Transportation Engineering - II
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Lecture – 25
Interlocking of Track

Dear students, welcome you back to the lecture series on course material of Transportation Engineering - II. In today's lecture, we will be discussing about the interlocking aspect of tracks which is one of the important aspects as far as the operation of points and switches in combination with signals is concerned. In the previous lectures, for the previous 3 or 4 lectures, we have been discussing about the controlling systems of train movement on the tracks. In this series, what we have seen is that and we have discussed about the various types of the signals which are operated on the tracks for different locations with different functions and we have also seen about the various types of methods which are in use by which the operation of the trains can be controlled.

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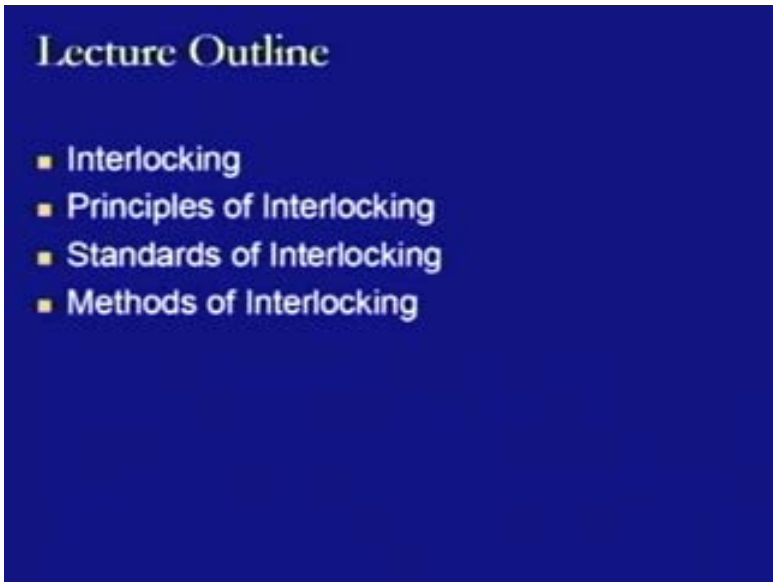

In today's lecture, we will be looking at certain aspects like the interlocking, the principles of interlocking, the standards of interlocking and the methods of interlocking. So, these are the things which we will be looking at and once we have done with this,

then we will also try to look at certain devices which are worked, which are used for the working of any interlocking of a track.

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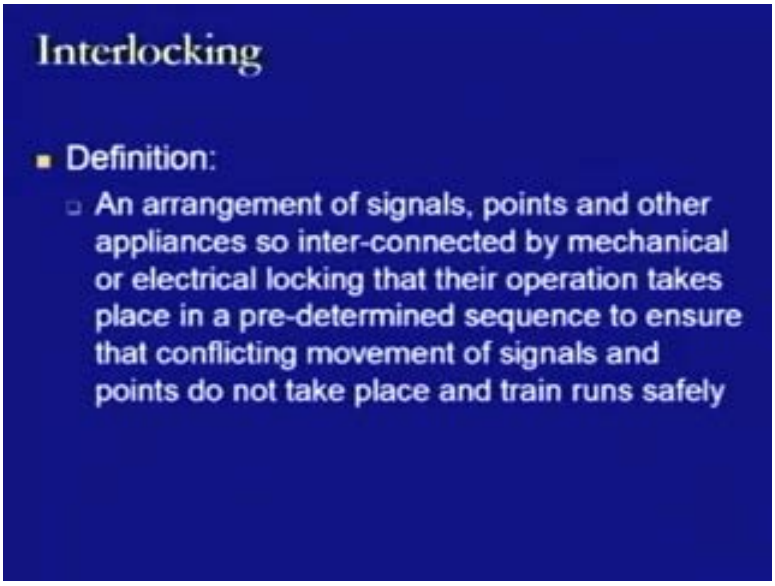

So, if we start with interlocking, interlocking can be defined as an arrangement of signals, points and other appliances, so interconnected by mechanical or electrical locking that their operation takes place in a predetermined sequence to ensure that conflicting movement of signals and points do not take place and train runs safely. So, that is what is the overall definition of any interlocking system of the tracks.

What it defines? It tries to define number of aspects within this definition. What it is trying to define is the type of the things which are involved in this interlocking arrangement that is signals, points and other appliances. Then, it talks about the methods by which this interlocking can be achieved, which may be mechanical or electric, electrical locking method and it also speaks of the procedure by which it can be attained.
It is a predetermined sequence. It is not that any of the things can be worked with at any point of a time without looking at the sequence of the procedure of movements which needs to be carried out when we combine the various appliances, so as to operate points and signals.

So, therefore we have to look at the predetermined sequence and when we go by this one, then there is a possibility that there will not be any conflicting movement of signals and points which will allow the movement of trains from either of the directions which further may get resulted into hazardous condition. Instead if that is being followed in a sequential manner, then there will not be any train on the track other than the one which is being allowed and that train will keep running safely. So, to ensure the safety of the train as well the track, the sequential procedure has to be maintained and operated upon.

So, what is the necessity of providing any interlocking system on the track?

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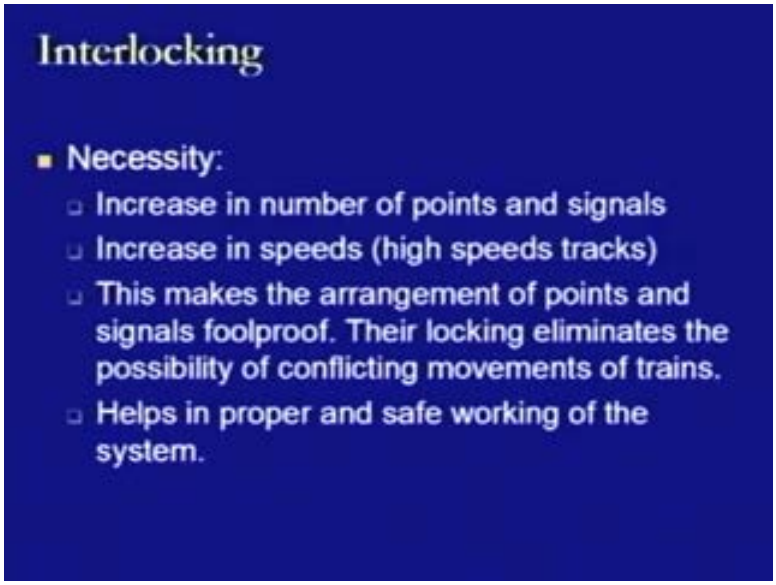

The necessity is to increase in the number of points and signals. This is one thing. Another is the increase in speeds on the high speed tracks and this makes the arrangement of points and signals fool proof. Their locking eliminates the possibility of confliction movements of trains and it helps in proper and safe working of the system. So, what it tries to define is that as soon as we increase the number of points and signals, what we are trying to do is we are trying to increase the efficiency of the tracks as far as the signals is concerned and we are trying to increase the intermingling of the systems in terms of

divergence or convergence to the main track by providing the opportunities of the directional movement of trains.

Now, when we are increasing this directional movement of the trains or we are having the merging or divergence of the trains of the path from each other, then in that case the overall traffic handling capacity of the system may increase. At the same time, because there are points and there are signals being provided at number of locations, then we can maintain the higher speed because of this interlocking arrangement and next thing is that as soon as the interlocking arrangement is being used, the safety is being maintained, because the possibility of movement of trains on the same sections in the same direction or in the same section in the opposite direction, that reduced.

Now, there are certain principles on which this interlocking system works. So, we will be looking at those principles that what are those.

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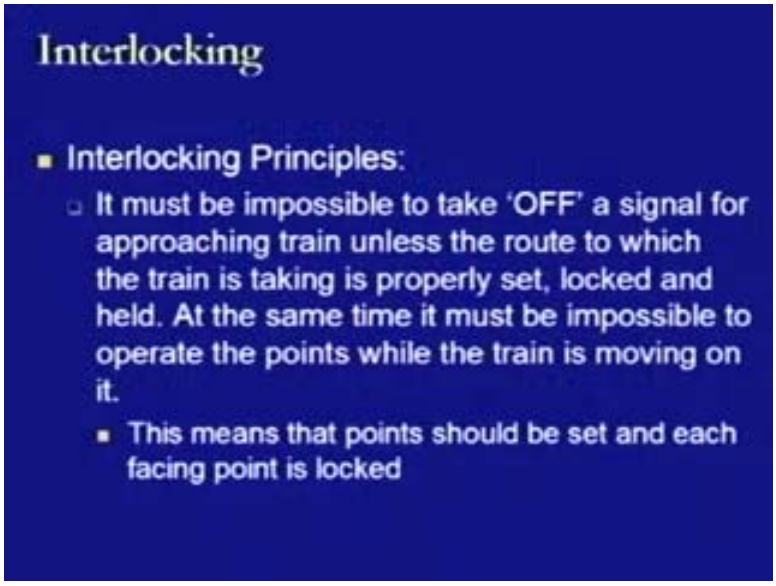

One is it must be impossible to take OFF a signal for approaching train, unless the route to which the train is taking is properly set, locked and held. At the same time, it must be impossible to operate the points while the train is moving on it. That is the very first

principle of interlocking system and this basically governs the overall safety of the movement of the train. What it says is that once a train is taking a certain route and in that particular route, whatever is the signal which is governing, which is defining that the train is taking this route and therefore cannot be taken up by any other train which is following, then the signal cannot be turned off to the OFF condition, means it should not show the green light for the following train. It should show the red light, because the train is already there into the section.

So, this is one thing which should become impossible if we have then the interlocking and another thing is that if the train is moving in the system, then whatever the points are there by which it has to make a directional movement, then they should get properly set locked and they should remain in position whatsoever happens to them, whatever type of jerks, whatever type of impacts are being caused at that location where the points have been provided or the switches have been provided they should not become unlocked and may cause a hazardous condition, again accidents or chances of derailment. It means what? That in this condition the point should be set and each facing point is locked, because if each facing point is locked, then only the train can take that track. So, that is the one thing which is to be done in this case, when we are talking about the very first principle of interlocking.

