

Create a Detailed CTC Machine Model with JMRI/PanelPro

Dick Bronson - *RR-CirKits, Inc.*

Other Clinics in this series:

- Introduction to Layout Control with JMRI/PanelPro

8:30 PM, Sunday, July 13th

- Add Signals to your Layout with JMRI/PanelPro

10:00 PM, Sunday, July 13th

- Introduction to Layout Control with JMRI/PanelPro

Repeated 4:00 PM, Friday, July 18th





- CTC Centralized Traffic Control
 - According to Wikipedia **Centralized Traffic Control** (CTC) is a signalling system used by railroads. The system consists of a centralized train dispatcher's office that controls railroad switches in the CTC territory and the signals that railroad engineers must obey in order to keep the traffic moving safely and smoothly across the railroad.
 - CTC systems are considered sufficient authority to run trains based strictly on signal indications. This is because CTC signals default to 'Stop' and require a human dispatcher to 'Clear' them.
 - The CTC panel depicted in this clinic is a Classic era US&S panel.



- CTC basics

- ABS defaults to 'Clear' signals, and drops to 'Stop' if the block immediately beyond the signal is occupied, or if the switch (turnout) beyond the signal is set against the direction of traffic.



CTC

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- CTC is a layer superimposed over the basic ABS system to hold all signals in the 'Stop' aspect unless cleared by the dispatcher to their ABS value. This means that the local ABS logic will always (normally) supercede to the lower speed aspect. I.e. The dispatcher does NOT set the signals to green. He just permits them to go green.



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 - 'Clear' to the dispatcher means *not stop*. 'Normal' to the dispatcher is all signals at stop.



CTC

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- The CTC Clinic 1 panel has indicators for all the required logic.



- **CTC basics**

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- We will NOT go step by step building the CTC panel. That in itself would require more time than we have. Instead we will start out with a completed example panel and first cover the operation of a CTC panel.
- Clinic 2 will look at the underlying Logix that make it all work.
- The CTCClinic1.xml panel has indicators for all the required logic.
- The CTCClinic3.xml panel only includes prototypical indications, other than the traffic simulation toggles.

Getting Started Lines



CTC

CTC basics

- This panel includes many icons whose only purpose is to aid in understanding what is going on.

Getting Started Lines



CTC basics

- This panel includes many icons whose only purpose is to aid in understanding what is going on.
- Traffic direction indicators. Some CTC panels do include traffic direction indicators for the single track sections. These lights are included as an aid to the dispatcher but are automatically set and cleared.



Getting Started Lines



CTC

CTC basics

- This panel also includes traffic direction indicators in the passing areas to show the logic required for operation. This was not usually done for passing sidings, but was sometimes done for multi-track lines when traffic could normally be sent either way on the same line.



Getting Started Lines



CTC

CTC basics

- This panel also includes traffic direction indicators in the passing areas to show the logic required for operation. This was not usually done for passing sidings, but was sometimes done for multi-track lines when traffic could normally be sent either way on the same line.
- CTC panels did not have actual signal indications. Operators could only infer aspects from the status of the panel lamps.

Getting Started Lines



CTC

CTC basics

- Traffic Simulation. There is no connection to other CTC panels, so off board traffic is simulated.



APPROACH
BELL
ALARM
CUTOUT

MANUFACTURED BY
UNION SWITCH & SIGNAL
410 ST. JOHN STREET, PITTSBURGH, PA. 15222 U.S.A.
UNION SWITCH & SIGNAL

Getting Started Lines

Traffic Simulator



Traffic Simulator



Occupancy simulator



CTC

CTC basics

- Traffic Simulation. There is no connection to other CTC panels, so off board traffic is simulated.
- Occupancy. These toggles are tied to occupancy detectors to allow the panel to run in simulation mode or track actual track occupancy.

Getting Started Lines



CTC

CTC basics

- Traffic Simulation. There is no connection to other CTC panels, so off board traffic is simulated.
- Occupancy. These toggles are tied to occupancy detectors to allow the panel to run in simulation mode or track actual track occupancy.
- Sound and delays. The sounds and delays in this panel are generated by Logix using resources available in JMRI.

Getting Started Lines



CTC

CTC operation

- This panel is shown in the 'Normal' condition. All switches are set to the mainline.



Getting Started Lines



CTC

CTC operation

- This panel is shown in the 'Normal' condition. All switches are set to the mainline.
- All traffic direction levers are set to the middle 'Signals Normal' position. This holds all signals in the 'Stop' aspect.

Getting Started Lines



CTC

CTC operation

- This panel is shown in the 'Normal' condition. All switches are set to the mainline.
- All traffic direction levers are set to the middle 'Signals Normal' position. This 'holds' all signals in the 'Stop' aspect.
- The PanelPro indication I use for 'hold' is a red outline with black center.

Getting Started Lines



CTC

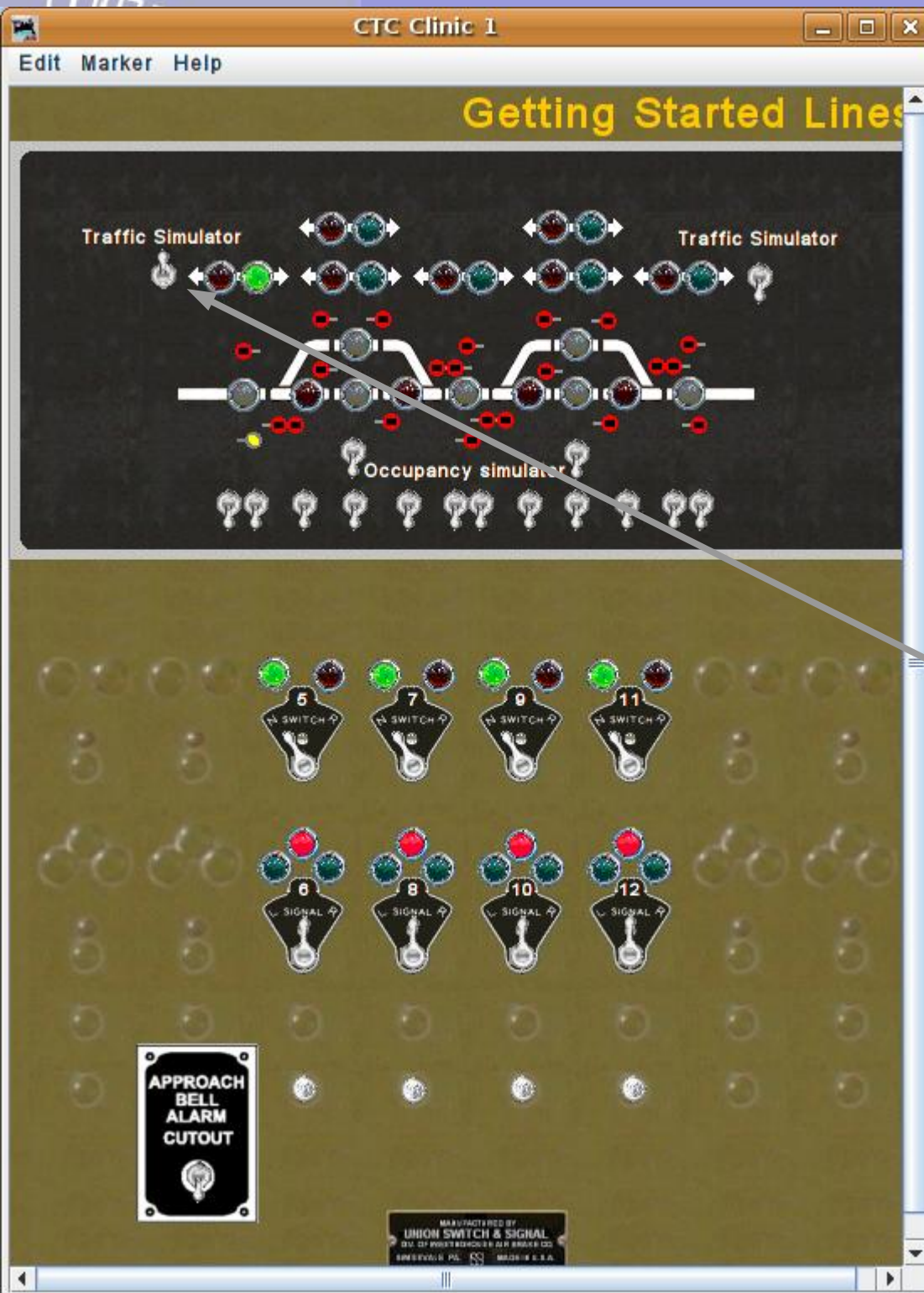
CTC operation

- This panel is shown in the 'Normal' condition. All switches are set to the mainline.
- All traffic direction levers are set to the middle 'Signals Normal' position. This 'holds' all signals in the 'Stop' aspect.
- The PanelPro indication I use for 'hold' is a red outline with black center.
- First lets consider how the CTC panel operates for a train entering the system.

