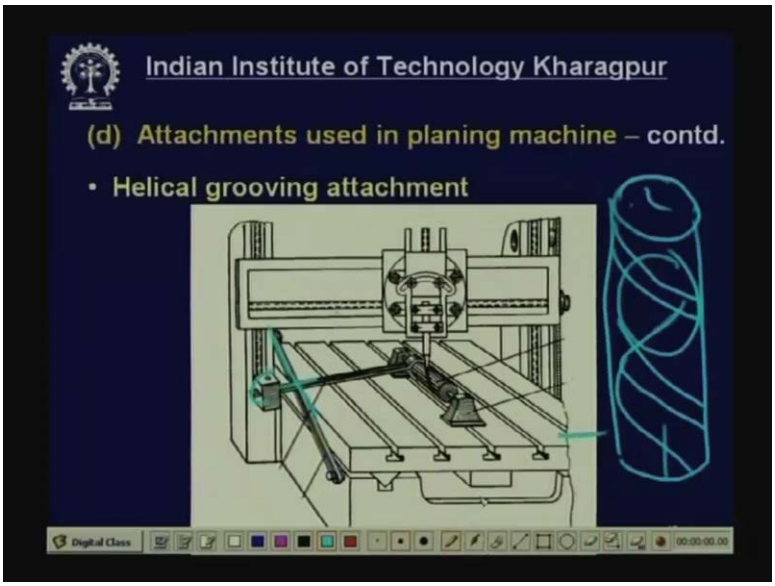

Helical grooving attachment; now this is often we need some Helical grooves of large pitch or large lathe on cylindrical rods say here is a rod, large rod of diameter say 200 millimeter and length is say 2 meter, so we want to cut a group a cut a groove like this. How this will be done? First of all this is a large job. So this cannot be done in shaping machine and milling machine can be but you do not have that kind of large milling machine milling machine but you may have one planing machine then what will you do? You burn this rod in this fashion between 2 centers and there is a bar which will clamp on this and when this table moves longitudinally this bar raise on another bar which is kept in an inclined fashion. Now when this is, here is a bar inclined fashion something moves in this direction this is move gradually. So end will gradually fall gradually fall this will cause slight rotation of the rod. So this rotation of the rod and longitudinal motion will produce together this helical group with the help of this cutting tool mounted over.

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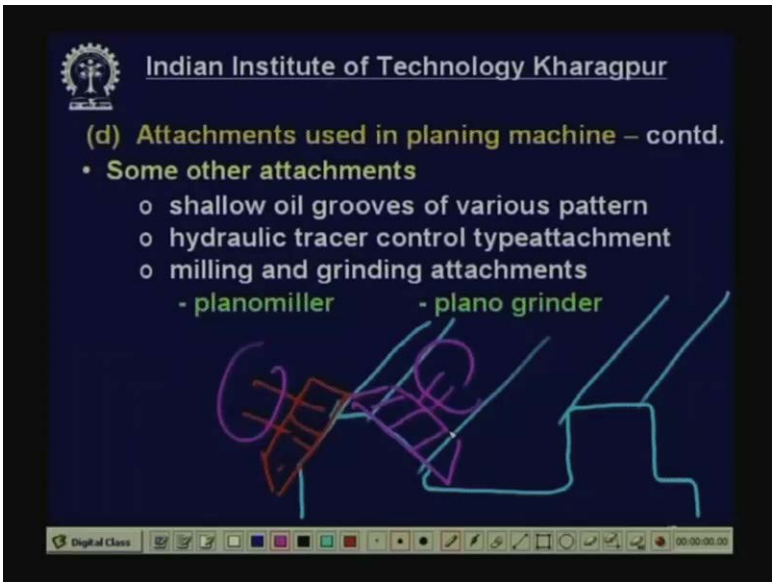

Now attachments used in some other attachments which are used in planing machines. Shallow oil grooves of various patterns on the machine tool beds. Hydraulic tracer control: Now you know the hydraulic copying in lathe, where a template is used followed by a stylus replicated to the product. Similarly in planing machine also, this hydraulic tracer attachment can be used to produce different contours by hydraulic copying milling and grinding attachments is a very common application. What is it? Here suppose this is the structure, this is cross section of a large some lathe bed or a machine bed. Now this can be done in planing machines by single point tools. But single points are very low productive. So then milling cutters can be used say 1 milling cutter will be used here. Face milling cutter there will be another face milling cutter here and this face milling will replay the single point tool. Single point tool does not require any motion. But the milling requires rotation. So this milling units this milling head will replace the single point tool head and they will be mounted on the vertical columns of the planing machine or into the horizontal column.