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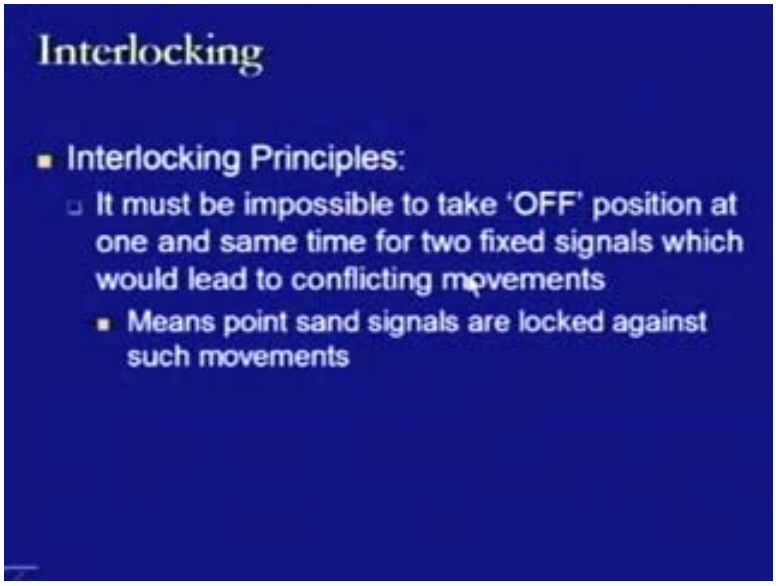

Then, another thing is that it must be impossible to take OFF position at one and same time for two fixed signals which would lead to conflicting movements. That is another necessity or another principle of interlocking that if there are two fixed signals which may define the movement of two trains in the opposite directions on the same track, then in that condition the another signal which may be defining the opposite directional movement should not be possible to make OFF position that is should not show green or proceed condition for the train to come on the same track on which the train is already moving. By this way, we are trying to ensuring the safety from the opposite direction.

So, that is one thing and how it translates is that it means that the points and signals are locked against such movements. That is now not only the points, but along with the points the signals in combination are locked and that is why the opposite directional movement on the same track will not be allowed and we maintain the safety of the train. Then, further it must be impossible for lose wagons to interfere with the route for which the points are set and the signals has taken OFF position.

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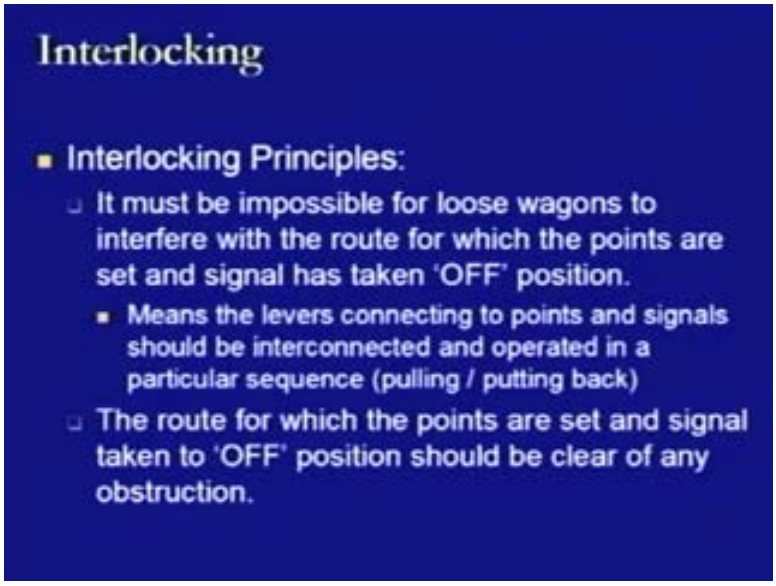

So, this is another aspect, because the wagons which are being attached to a locomotive, they are loosely connected wagons, they are not stiffly connected wagons and that is why there are possibilities of lateral or the front or back and forth movements of those wagons depending on the jerks which are coming from the track. So, that sense they should, the movement of these wagons, loose wagons, should not interfere with the points which are being already set as well as the signals which has taken the OFF position.

What it means is that the levers which are connecting to the points and signals they should remain interconnected and operated in a particular sequence that is pulling or putting back whatever the sequence is there, by using that sequence only those levers should move. Otherwise, with jerks being provided by the wagons, if they are starting moving, then again the whole chances of derailment taking place at that location. The route for which the points are set and signal taken to OFF position should be clear of any obstruction.

This is another important thing, because once we have interlocked the system, the system means we are talking about the points and signals in combination with each other, then in that condition there should not remain obstruction on the route and it should be clear of

all those, so that the trains can move with the OFF position condition means the green light condition. So, once we have looked at all the principles which are required so as to operate the points and the signals in combination with each other for the tracks, the combination of tracks that is the main tracks and turnouts, now we look at some of the interlocking standards.

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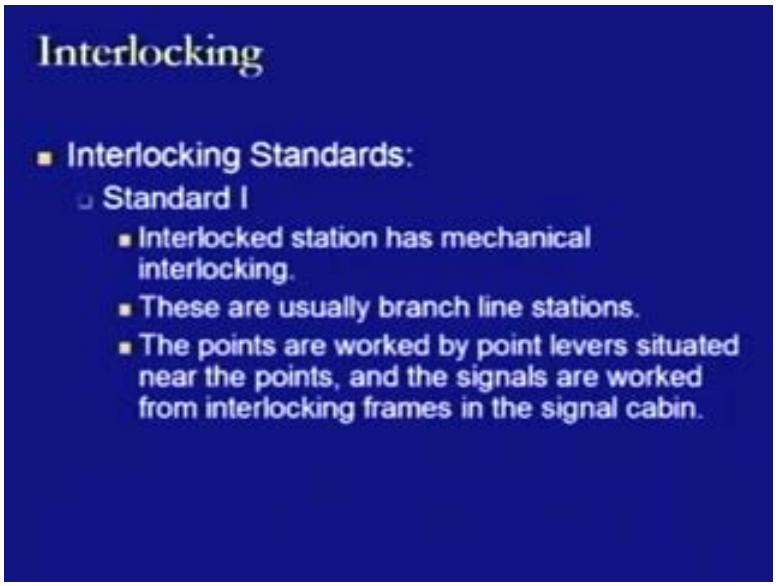

There are number of interlocking standards moving from Standard I II III and so and here in the case of Standard I what it says is that the interlocked station has mechanical interlocking. This is what it says. These are usually branch line stations and the points are worked by point levers which are situated near the points and the signals are worked from interlocking frames in the signal cabin. So, this is about the Standard I type of interlocking arrangement, where they are operated on mechanical systems and there are the branch line stations and another thing is that they have separate set of interlocking arrangements for points and signals.

It is not a combination with each other and therefore, we have to set them separately at two different locations. The points are worked where the points are being provided by providing the levers at that particular location itself, where the signals are worked from

the signal cabin. So, a person has to go up to the point or there is a points hut which is provided adjacent to the location of the point where the points man will be available and then that points man through telephonically when the information is received, will set the points in a certain fashion.

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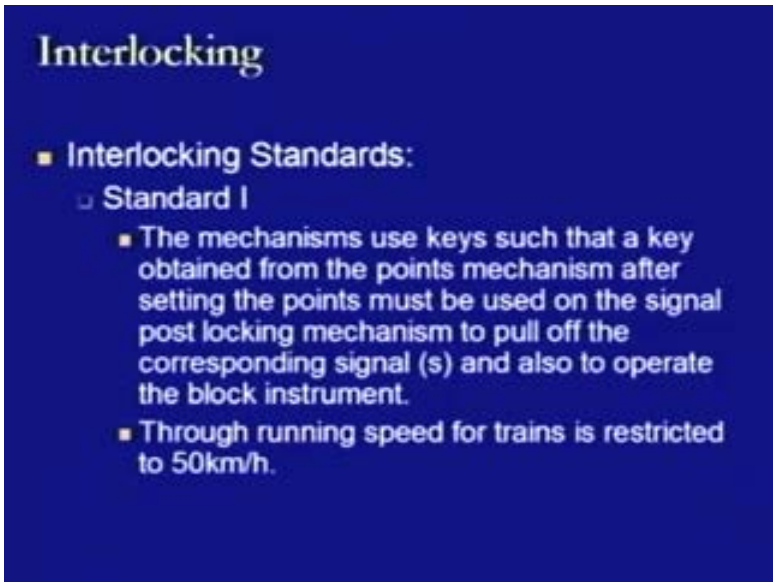

Then, there is another, in this Standard I itself, the mechanism use keys such that a key obtained from the point mechanism after setting the points must be used on the signal post locking mechanism to pull off the corresponding signal or the signals and also to operate the block instrument. What it means is that once we are operating the points mechanism, at that points mechanism, there is keys arrangement and once we lock the points, then the keys will become free and these keys are used to operate the signal system. So, this case will be taken to the signal and will be inserted into that signal and once they are inserted, then only the signals can be locked and once they have been locked in combination with the points, then nothing can be changed unless again the keys are inserted and they are released. So, that is how the overall system will be working in this case of Standard I and in this case, the through running speed for trains are restricted to 50 kilometer per hour.