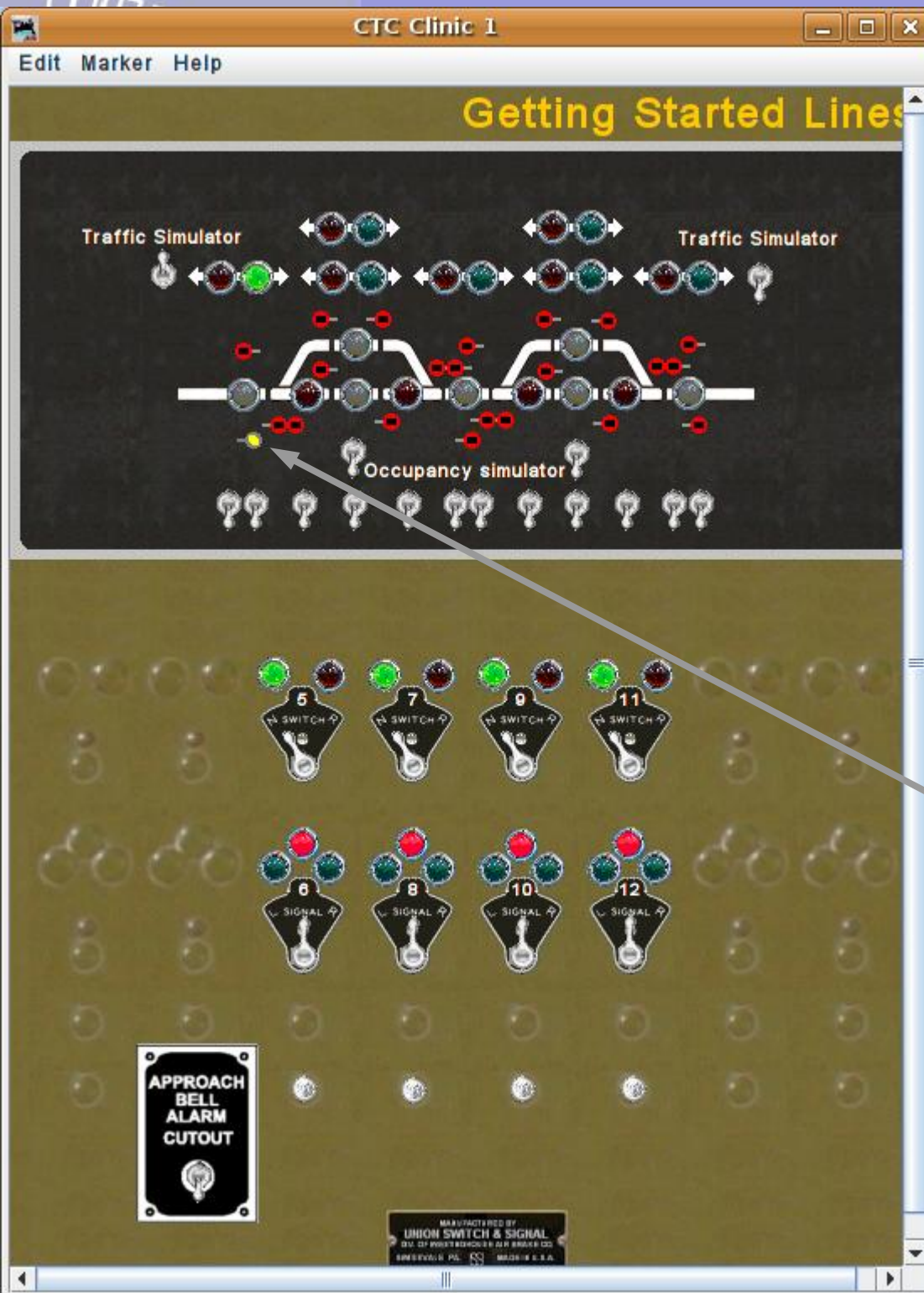
CTC

CTC operation

- The first indication of an approaching train would be that the traffic indication from the previous CTC system would light up for eastbound. We simulate this by flipping the toggle.



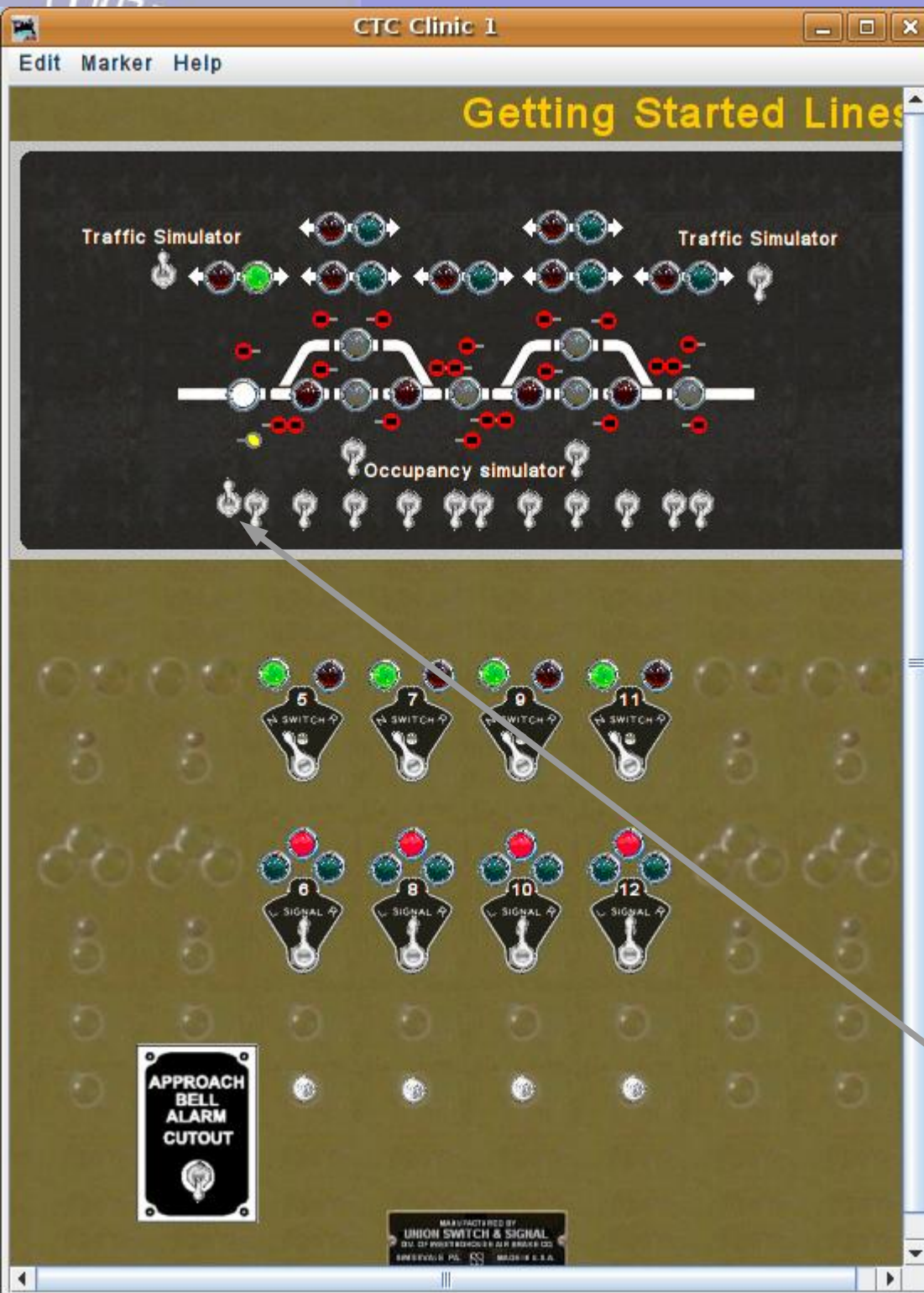
CTC



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- Note that the mid block signal/s are cleared for eastbound traffic. The dispatcher does NOT see this.