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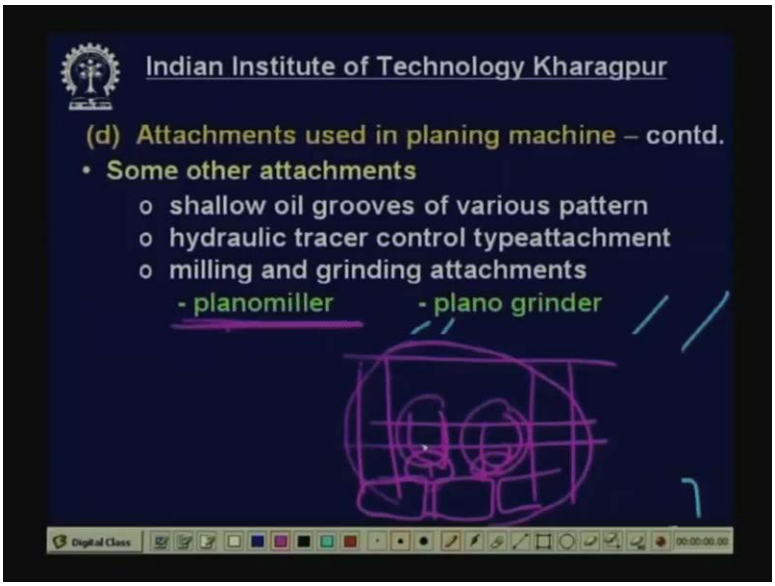

So these milling heads will be hanging or this will be put on side and all these cutters will produced the job in one stroke. So this is a very high productive system. Now this is very column utilizing this concept now a days a machine called Plano miller have been developed. Now if we want high finish or finishing finish grind finishing after machining milling then we have to replace the milling cutters all the milling cutters by grinding wheels. And all the grinding wheels grinding heads by the grinding which will rotate at high speed by individual motors and you get all the surfaces done by grinding wheels. You can use grinding wheels and finish it. So, then this will lead to what is called Plano grinder. So Plano grinders are very common nowadays. They are used and they are no longer called attachment.

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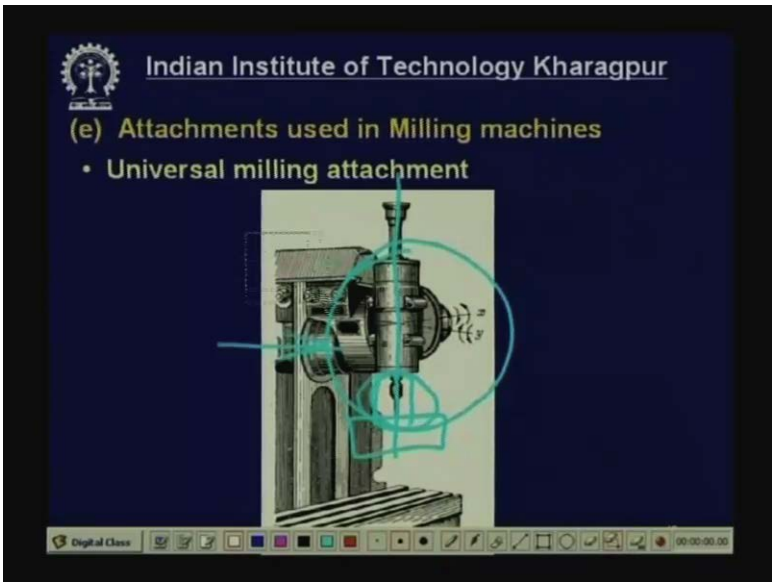

Now this is the last stage. Attachments used in milling machines alright .You know milling machines are very versatile. It is as versatile all most has centre lathes and lot of work can be done in milling machines. Now the conventional milling machines which one is most common that is horizontal arbor type. In horizontal arbor type milling machines, in the arbor we mount different types of cutting tools like say slab milling cutter, shell mill cutter, plane milling cutter, helical fluted or straight fluted, then side milling cutters then si double side cutters horn cutters gear forming cutters slitting cutters slot cutters and what not but all these cutters have a hole a bore and through the bore this mandle or the arbor passes.

These are most common application of milling machine. But here other kind of operations also which are accomplished by solid tools like end mill cutters with a shine. Then face milling cutters; for that, different types of milling machines are available and normally used. Now you may not have that amount of order or activities occasionally this different type of work may come to you. You cannot afford by purchase so machines milling machines of different type but you may have you purchase only one say horizontal milling arbor type. If you cannot afford and then what you do? You just mount an attachment. This is an attachment which is mounted on the horizontal spindle and this horizontal rotation spindle is converted to rotation of the spindle vertical spindle. There you can mount this end mill cutter, even face mill cutter and get the work done. So this is one universal attachment. Next is another indexing or dividing head.