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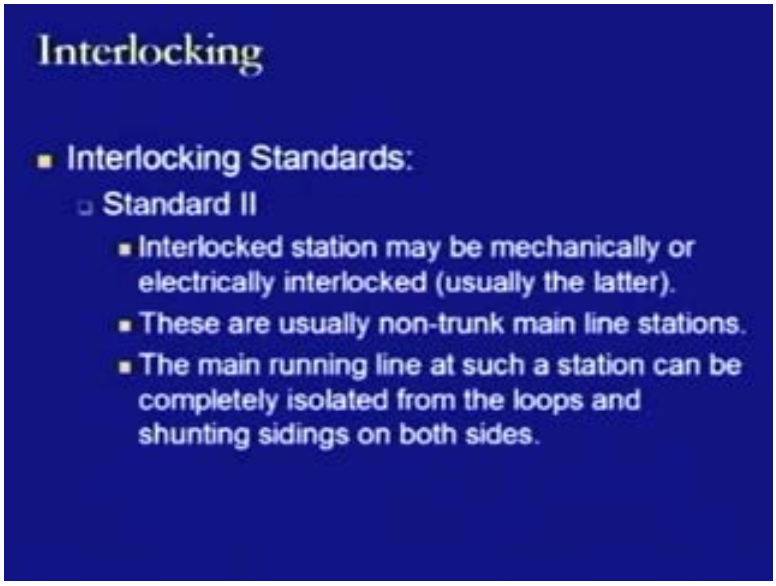

Then, we have another standard which is Standard II, in which case not only the mechanical, but we also have the electrically interlocked systems by which the stations can be interlocked and now this, most of the times we are using the electrically interlocked systems instead of mechanically interlocked system, because the operation as we have seen in the case of centralized traffic control systems and automatic train control systems which are the advanced train control systems, they are working on the basis of electrical circuits being provided along the track and the points and switches as well as the signals can be operated by a single person while setting in a cabin at one place or one location.

So, that is why now we have most of the time the electrically interlocked systems instead of the mechanically interlocked systems and these are usually non trunk main line stations. Still they are not on the trunk main lines and the main running line at such a station can be completely isolated from the loops and shunting sidings on both sides. This is another sort of restriction where we are trying to isolate this particular section from the loop line which allows the overtaking sort of condition in any of the station as well as there can be the shunting sidings where we take off the train which has already completed its journey and now the wagons etc., has to be sorted out or a new train has to be found

for dispatching. That is where the shunting sidings are or the shunting sidings may also be there for the locomotives, so as to take the locomotives to the locomotive yards.

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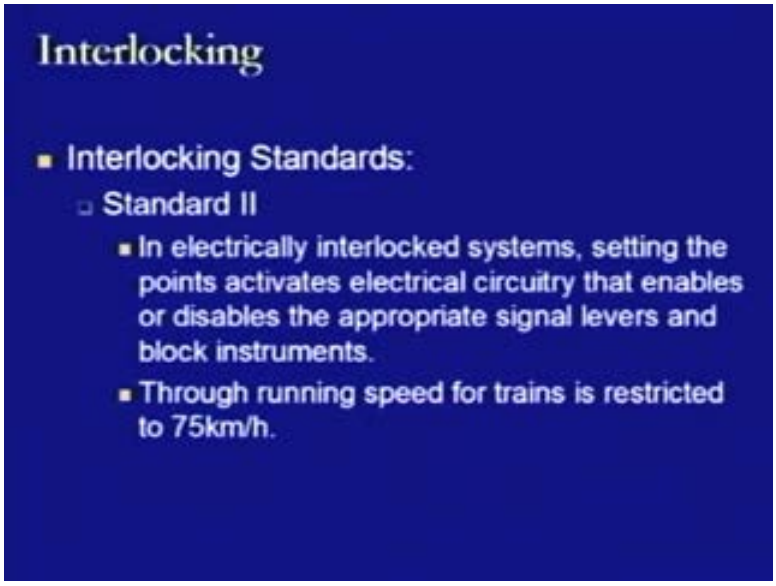

Within the system, in the case of electrically interlocked system, setting the points activates electrical circuitry that enables or disables the appropriate signal levers and block instruments. So, that is what basically depends on the electric circles and making the electric circles cut off and once it is being cut off for it is being provided on the basis of that, the signal levers of the block instruments will be working. Now, in this case with respect to the Standard I interlocking standard that through running speed is more than that and it is restricted up to 75 kilometers per hour instead of 50 kilometers per hour as available in the case of Standard I.

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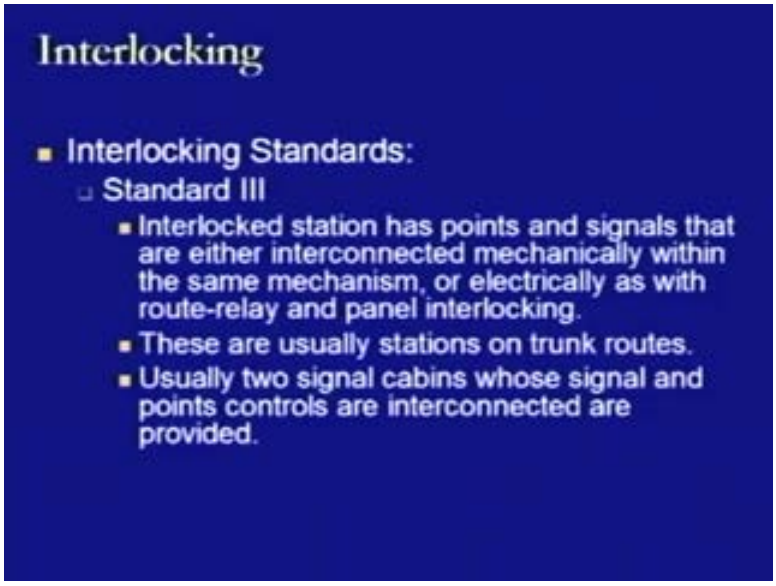

Then, further we have the Standard III interlocking standard system, whereas the interlocked station has points and signals that are either interconnected mechanically within the same mechanism or electrically as with route-relay and panel interlocking. So, that is the system which we are using. If it is an electric system, then it is route-relay and panel interlocking system, instead of mechanical system like key operated system or a normal simple electrical operated system with simple circuitry. These are usually stations on the trunk routes as compared to the previous methods where they were not on the trunk routes and usually two signal cabins, whose signal and points controls are interconnected, are provided in this system.

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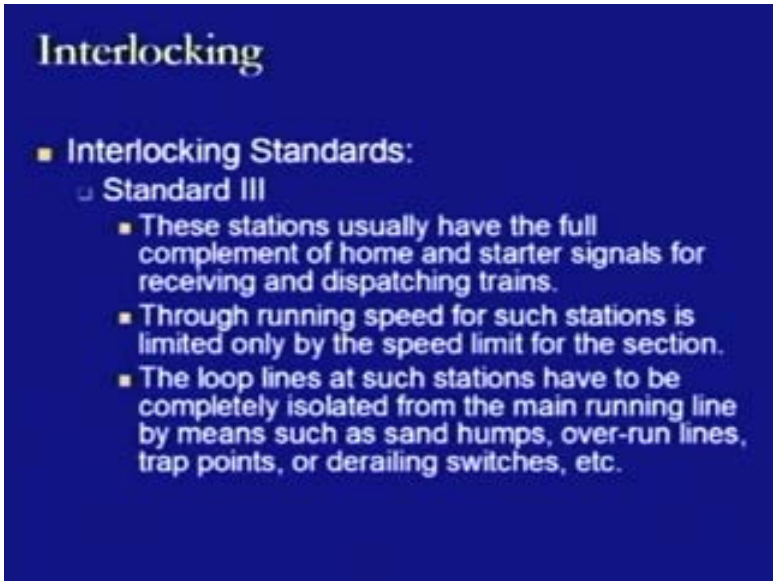

Then, further in these cases, the stations usually have the full complement of home and starter signals for receiving and dispatching the trains. That is whatever station limits are there, within those stations at the either side of the station limits we have the home signals and starter signals and these home signals and starter signals are totally controlled by the station limits and station masters first receive and dispatch the trains. Through running speed of such stations is limited only by the speed limit for the section which is specified by the section engineer and the loop lines at such stations have to be completely isolated from the main running line by means such as sand humps, over-run lines, trap points or derailing switches, etc., and that is how the isolation of the main line with the loop line is made and this probably you must have seen at some point of time that the loop line moves forward and then slowly it vanishes into the sand or it starts going upwards on a ramp. These are the different ways by which the isolation of loop lines is achieved with respect to the main line on which the main traffic will keep on moving.

Then there is another category within the standard III, which is termed as standard III.I or sometimes III/I.

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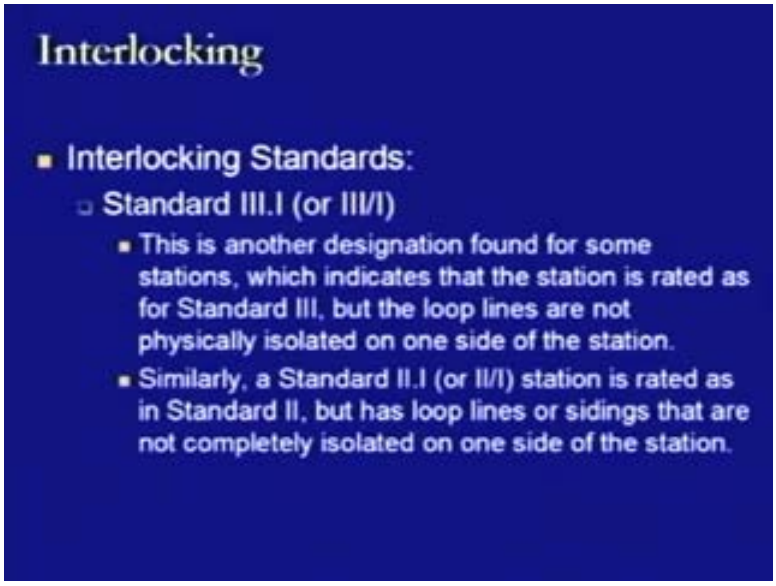

This is nothing but another designation which is found for some stations, which indicates that the station is rated as for Standard III, but the loop lines are not physically isolated on one side of the station. So, that is the differentiation between the Standard III and Standard III.I. So, here the loop lines are not physically isolated and similarly in the case of Standard II also there is Standard II.I, where the Standard II.I station is rated as in Standard II, but has loop lines or sidings that are not completely isolated on one side of the station.

Probably on the other side of the station they have been isolated, but at one side the flexibility of operating on the loop line remains. So, that is a simple variation of the previous standards. That is Standard II or Standard III. Once we have looked at the different principles of interlocking and we have also seen the various standards of interlocking, now we will be looking at the types of the methods which are generally used for interlocking of the tracks.