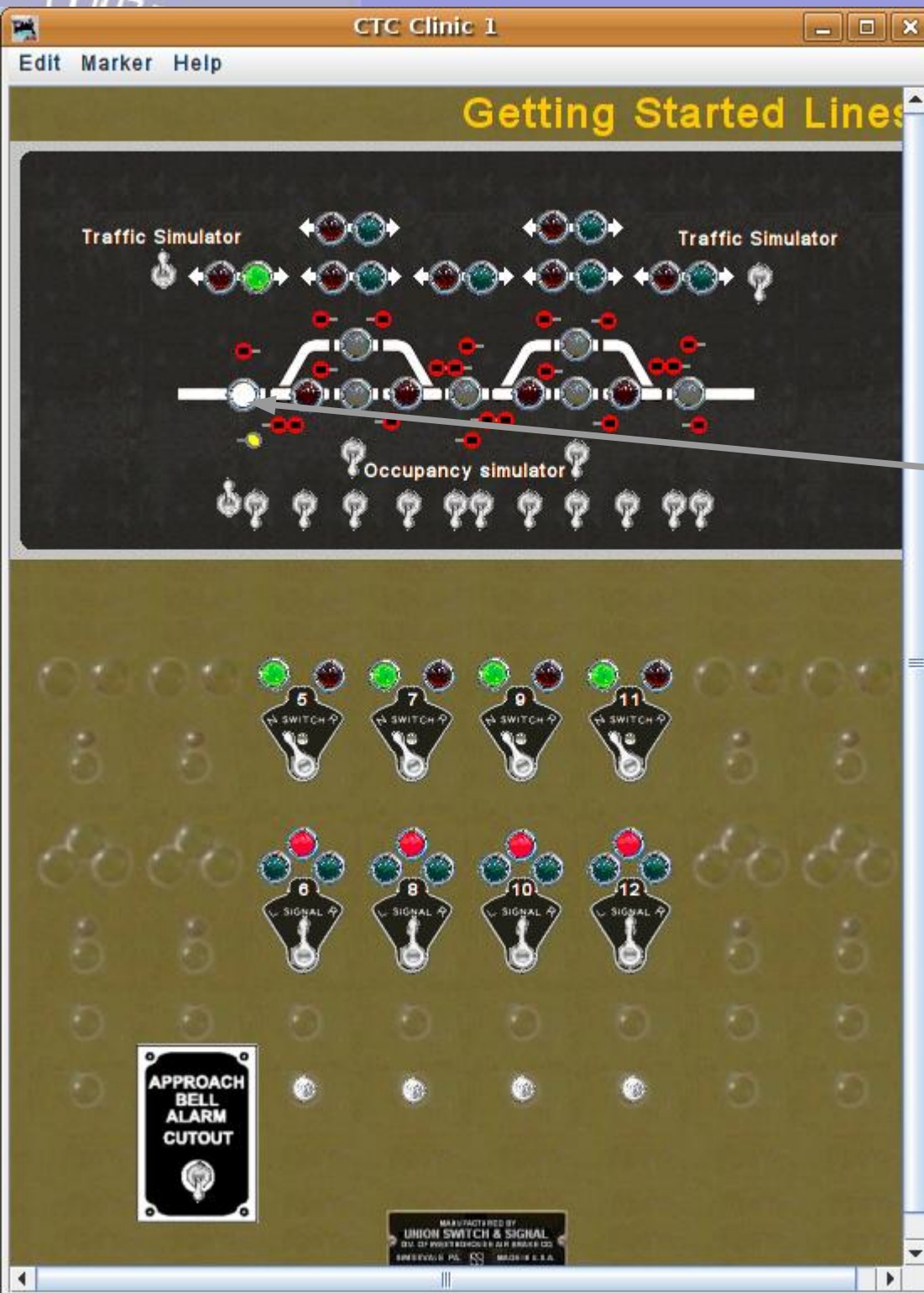
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CTC operation

- The first indication of an approaching train would be that the traffic indication from the previous CTC system would light up for eastbound. We simulate this by flipping the toggle.
- Note that the mid block signal/s are cleared for eastbound traffic. The dispatcher does NOT see this.
- We flip the 'occupancy' toggle to indicate a train has just entered the intermediate block.

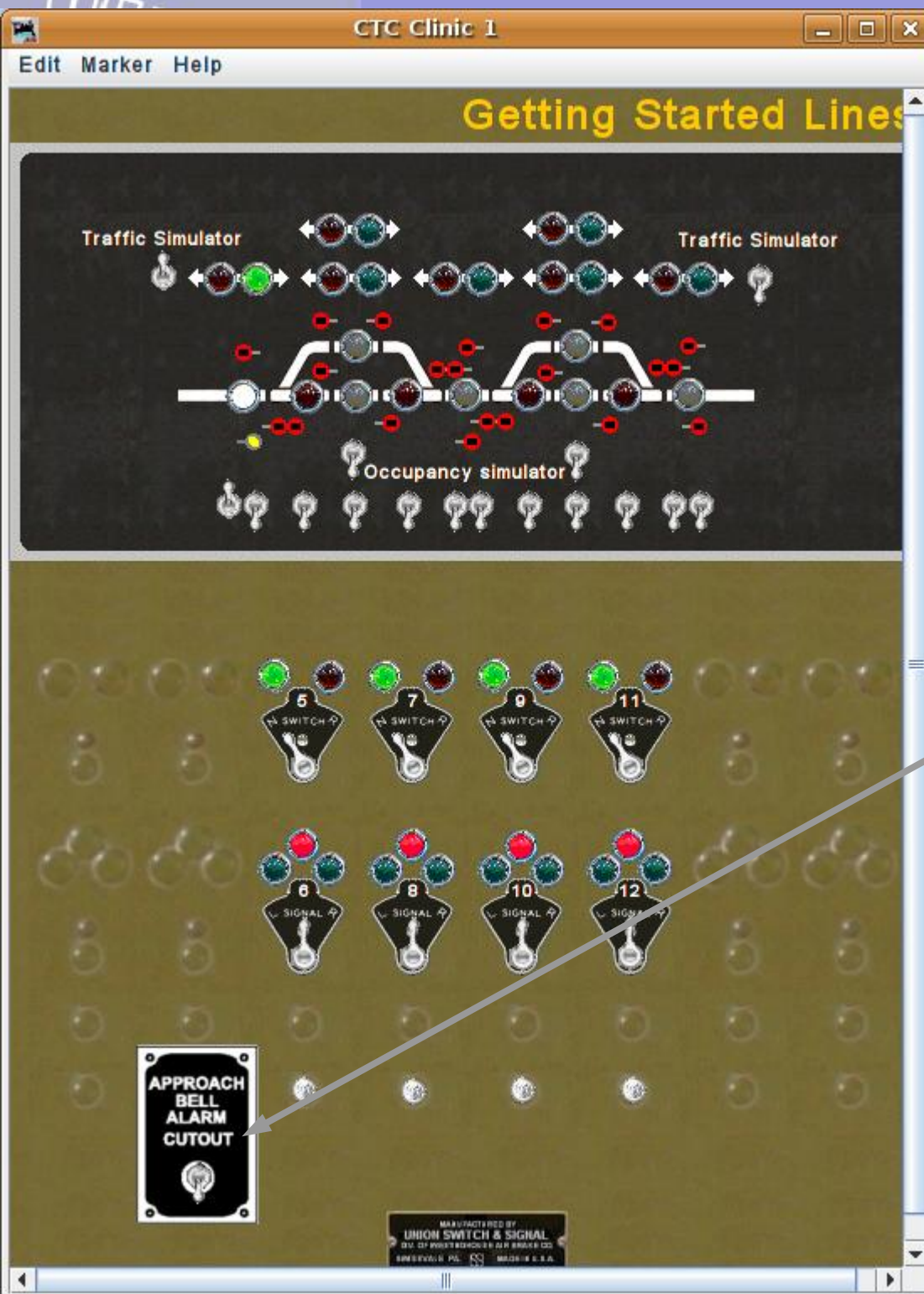
CTC



CTC operation

- The code relay unit in the CTC machine goes into action and a few seconds later the occupancy light illuminates.