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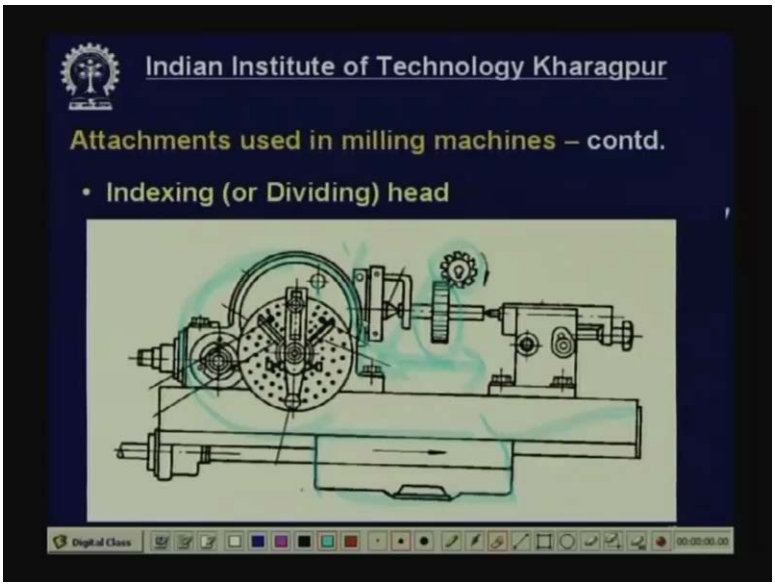

Now this whether it is a doubt you know there is controversy whether this should be called an attachment or accessory. It is so frequently and widely use in milling machine and also some in other machines they are often called accessory but since these are separately ordered and purchased and paid we call it attachment but it can be called accessory there is nothing wrong in it. What does it do? Now this is rotation, a job has to be rotated a rod or a job rod like job has to be rotated. Now not a complete rotation partial rotation and then it is called unit angle rotation. Every time you rotate by one six or say 60 degree, then under 60 degree this is called indexing motion. These are used for making prisms in milling machines, then cutting the teeth of gear okay this indexing has to be made. Suppose you have to produce the gear. First of all, you make one tooth and by indexing then you cut another tooth like that. So this is called indexing and for this purpose this attachment is used.

For example say there is a gear, this is a gear to be cut which has got number of teeth stay to spur gear there is a milling cutter is a milling machine. So this mounted in milling machine on the tap this is a bed or table on the table this is mounted. Now after mounting like this, this will be moved in this direction. So you produce one slot or one tooth gap after that you bring it back. After bringing it back, you just index it with the help of this mechanism you rotate this gear by one tooth gap. Suppose if it is 20 teeth then one by twentieth rotation this has to be rotated and so by indexing you can do this kind of work.
Now this differential this indexing mechanism can be simple type, elementary type, this can be compound type this can be differential type there are different types.

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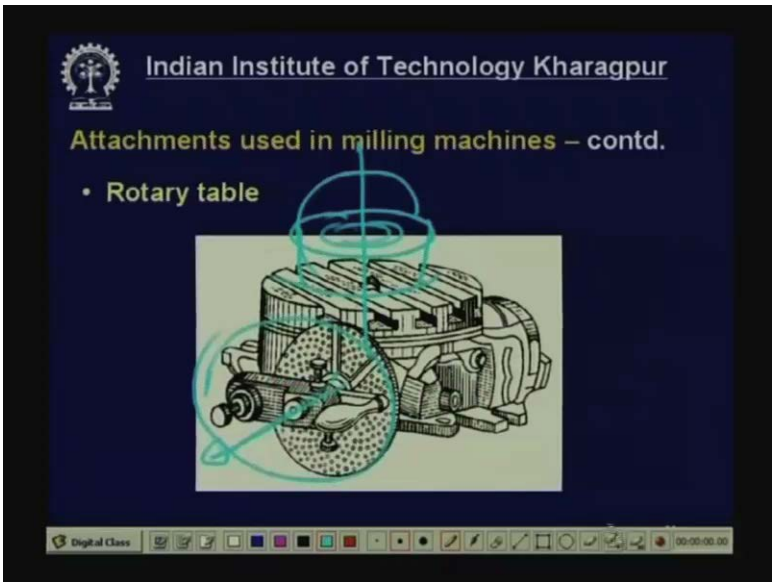

Next one rotary table: This is very common is a separate piece which is available in the market. It can be it can also be consider as an accessory. Here you can mount the work piece here suppose you mount the work piece here cylindrical or different type in a drilling machine or milling machine mostly milling machine and you can do different types for slotting, slitting, grooving like that and this can be rotated above this axis with the help of this crank. Now this can be done manually or if we just join this screw or axis with the lead screw of the machine then this can rotate automatically. So this is very common accessory or it is open called attachments and so on.