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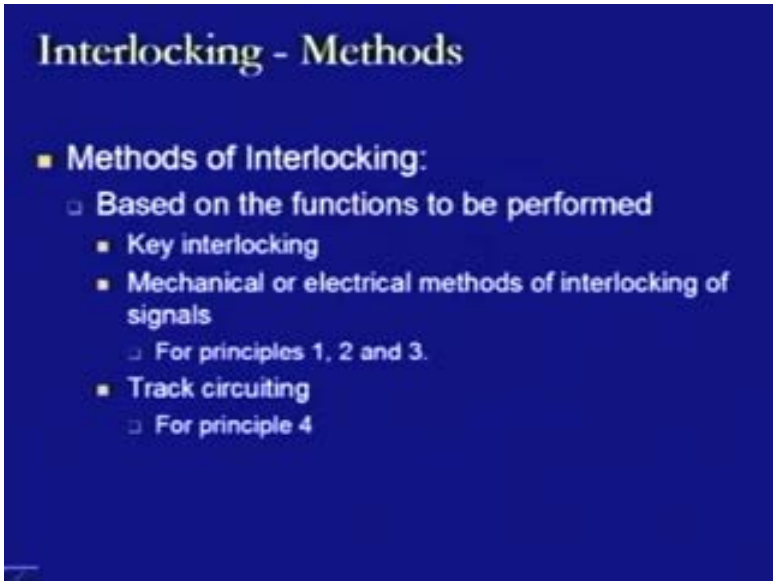

The various methods for interlocking of the tracks are these are based on basically the functions which need to be performed and as we have seen while we have discussed about the various standards of interlocking, then we have seen that there is a use of a key, there is mechanical system or there is electrical system or track circuitry system or the relay and point system. So, they are all the ways by which the different methods can be categorized from each other and that is what is being defined here also that on the basis of functions which needs to be performed, they can be classified as key interlocking, mechanical or electrical methods of interlocking of signals. That is what we have seen in the case of initial principles of principle 1, 2 and 3, where we talked about the movements on the single line and the double line condition and try to operate the train in particular section with no train from the other side and attract circuitry which is for principle 4.

So, we have the four principles of interlocking and for all the four principles of interlocking, how they are getting satisfied is the methods as being listed here. Out of these methods which we have just seen, which we can use for interlocking systems, we start with the first method that is key interlocking system. In the case of key interlocking system, some idea we have already taken is that there is box from where the, as soon as the points are set, then the keys are taken out and those keys are used, so as to operate the

signals, because unless until these keys are pressed into the location where they are supposed to locate it and then only those signals can be operated.

So, that is how a combination of a point with the signal is achieved. Unless until, these keys are available or inserted, the signals cannot be operated. So, that becomes the basis of key interlocking principle and we are looking at how it works. This is one of the simplest methods of interlocking system. This is one thing.

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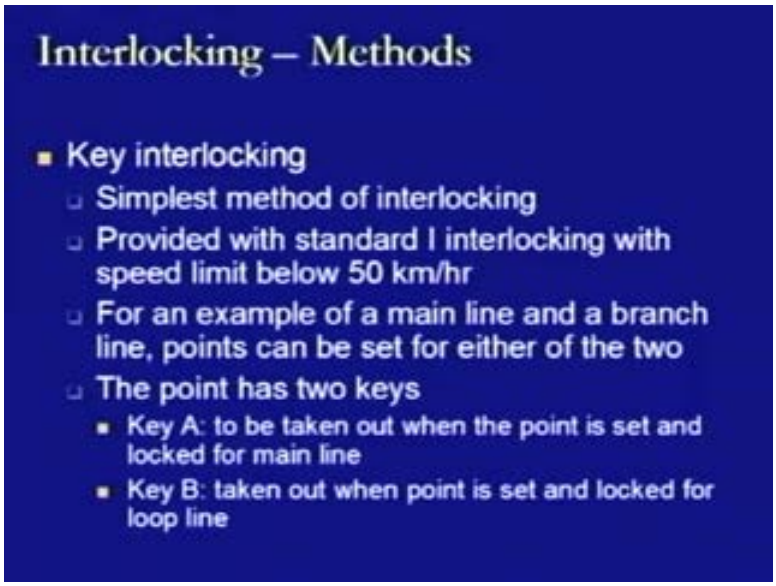

Second thing is that it is provided with standard interlocking with speed limit below 50 kilometers per hour. That is what we have seen in the case of inter, interlocking Standard I, where it works with the key interlocking systems and we have also seen the speed limits for up to 50 kilometers per hour. So, the same thing is being enumerated here also. For an example of a main line and a branch line, points can be set for either of the two. If we take an example that there is one main line and from that main line a branch line is coming out may be in the form of a turn out, then as soon as there is a turn out, there will be points.

So, these points can be set for either of the two conditions like the point has, the point has two keys that is key A and key B. Key A is to be taken out when the point is set and locked for main line, whereas key B is to be taken out when the point is set and locked for the loop line. So, that is the difference between the two keys which are provided at the point location itself. So, if we are operating the main line, we will be taking out key A; if we are operating the loop line, we will be taking out key B.

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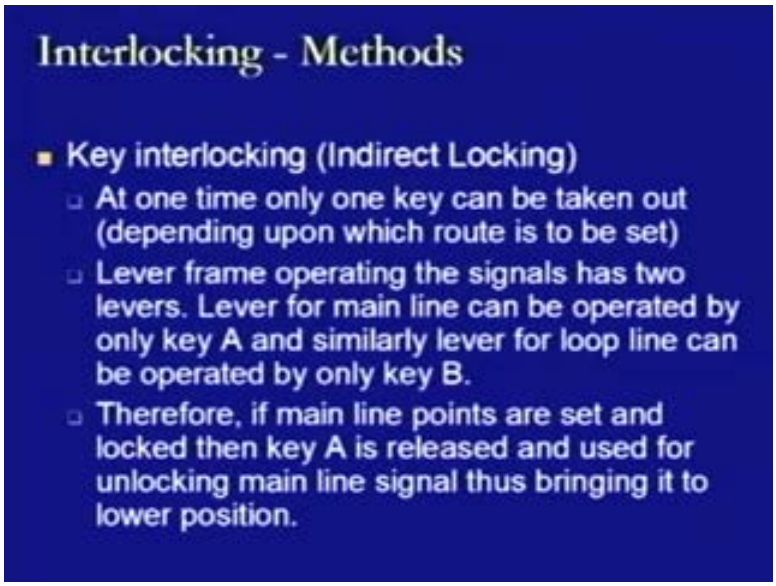

So, in this case of indirect form of locking, what we will be doing is that at one time only one key can be taken out. So, that all depends on whether we are interested in setting the main line track or we are interested in setting the branch line track. So, depending on that one, we will be taking out respectively either the key A or key B. So, once that is being taken out, either of the key is taken out, the other key cannot be taken out; it becomes fixed or locked within the box system. Then, the lever frame operating the signals has two levers. The lever for main line can be operated by only key A and similarly, lever for loop line can be operated by only key B. So, that is the set of levers which needs to be used, so as to operate the signals.

So, depending on again which line we are talking about, we have taken already the key and that key is to be inserted now in this layout frame. So, once this is released, then we can operate the lever so as to make the signals operative. Therefore, if main line points are set and locked, then key A is released and used for unlocking main line signal, thus bringing it to lower position. So, that is how it works. So, as soon as the key A is released and used to unlock the main line signal, the main line signal, if it is a semaphore signal, it will be in a horizontal position. But, as soon as it is unlocked it will come down and it will take a lower position that is the inclined position showing the proceed condition. So, that was about the key interlocking condition.

Now, we will be looking at the mechanical interlocking condition. In the case of mechanical interlocking condition, it is little complex condition where lot many types of accessories need to be operated in relation with each other. Though these will be done with the use of levers being provided on the side, how many lines are there for which that sort of an operation is to be performed and these levers are interconnected with each other and with the operation of one particular lever, one set of operation or function is completed and in this system of mechanical interlocking, then there is a procedural sequence in which all those levers has to be operated, so as to set either the main line or the branch line.

If that procedural sequence is not being used, then in that case, the main line or branch lines cannot be set and there will be hindrance in the operation of even the levers itself, because there is a sort of a locking and unlocking arrangement which is being provided with the movement of the levers. So, that is what it becomes in short or as far as the summary is concerned of any mechanical interlocking system. Now, with this particular aspect in mind, we have to look at how the mechanical interlocking system works. So, we will be looking at the combination of levers. We will be looking at the combination of, with these levers that ….. or the locks or the bars which will be moving with respect to each other. So, these are some of the things or devices which needs to be operated when any point or signal is to be operated.

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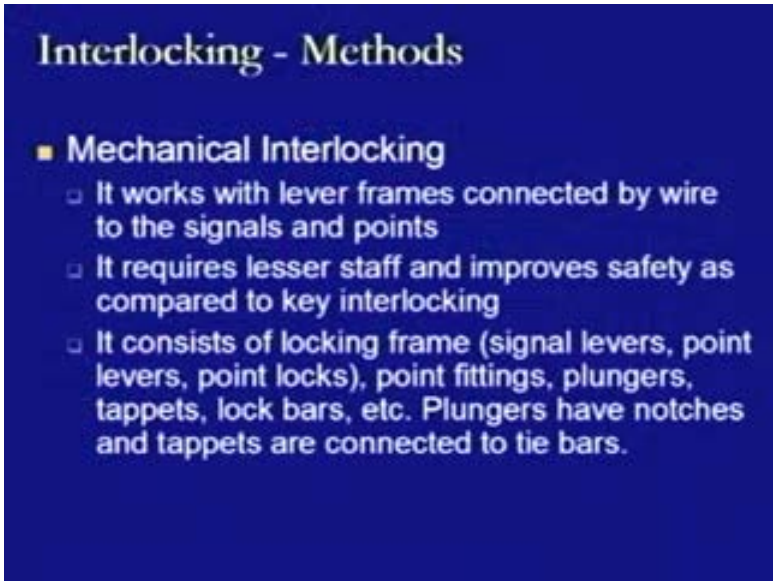

So, what happens is in this case is that it works with lever frames which are connected by wire to the signals and points. So, that is the very first thing here is that the levers which have been provided, they are connected to the signals as well as they are connected to the points by wires and this you must have observed when you have traveled by train or when you have been moving, may be along the tracks at any point of time or place, where you must have seen that there is a sort of a small box on the side of the track from which the wires are coming and they are going across the track. At the same time, they are also going parallel to that track from that box. Those are the wires which are trying to operate, which are used to operate the signals and the points.