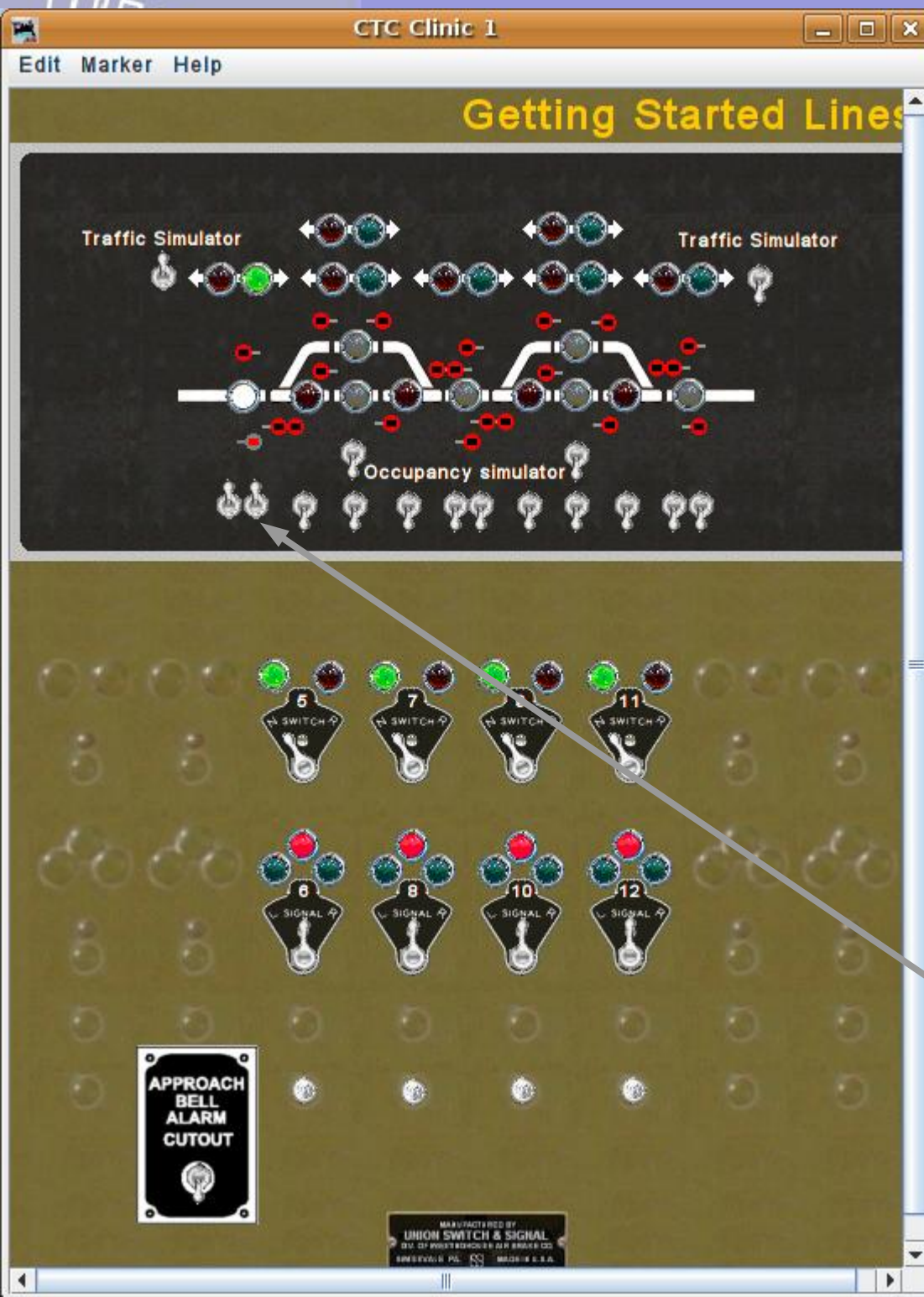
CTC



CTC operation

- The code relay unit in the CTC machine goes into action and a few seconds later the occupancy light illuminates.
- The approach bell will always sound when off panel traffic moves onto the board. The 'cutout' is only to silence the OS approach bell.

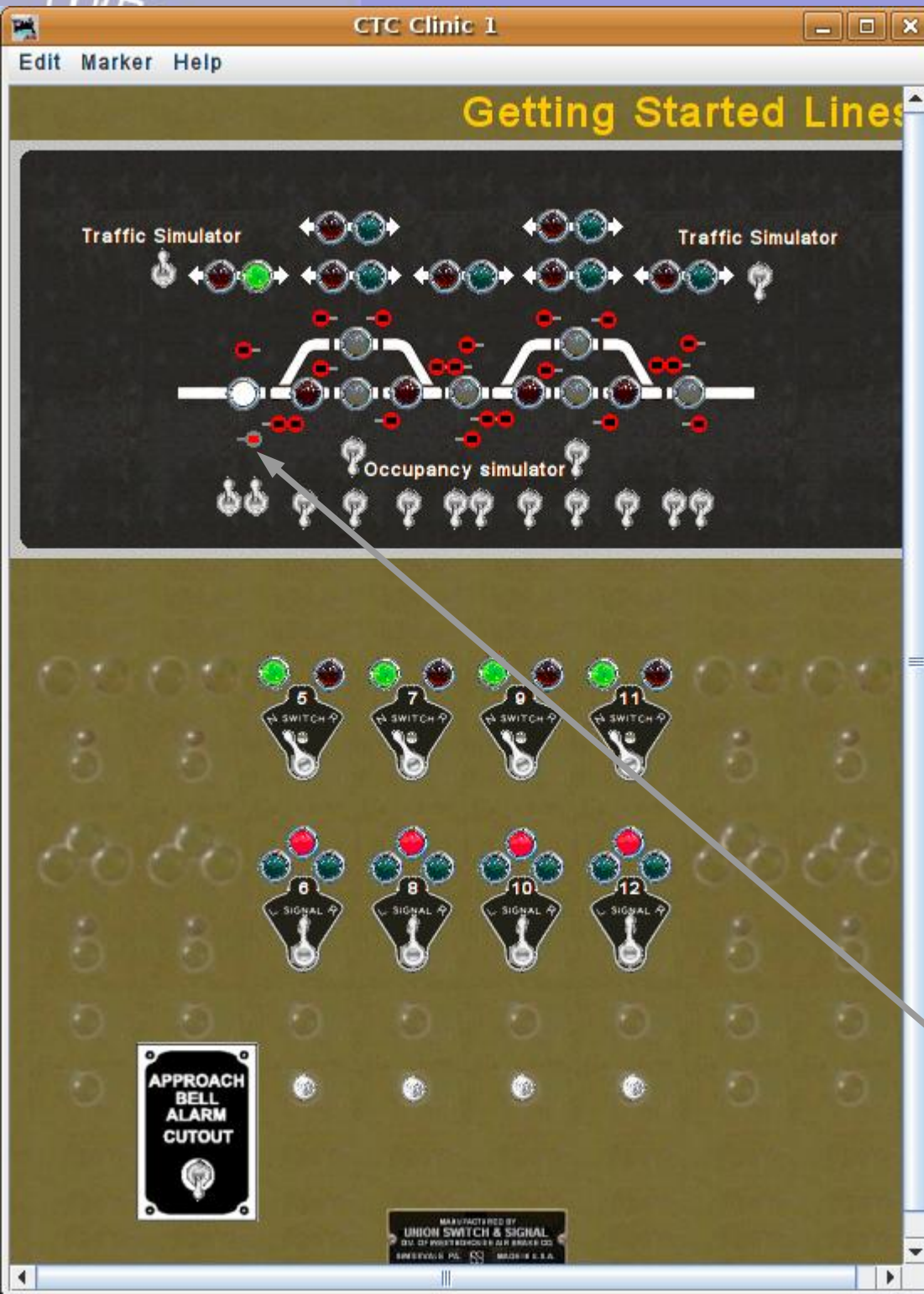
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- We operate the next block occupancy sensor.