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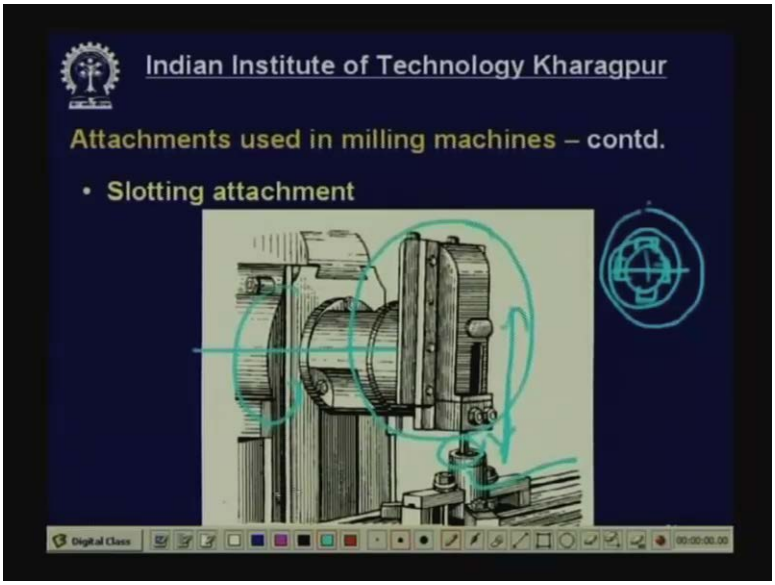

Now slotting attachment, can you believe that in milling machine, the slots can be cut inter say key way slotting. Say there is a gear, so this is a gear blank then a slot has to be cut or if it is spline, the number of slot has to be cut. These internal slots can be cut by slotting process and this is the slotting attachment which is mounted on the horizontal spindle. So, this rotation of the spindle is converted into reciprocation of the cutting tool. The cutting tool is inside and this is the work piece. So this will keep on reciprocating because of the rotation and you get this slot done and then after indexing you can make another slot. So we can do different types of internal work by the slotting attachment. This was very common, but now days it is not getting that much used.

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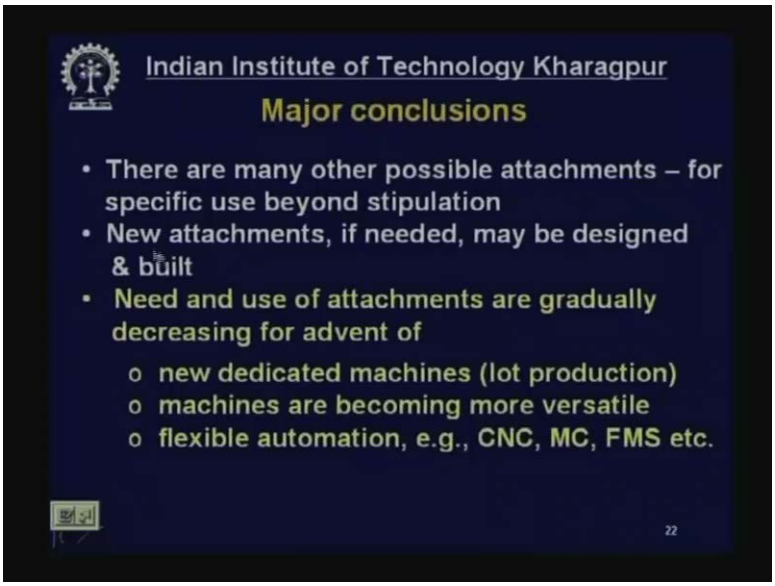

Now the major conclusions what we describe so for,there are many other possible attachments for specific used beyond stipulation. All machine tools conventional machine tools are stipulated for range of activities but that range can be expanded by some attachments or some specific work. New attachments if needed may be design and built by people. Now need and use but all these things so these are already getting used early it was more used. But it can also be developed further but point is need and use of attachments are gradually decreasing for advent of new dedicated machines, mass production. So these machines are very single purpose and do a particular type of work at high speed and high quality. So the attachments are no more necessary and these machines are not expensive also this can be procured.

Machines are becoming more versatile. So one machine can do lot of work type of work now a days. So, attachments are no more necessary. Particularly after advent of flexible automation for example computer numerical control, milling machine and the turning machine and so on. Machining center flexible manufacturing system which is highly flexibly automatic, computerized any type of job of any configuration to any accuracy any complexity can be produced. These machine tools have very expensive,

sophisticated. It is not easy to make it available but if available, they are come to our reach. Within our reach and as a result this will need and use attachments should be gradually eliminated.

Thank you.