This is the way by which it works and that is why it is a mechanical interlocking condition. It requires lesser staff and it improves safety as compared to key interlocking, because in the previous case where we have been talking about the key interlocking aspect, a person has to first of all come to the box where the keys are there for the locking of the points and once the key is being taken out and another key is being locked, then this key is to be taken to the signal post where it is to be inserted, so as to operate the lever of the signal. It means there is a requirement of more persons depending on the number of such combinations of points and signals.

If it is a big station, then you require more number of persons so as to operate all those, whereas in this mechanical interlocking system, it will be a little lesser than that one, because there is a connectivity of the signal post and the point location by the wires to the one single location and that is known as the controlling tower and at that particular place all the levers are provided. So, when these levers are operated, the signals and points will also be operated. So, one or two persons who are being provided duty in that room can operate and that is how, there less number of staff persons are required and at the same time, when less number of persons are there, the responsibility increases and attentiveness also increases. Therefore, the chances of any unsafe condition of running or operation of those points and signals will reduce and that is how it improves the safety as compared to the previous key interlocking arrangement.

Further, it consists of locking frame and this locking frame is a combination of signal levers, point levers point locks, etc., and it also consists of point fittings, plungers, tappets, lock bars, etc. So, these are some of the main components which we will be using if we have to mechanically interlock any point and signal and plungers have notches and tappets are connected to tie bars. So, what we see is that there are number of accessories which need to be moved in combination with each other when the mechanical interlocking system is to be used.

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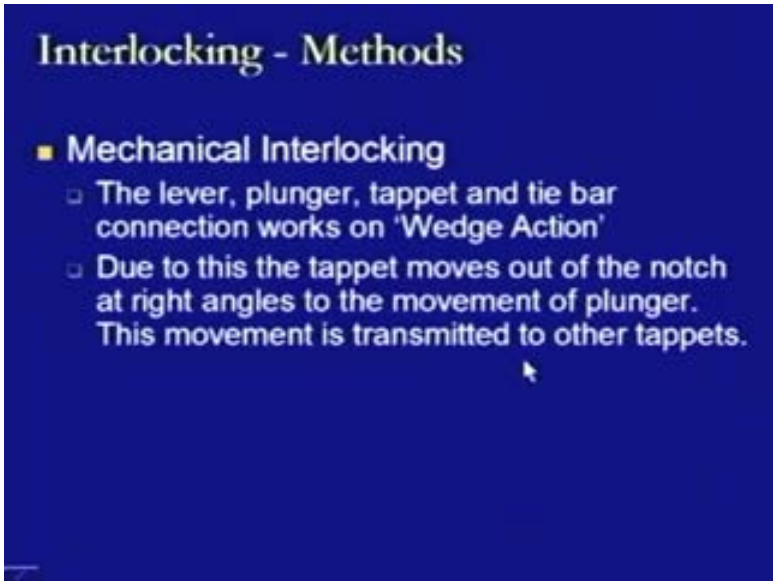

Now, further in this one, the lever, plunger, tappet and tie bar, the connection works on wedge action theory. Now, the wedge action theory says that if you have to interlock, then in that case a sort of a wedge is to be inserted in a group and as soon as that wedge is inserted in a group, then it will not allow the movement and it will make the things fixed. So, using this theory, this combination of lever, plunger, tappet and tie bar that is worked upon and due to this the tappet moves out of the notch at right angles to the movement of plunger and this movement is transmitted to other tappets. That is how it works.

The tappets and the plungers they move at 90 degrees to each other and as soon as the lever is operated, the tappet will come out of the notch and when it comes out of the notch, then at right angles there will be a movement of the plunger and as this tappet moves, there may be some combination of tappets which will be moving in combination with each other and that is how the movement will get transmitted to other tappets too. So, there is sort of a series of tappets which work together depending on what lever is being operated upon.

What we look is this diagram.

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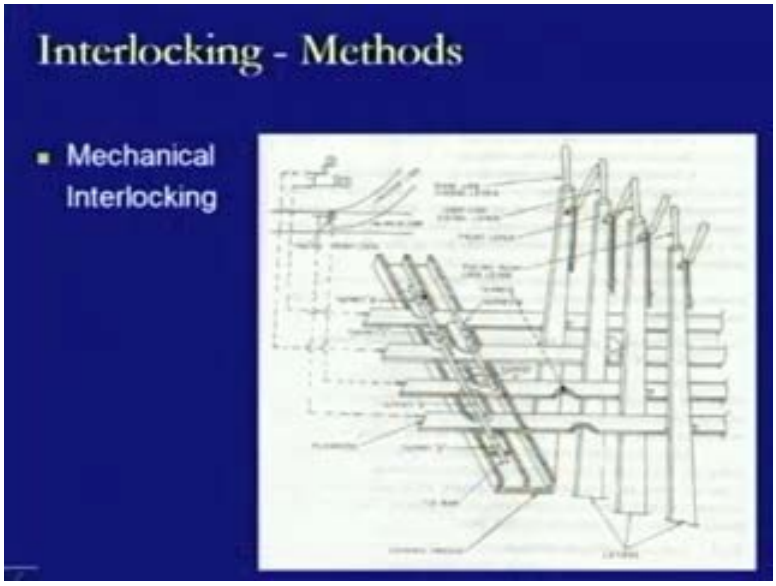

This is probably you must have seen this type of levers at certain locations on the side of the track or sometimes in the movies also where switching the direction of train on a track, we find that a person is moving the levers and that is how at certain location there is a connectivity of the track is being made, so that the train can take a turn on this side. So, what we see in this diagram is that here there is a main track and from this main track there is branch line coming out on this side and therefore, the connectivity of this branch line with the main track that is at this location there is points and switches.

Now, these points and switches have to be connected to this mechanical device which is provided in the cabin. At the same time, with respect to this one there is signal being provided here which defines whether we are going on the main line or we are going on the branch line. So, it means the signals, these two signal phases also needs to be connected to the cabin, so that when it is being set for the main line, then signal for the main line will be working and whereas when it is being set for branch line, then the signal for the branch line will be worked upon. So, these dotted lines which are being shown here from these two signals as well as from the location of the points that is it is coming from this direction and this direction. So, they are coming like this. They are the wires. So, these are the wires which are coming to the cabin.

So, from this cabin, now this is also going for the operation of two signals and the point or the switch for the connectivity of either the main line or for the connectivity of the branch line. So, depending on this number of wires, we will be having number of levers provided in the cabin. So, if we have these four wires which are coming here, then we have the four levers being provided here. So, in these four levers, this is the main line signal lever. Then, we have the loop line signal lever, then we have the front lever which is the facing point lock lever and another lever being provided for further operation and releasing of the levers. So, these are the different levers in series, main line signal, loop line signal, then for points and the release of those one. That is how they are working or they are operating.

Then here we have the tie bar being provided here. This is the tie bar and this one and then these are the locking tools which move in this direction, in this way or this way and when these levers are operated in this direction or in this direction, depending on this, we have these plungers which will be moving and within these plungers, then some groups have been provided like this at this location or at this location or this location; similarly here at this way or here at this location or likewise. Here you can see that this one or this one, they are the grooving condition. They are the basically tappets and these tappet locations are the locations where the wedge action will be taking place and we have these plunger, the movement of these plungers, the different tappets which are being attached to the tie bar they will be moving either in these groove or the other tappet locations and that is how with the operation of these levers, there will be a relative movement of the things.

Like if we operate this lever mean where we have the fixing and the releasing of the lever are being provided on this one. So, if it is operated in this direction like this, then this plunger will be moving in the forward direction and when it moves in the forward direction, then it will put a pressure at this location on the tie bar. So, the tappet B will move out of its location. At the same time, this tappet A will also come out of this location. Now, when these two are going out of the location, this will be moving in this

direction and this will be moving in this direction. So, that is a relative 90 degree movement of the different type of components which are attached with each other.

At the same time, when this moves out and there is a movement like this, when another lever is being operated that is this lever is being operated, then it will allow this particular groove to come into a position, so that the tappet E gets fixed in that one. So, there will be a series of tappets which will be working in association with each other, depending on which particular lever is being operated and then, after that which is the series in which the levers have been operated for providing the movement either on this line or on the main line. So, we will be looking at this aspect that is how all these levers work in combination with each other. The only thing we have remember with respect to this diagram is that we have a lever for main line signal, lever for loop line signal and a lever for the points and that is how, here it will be. Then, we have tappets being provided in the initial condition as B, then C and A and then, tappet F, E and D. So, that is a series they have been provided.

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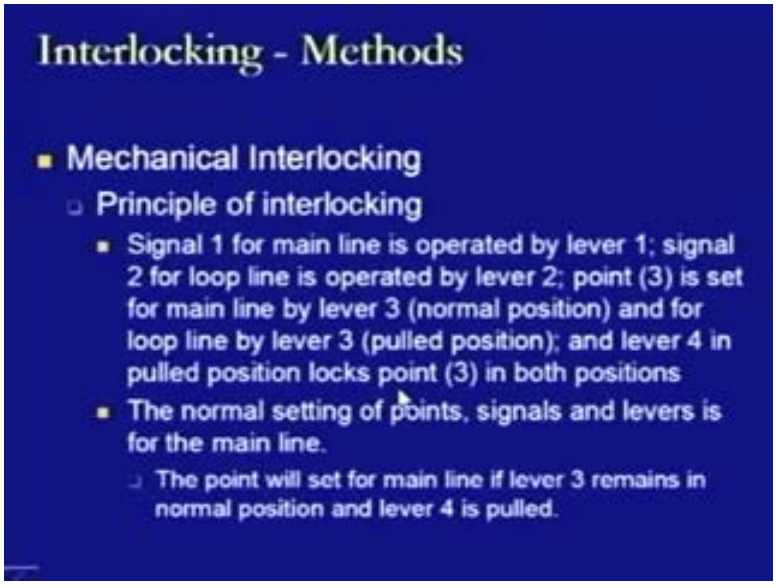

So, we look at the procedure how it is working, what is the principle of interlocking. In this case, the signal 1 for main line is operated by lever 1. So, signal 2 for loop line is

operated by lever 2, point 3 is set for main line by lever 3 in the normal condition and for loop line by lever 3 in the pulled condition. So, if the lever 3 is being left in the normal condition as being shown in the diagram previously, then it is for the main line. But, if it is pulled in the backward direction, then it is being set for the loop line. Lever 4 in pulled position locks the point 3 in both positions. So, that is for locking of the pulled positions of the levers, so the lever 4 is being used and that is being used for whatever is the condition.