CTC



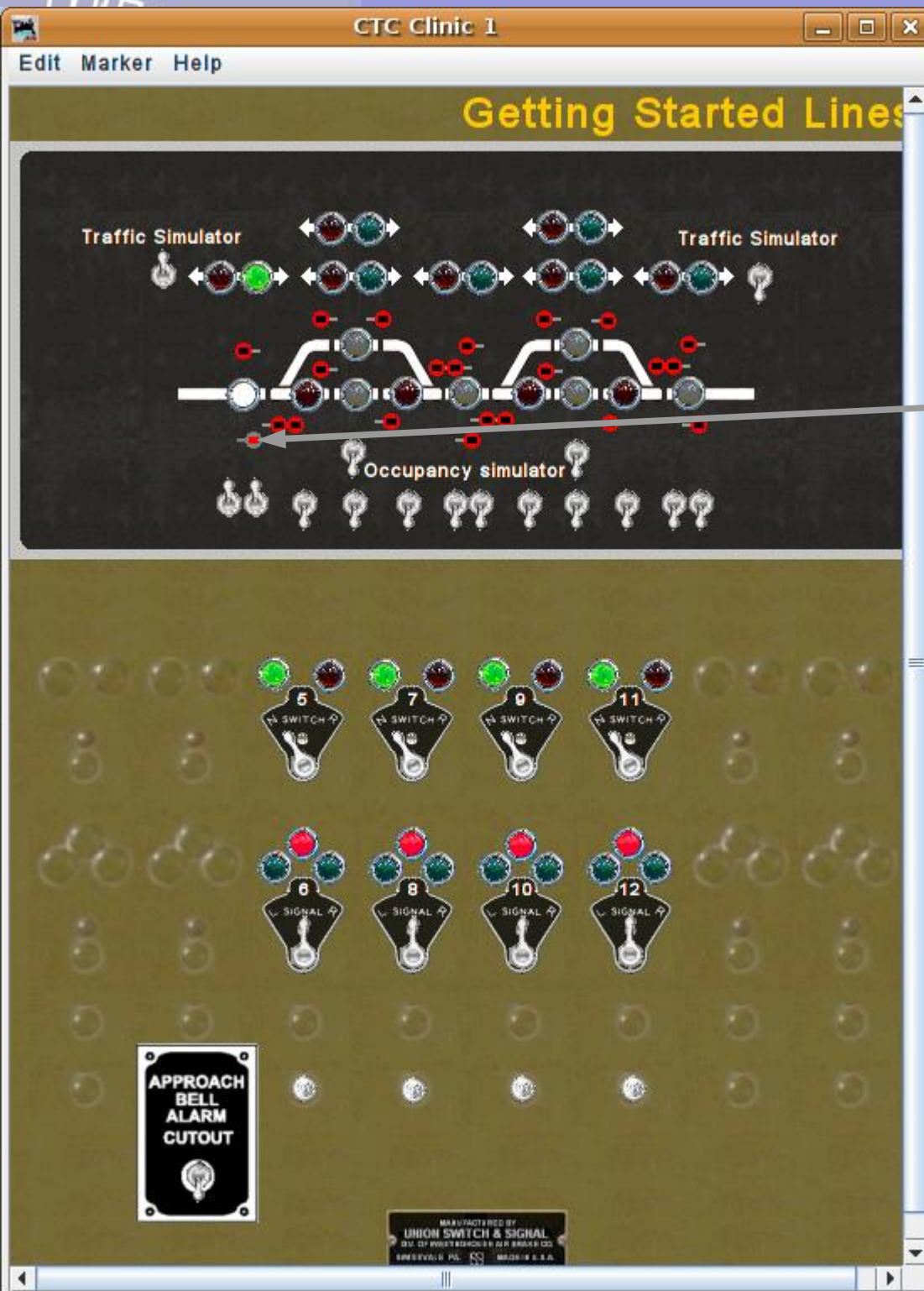
CTC operation

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- The approach bell will always sound when off panel traffic moves onto the board. The 'cutout' is only to silence the OS approach bell.
- We operate the next block occupancy sensor.
- The only indication of this is that the intermediate block signal goes to red.

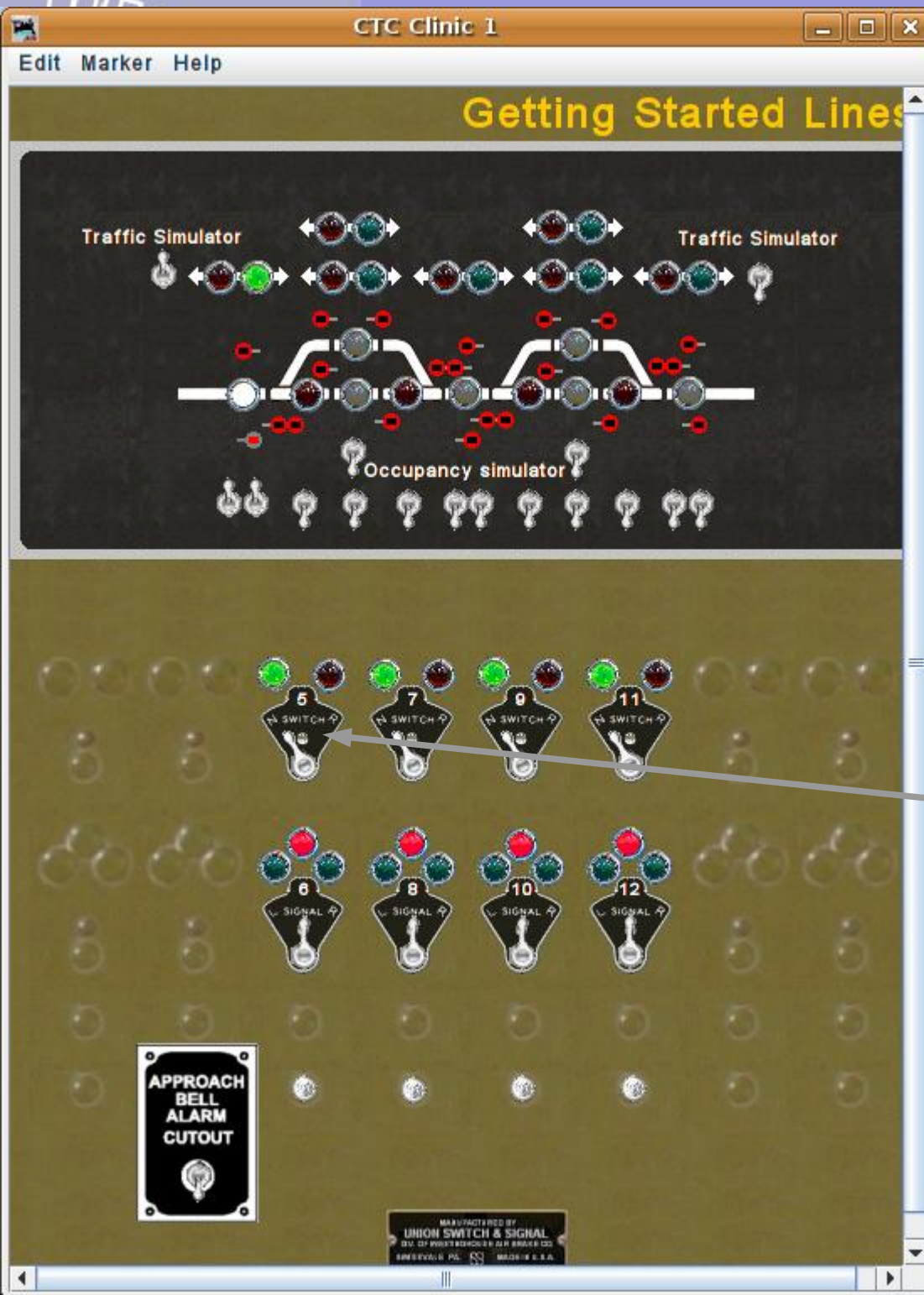
CTC

CTC operation

- The dispatcher of course can not see the signals many miles away. All he knows is that a train is on the way into his territory, and he needs to deal with it.