The normal setting of points, signals and levers is generally for the main line and in this condition the point will set for main line if lever 3 remains in normal position and lever 4 is pulled. So, that is the initial settings of the levers. So, when we look at the initial setting where the trains are moving on the main line track, we have found that the lever 3 is in normal position and lever 4 is in the backward position. That means it is being pulled towards the person.

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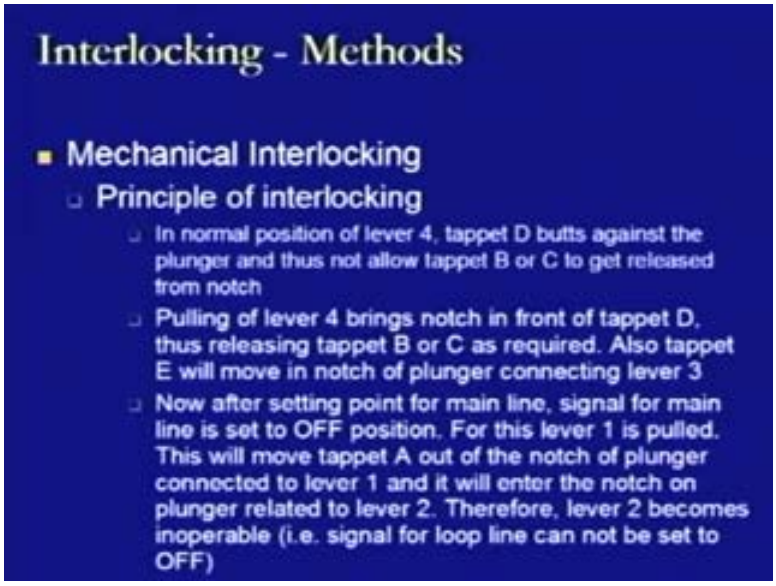

Then, further in the normal position of lever 4, the tappet D butts against the plunger and thus not allow tappet B or C to get released from the notch. So, that is what will happen if the lever 4 comes into the normal position which was shown in the diagram.

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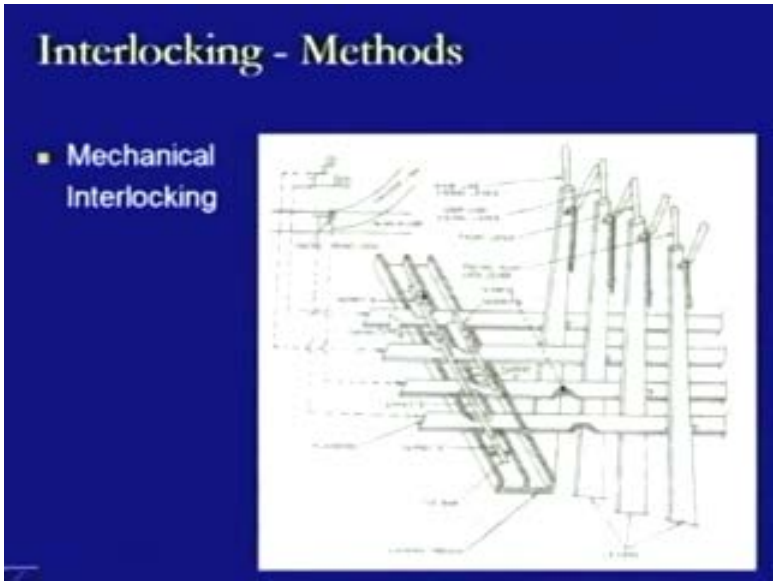

That is if we go to the diagram, this one, this is the lever 4 and this is the normal position of the lever 4. Then, in this condition the tappet D is in the groove condition that is not allowing any other tappet or any other plunger to get released and move. Now, when it is being pushed in the backward direction or is being pulled towards the person who is pulling it, then only this will get released and this is what we will be looking at.

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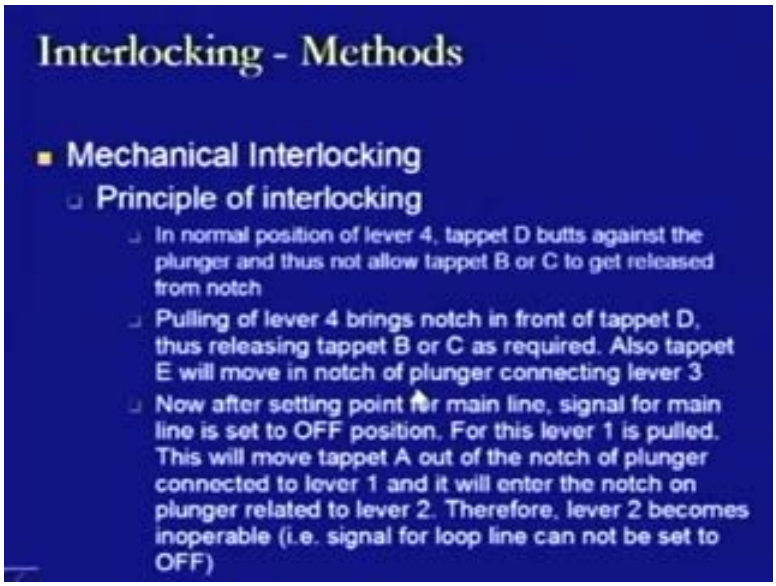

So, pulling of lever 4 brings notch in front of tappet D. So, the notch which is provided in the plunger will come in front of the tappet D as soon as the lever 4 is pulled back, thus releasing tappet B or C as required, depending on whether we are looking for the loop line signal or the main line signal. Also, tappet E will move in notch of plunger connecting lever 3 that is for the points. So, for points again, as soon as this D tappet is coming out, it will also be releasing tappet E now, which is to be worked upon if we just pull the lever 3. Now, after setting the points for the main line signal or main line signal is set to OFF position, so that is we have to do and for this what we will be doing is that for this lever 1 is pulled.

Lever 1 is related to the signal of the main lines. So, when now it is pulled, …… and the signal once the point is being placed. Now, this will move the tappet A, which is released from the plunger related to this lever 1 out of the notch of the plunger connected to lever 1 and it will enter the notch on the plunger related to lever 2. So, this is what will be happening. It has come out of the lever 1 and it will be moving into the notch which is related to the lever 2. Therefore, now what will happen is that this lever 2 will become locked and it cannot be operated. It means, now we cannot set the signal for the loop line. So, that is how it is working in relative position to each other. So, as soon as we have moved the lever 1, lever 2 has been fixed and we cannot operate simultaneously the two of the … levers.

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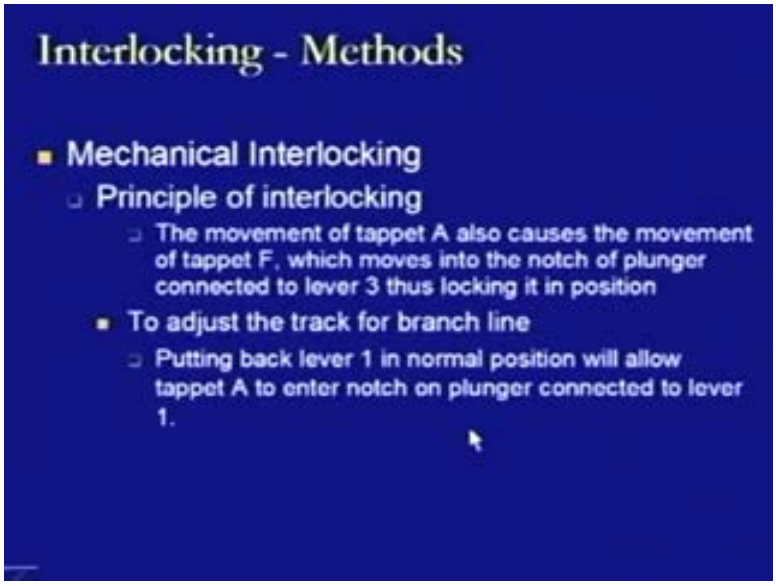

Further, the movement of tappet A also causes the movement of tappet F which moves into the notch of plunger connected to lever 3, thus also locking this lever which is being provided for the point. So, this is, there are two things simultaneously which has happened, as soon as we have pulled the lever 1 which was supposed to set the signal of main line. One thing is that it has locked the lever 2 in position, so that the signal of the loop line cannot be maintained, cannot be pulled out to the OFF position and the second thing is that it has also made the lever 3 locked in position, so that the point is being set and locked.

Now, to adjust the track for branch line, what we have to do is that we will put that lever 1 in normal position and once we put that lever 1 in normal position, then the tappet A will come into the notch and on the plunger connected to lever 1 and that is how the lever 1 will become locked and it will release the lever that is for signal of the loop line as well as for setting the points.

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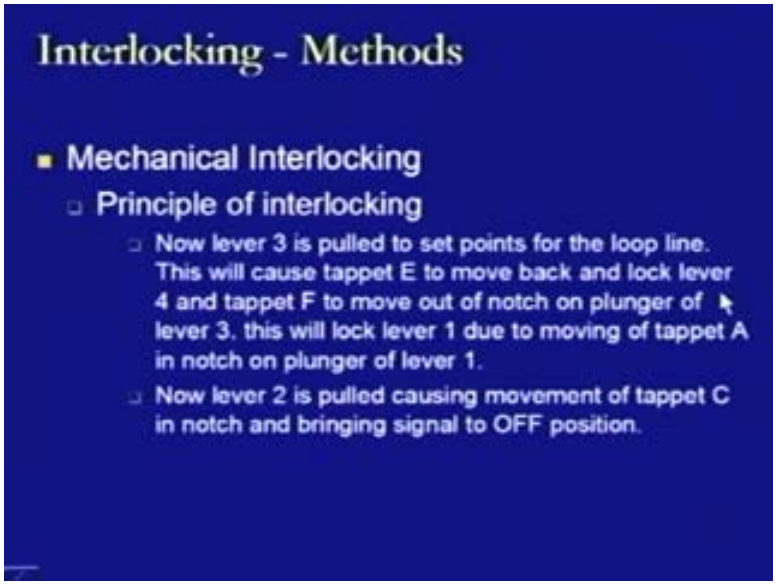

So, now what we will be doing for putting for the branch line is that we will now be using the lever 3 and it will be pulled to set the points for loop line. Now, once it is being set for the loop line, what will be happening is that it will cause tappet E to move back and lock the lever 4 and the tappet F to move out of the notch on plunger of lever 3, thus locking lever 1 due to the movement of tappet A in notch on plunger of lever 1. So, again we have to be serious that there is a relative movement with respect to tappet E and tappet A as well as with respect to tappet F, which are provided on the different levers and that is how the three levers which are being operated one after the other that, locks, so that now only when we pull the lever 2 which causes the movement of tappet C into the notch brings the signal for the branch line to the OFF position. So, that is how we can set, we can make the interlocking for the main line or for the branch line using the four levers as shown in the diagram. So, that is the overall principle of interlocking in the case of mechanical interlocking process.

Now, we come to the electrically operated interlocking condition.

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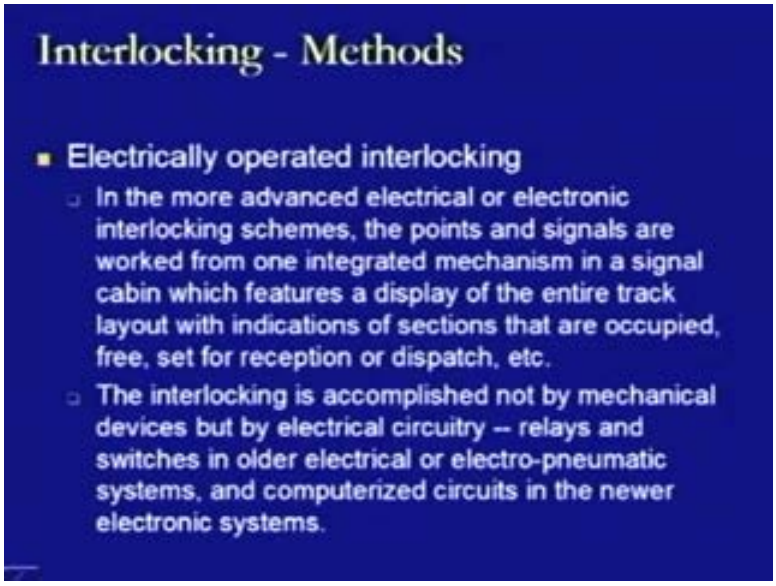

In this electrically operated interlocking condition, what we do is that the more advanced condition where the electric or electronic interlocking schemes are used and the points and signals are worked from one integrated mechanical signal cabin which features a display of the entire track as we have seen in the case of CTC system, the centralized traffic control system with indications of sections that are occupied, that are free or that are set for reception or dispatch, etc. ….. everything is available in the form of a diagram on the panel and that can be viewed while sitting in one single cabin at certain location. So, that what is the principle behind the automatic train control system as well as the centralized train control system and that is why it is suited to that type of system, more.

The interlocking is accomplished not by mechanical devices, but by electrical circuitry where the relays and switches in older electrical or electro-pneumatic systems or computerized circuits in the newer electronic systems are used. So, in the previous systems what we have been using was the relays and the switches, where nowadays in the new systems the computerized circuits are there. Everything is controlled by computers being fed in the form of software and that is how it keeps on controlling the overall system.

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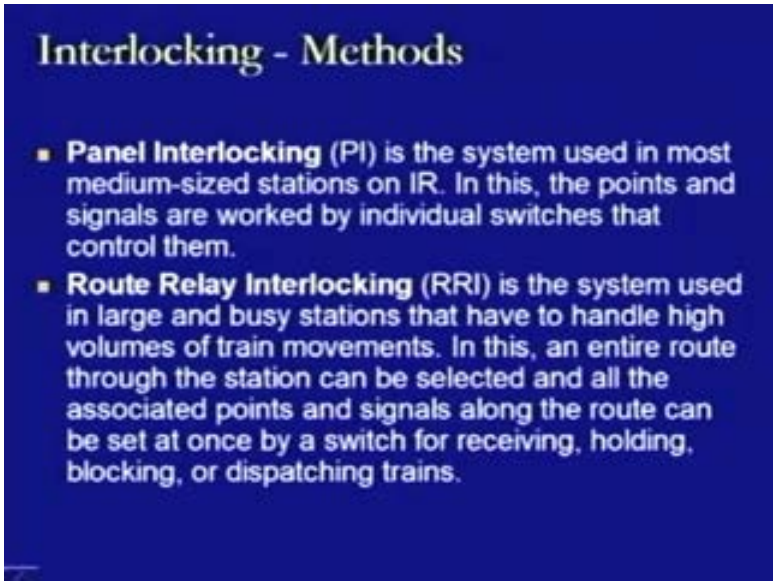

Then, there is a panel interlocking system, PI system where it used in most medium sized stations on Indian railways. In this, the points and signals are worked by individual switches that control them. That is the way it is worked, whereas there is a route-relay interlocking system which in short is termed as RRI. This is the system which is used in large and busy stations that have to handle high volumes of train movements and in this system an entire route through the station can be selected and all the associated points and signals along the route can be set at once by a switch for receiving, holding, blocking or dispatching the trains; means it is a condition, where whatever the number of points are being provided, whatever number of signals are being provided along the route, there is relay of the communication of the message by which all the things are getting interlocked with each other by using one single switch or by using one single such point which is provided within the controlling cabin and that is what is the system of route relay interlocking.

So, this helps in eliminating the errors which may be there while setting the different points or while setting the different signals and route, due to any human error as we have seen in the case of CTC system, where for each and every point as well as for every signal a thumb off switch was provided on the board and we have to operate that thumb

off switch, so as to operate that point or that signal. But in this case, because each and every signal or point on the route is being connected to each other, therefore that sort of human error may get eliminated in this system.

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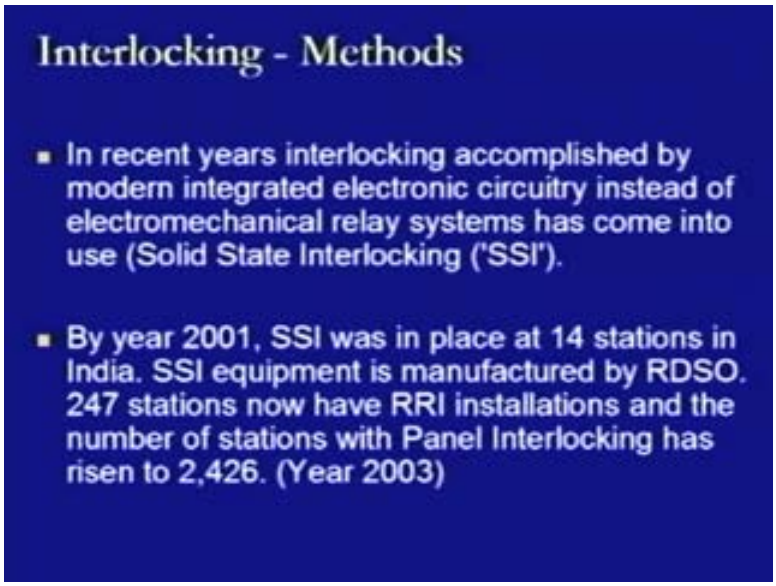

In recent years interlocking accomplished by the modern integrated electronic circuitry instead of electromechanical relay systems has come into use which is termed as solid state interlocking system. By the year 2001, this solid state interlocking was in place at 14 stations in India and the equipment is manufactured by RDSO. This is again the organization of railways, where 247 stations now have the route relay installations and the number of stations with panel interlocking has risen to 2426. That was the statistics up to the year 2003 and now probably large number of stations has already been connected by these systems.

Now, we come to the mechanical devices which are used for the interlocking.

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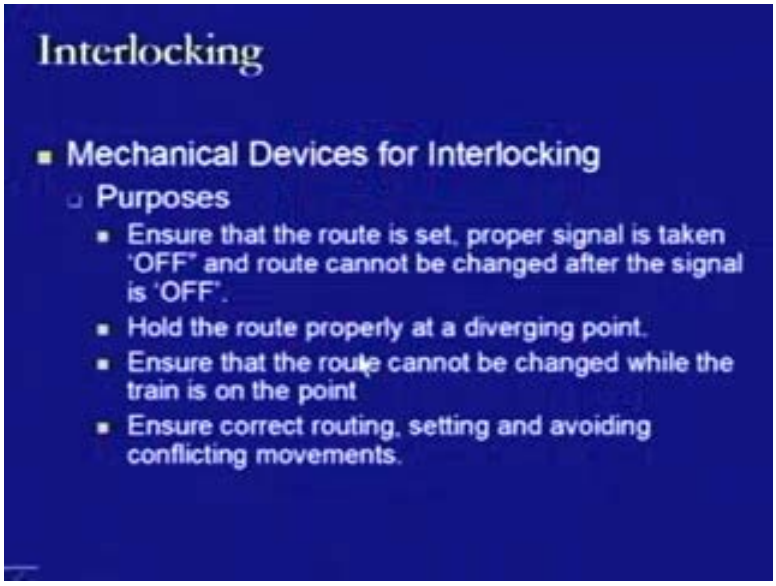

The purpose behind these mechanical device is that they ensure that the route is set, proper signal is taken OFF and the route cannot be changed after the signal is OFF and they hold the route properly at a diverging point and ensures that the route cannot be changed while the train is on the point and they also ensures the correct routing setting and avoiding conflicting movements. So, that is the basis for which or the objective for which the mechanical devices are provided.