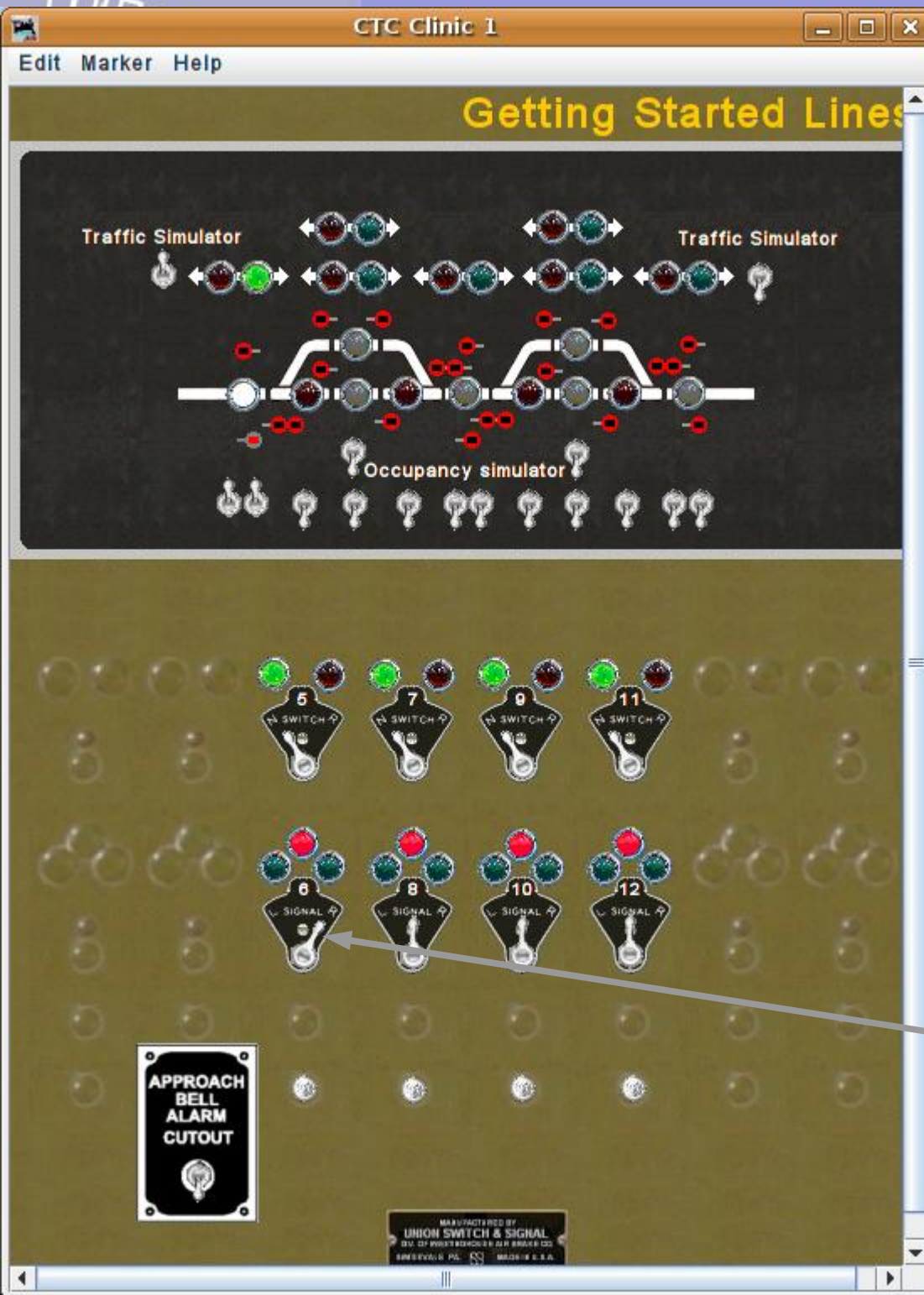
CTC



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- The dispatcher of course can not see the signals many miles away. All he knows is that a train is on the way into his territory, and he needs to deal with it.
- He elects to let the train proceed into the plant on the main, so he leaves the switch lever as it was.

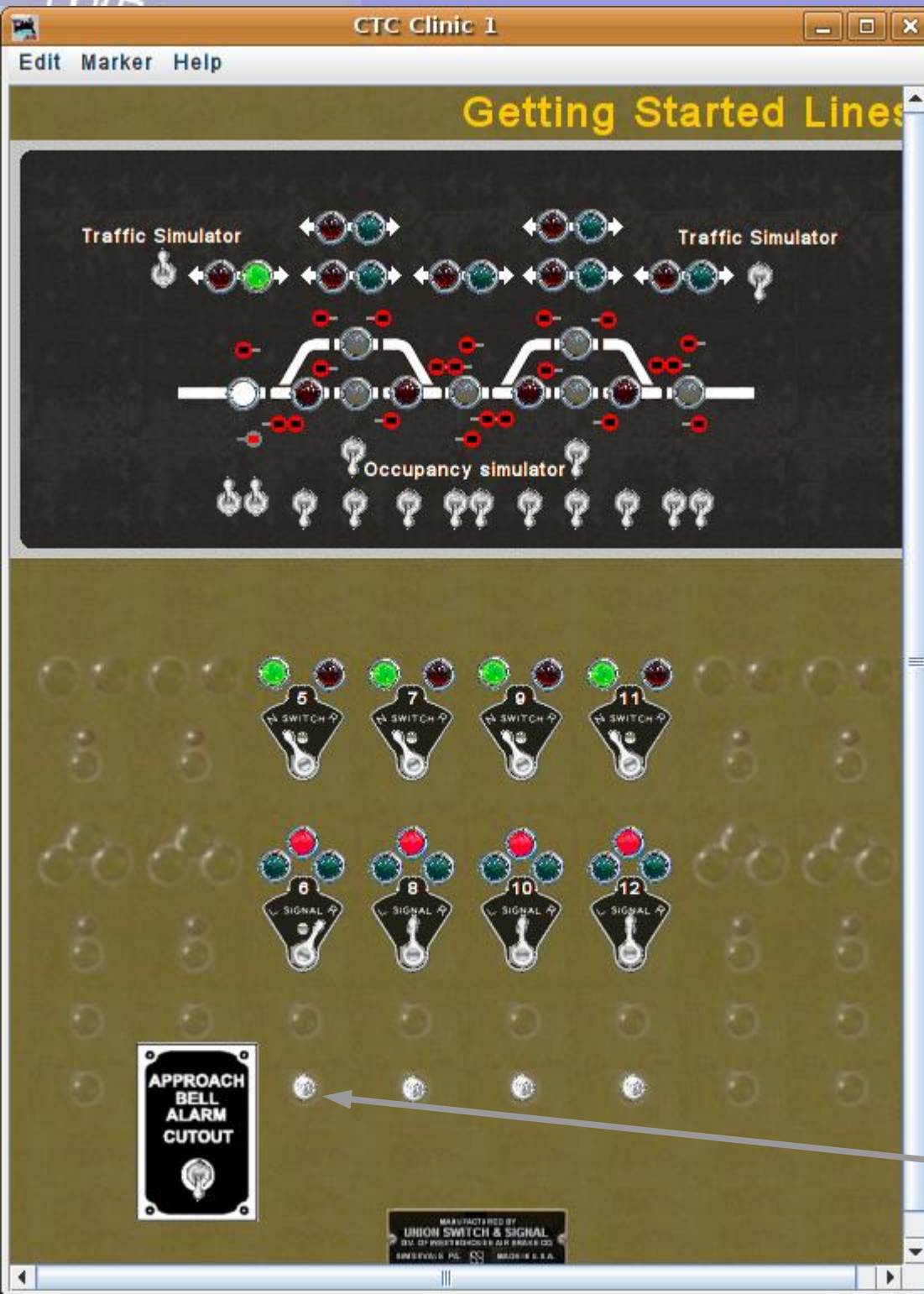
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- He elects to let the train proceed into the plant on the main, so he leaves the switch lever as it was.
- He changes the signal lever to 'R' (right).