Within these mechanical devices the first thing is the detector.

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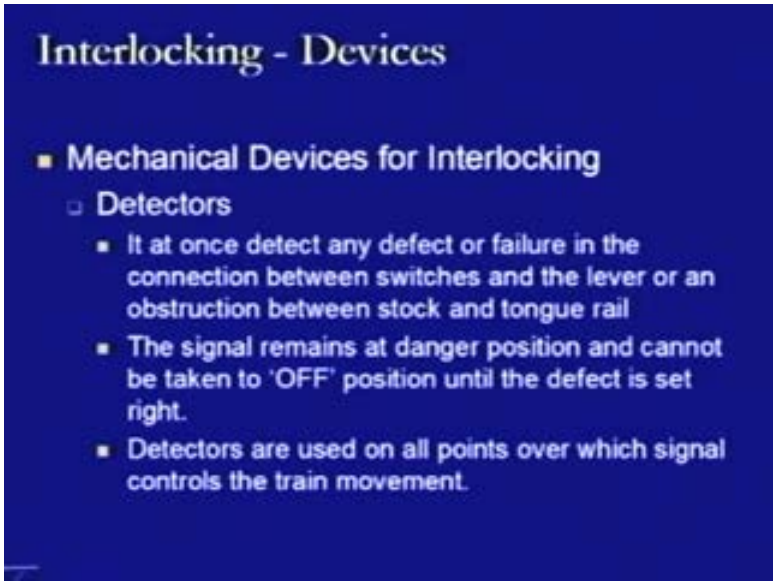

It at once detects any defect or failure in the connection between switches and the lever or an obstruction between stock and tongue rail. The signal remains at danger position and cannot be taken to the OFF position until the defect is set right and the detectors are used on all points over which signal controls the train movement.

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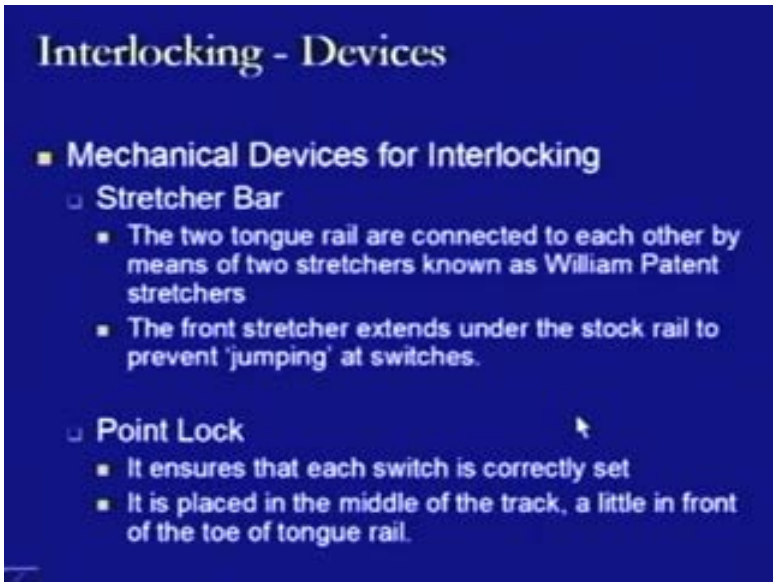

Then, we have the stretcher bars. The two tongue rails are connected to each other by means of two stretchers which are known as William Patent stretchers. The front stretcher extends under the stock rail to prevent jumping at switches. Then there is a point lock. It ensures that each switch is correctly set. It is placed in the middle of the track, a little in front of the toe of the tongue rail.

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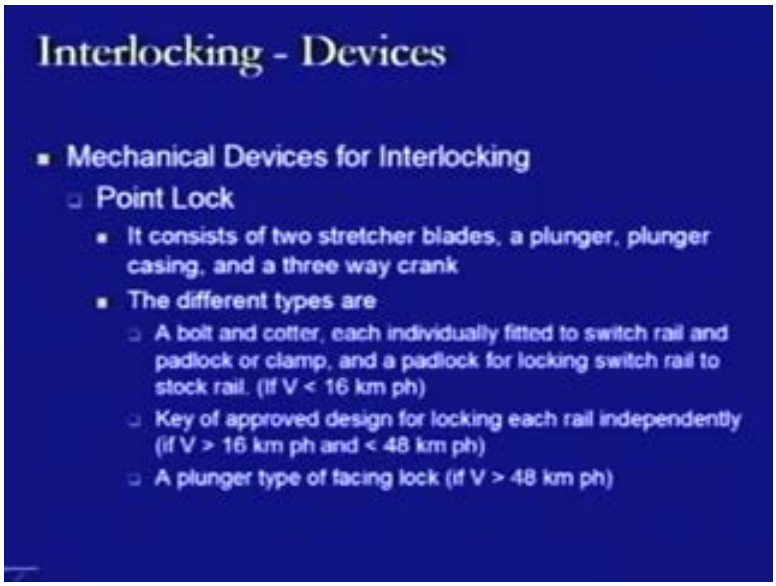

Then there is a, in the case of point lock still then it consists of two stretcher blades, plunger, plunger casing and a three way crank and the different types are a bolt and cotter type, each individually fitted to switch rail and padlock or clamp and a padlock for locking switch rail to stock rail, if the speed is less than 16 kilometer per hour or key of approved design for locking each rail independently if the speed is greater than 16 kilometer per hour, but less than 48 kilometer per hour and a plunger type of facing lock if the speed is greater than 48 kilometers per hour.

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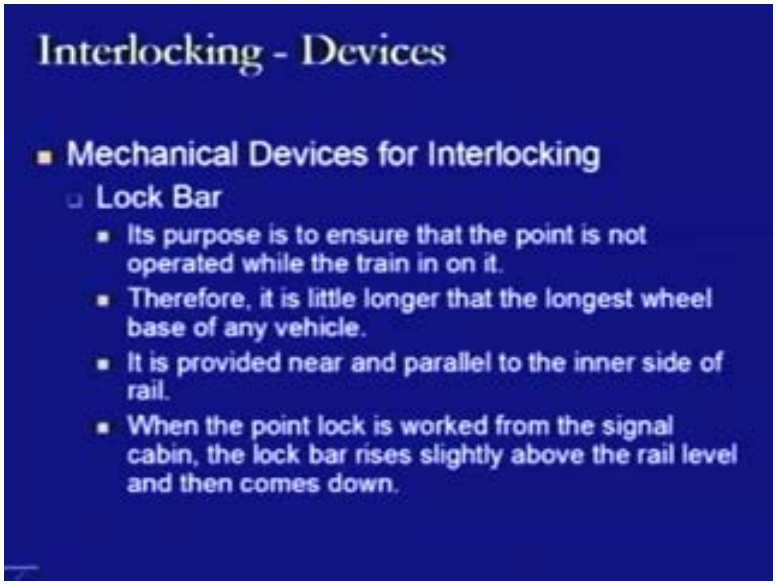

Then the lock bar's purpose is to ensure that the point is not operated while the train is on it. Therefore, it is little longer than the longest wheel base of any vehicle. It is provided near and parallel to the inner side of the rail. When the point lock is worked from the signal cabin, the lock bar rises slightly above the rail level and then comes down. That is how it works.

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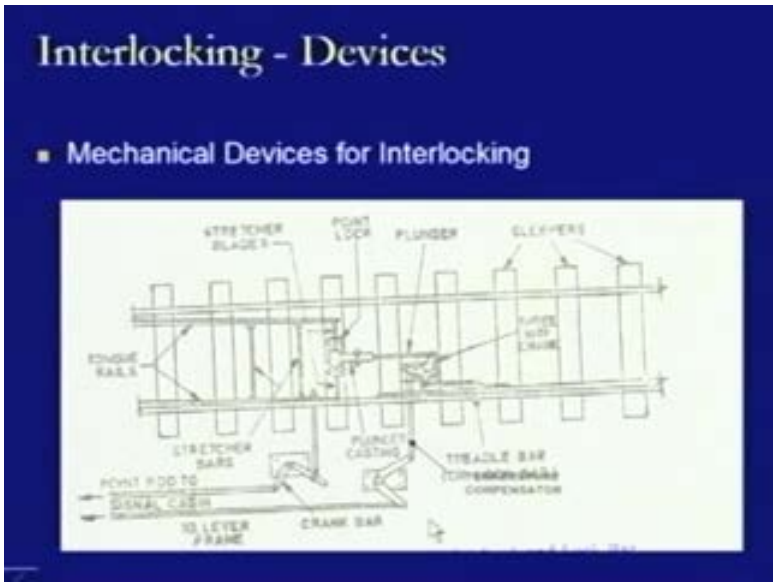

That is a diagram which tries to show all the mechanical devices which we have discussed just now. These are the rails, this is the tongue rail which is coming into the tappet condition and survey at this location and then, we have the stretcher bars which are shown here. They are connecting the two tongue rails that is this one and the other tongue rail being placed side to this main track.

Then there is a three way crank, this is connected by the plunger to the point lock being provided here. This is what is the point lock. It is provided with the stretcher blades that is at this location, at this location and then there is compensator being provided here for the plunger casing where the crank bar and all these are going to the lever frame to the signals cabin. So, these are the different things, different mechanical devices which we have discussed and are used for interlocking system of the various points.

So, this is what we have looked as far as further in the case of controlling of the movement of trains is concerned on the tracks. This is the final thing which is used, so that the operation of the trains on the track remains safer, subjective it has to move on the main line or the branch line and only one type of movement can be provided at one point of a time and this is what is known as interlocking. So, we stop at this point and will be meeting in another lecture to look at some of the aspects of high speed rails and till then good bye.