CTC



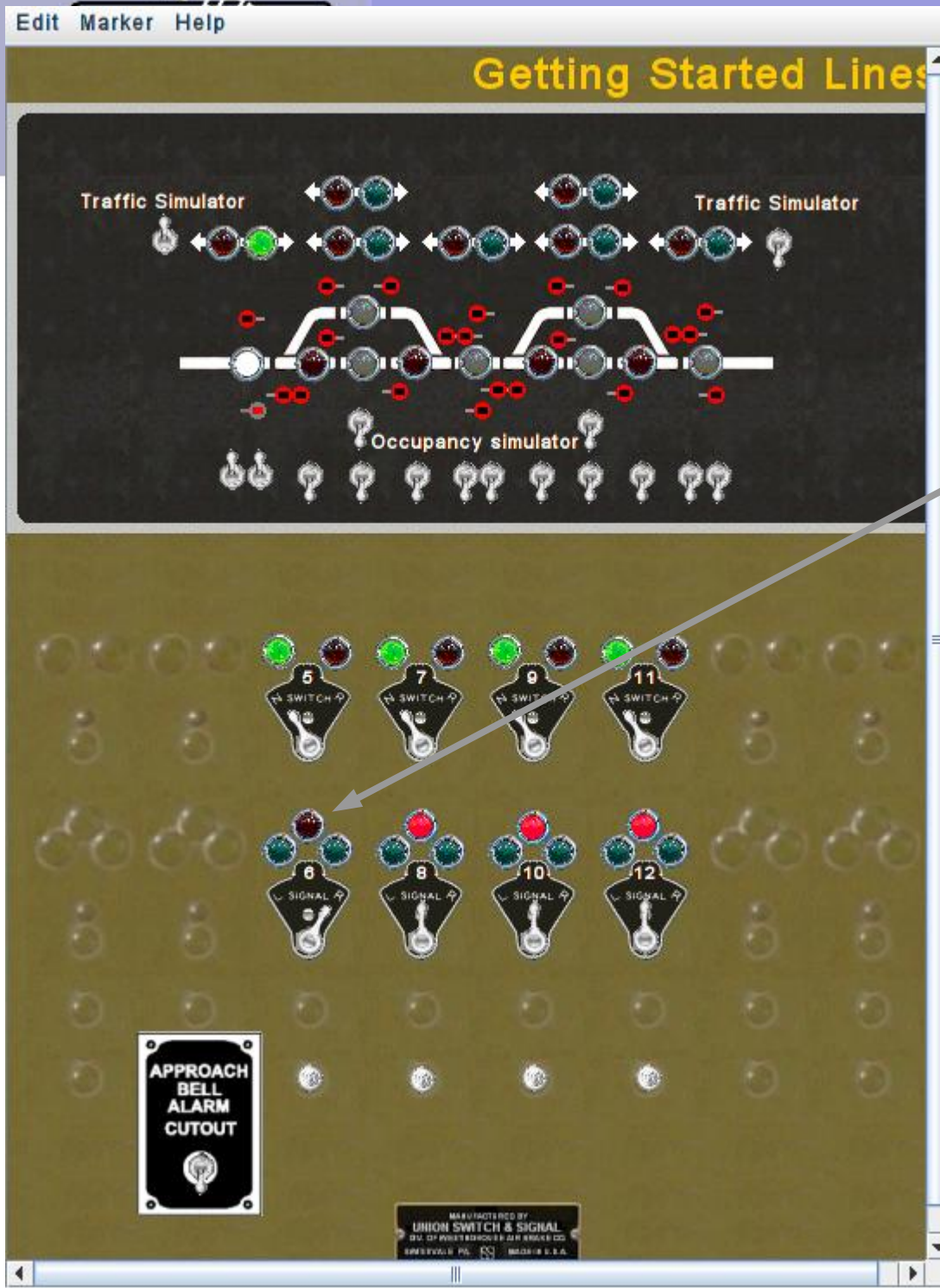
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- He elects to let the train proceed into the plant on the main, so he leaves the switch lever as it was.
- He changes the signal lever to 'R' (right).
- Then presses the 'Code' button.

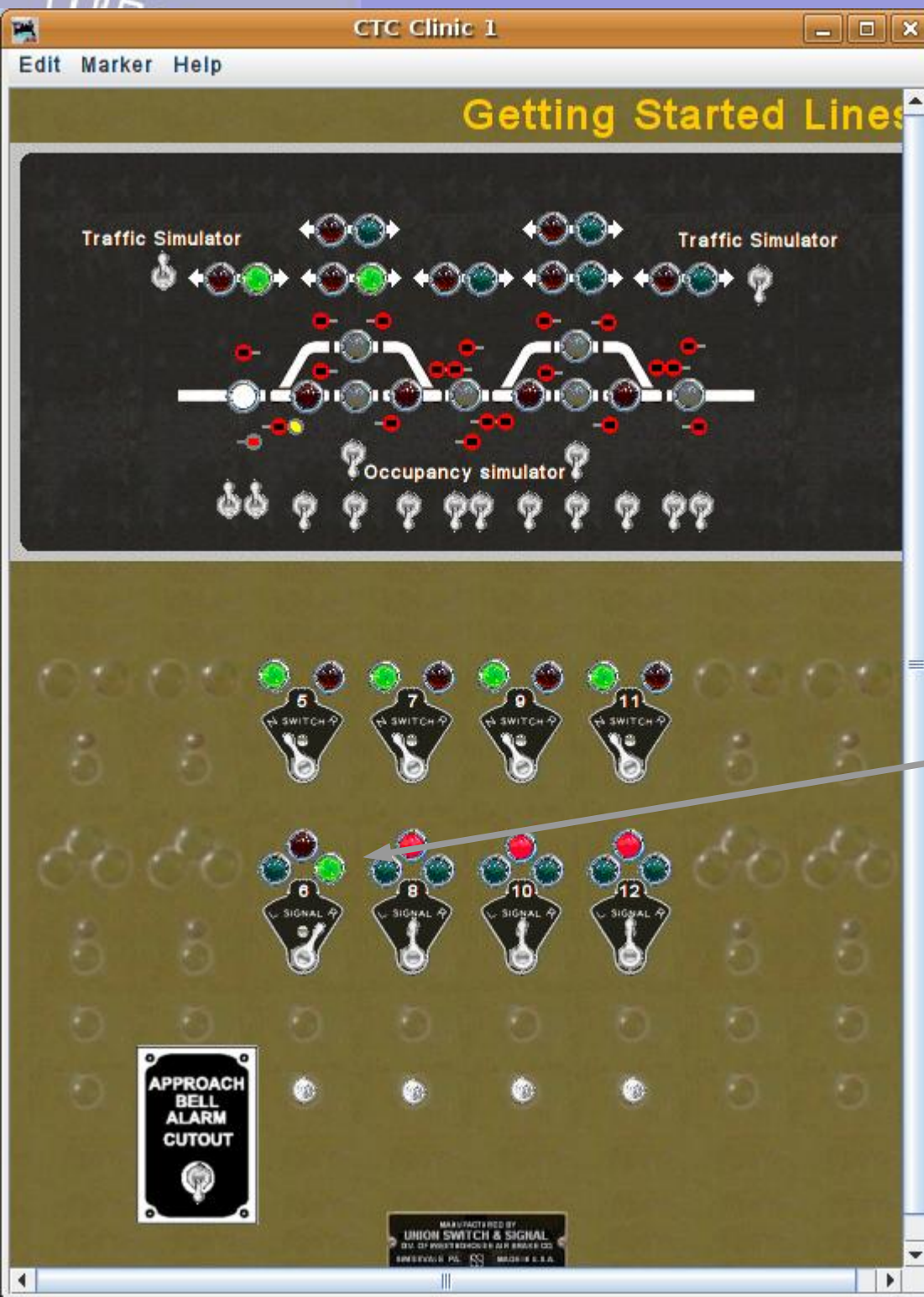
CTC

CTC operation

- The 'Signals Normal' light goes out, indicating that the operation is pending while the command is sent out to the signal plant.



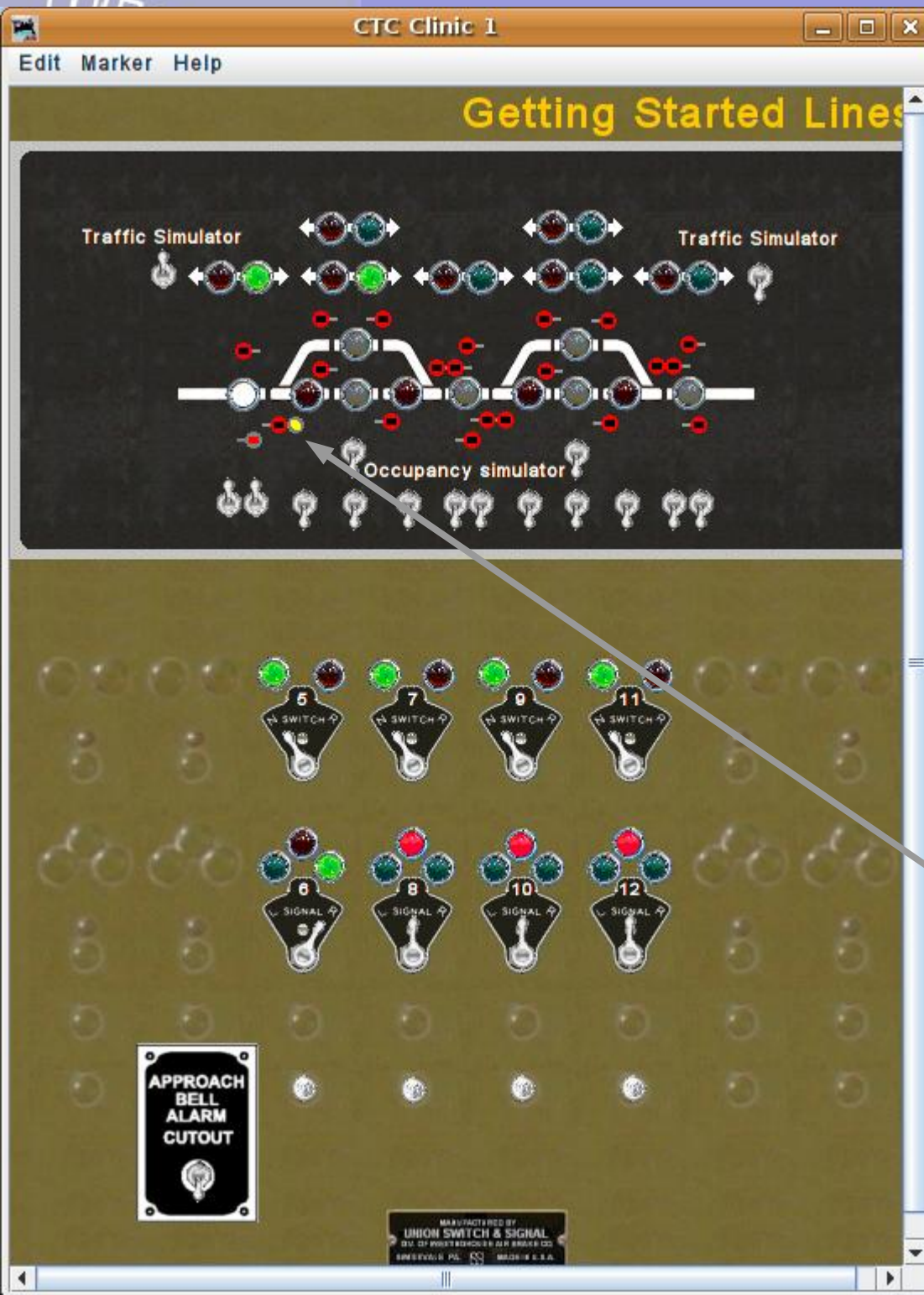
CTC



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- The 'Signals Normal' light goes out, indicating that the operation is pending while the command is sent out to the signal plant.
- Once the plant 'clears' the signal it acknowledges to the CTC machine and the 'R' clear lamp illuminates.

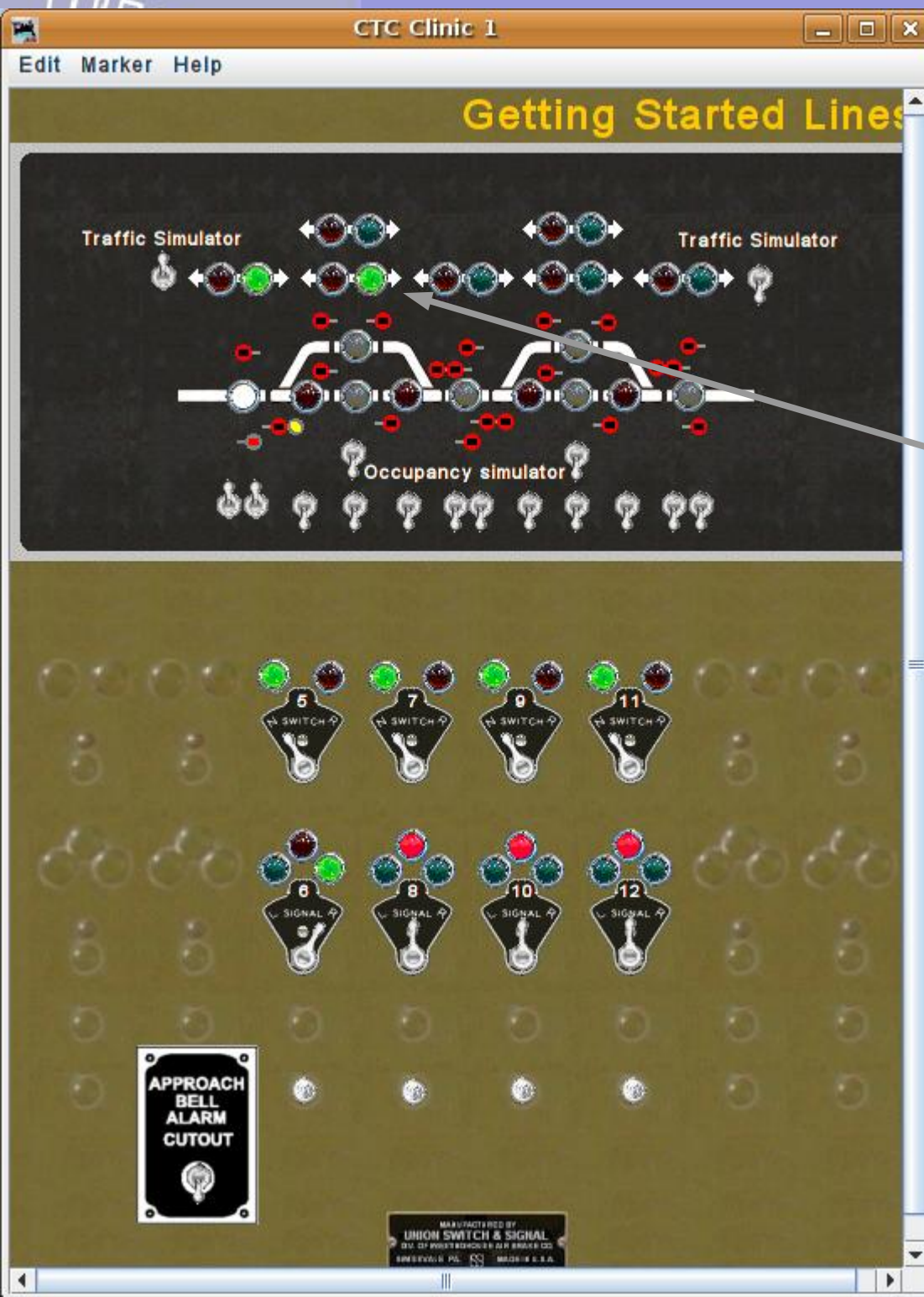
CTC



CTC operation

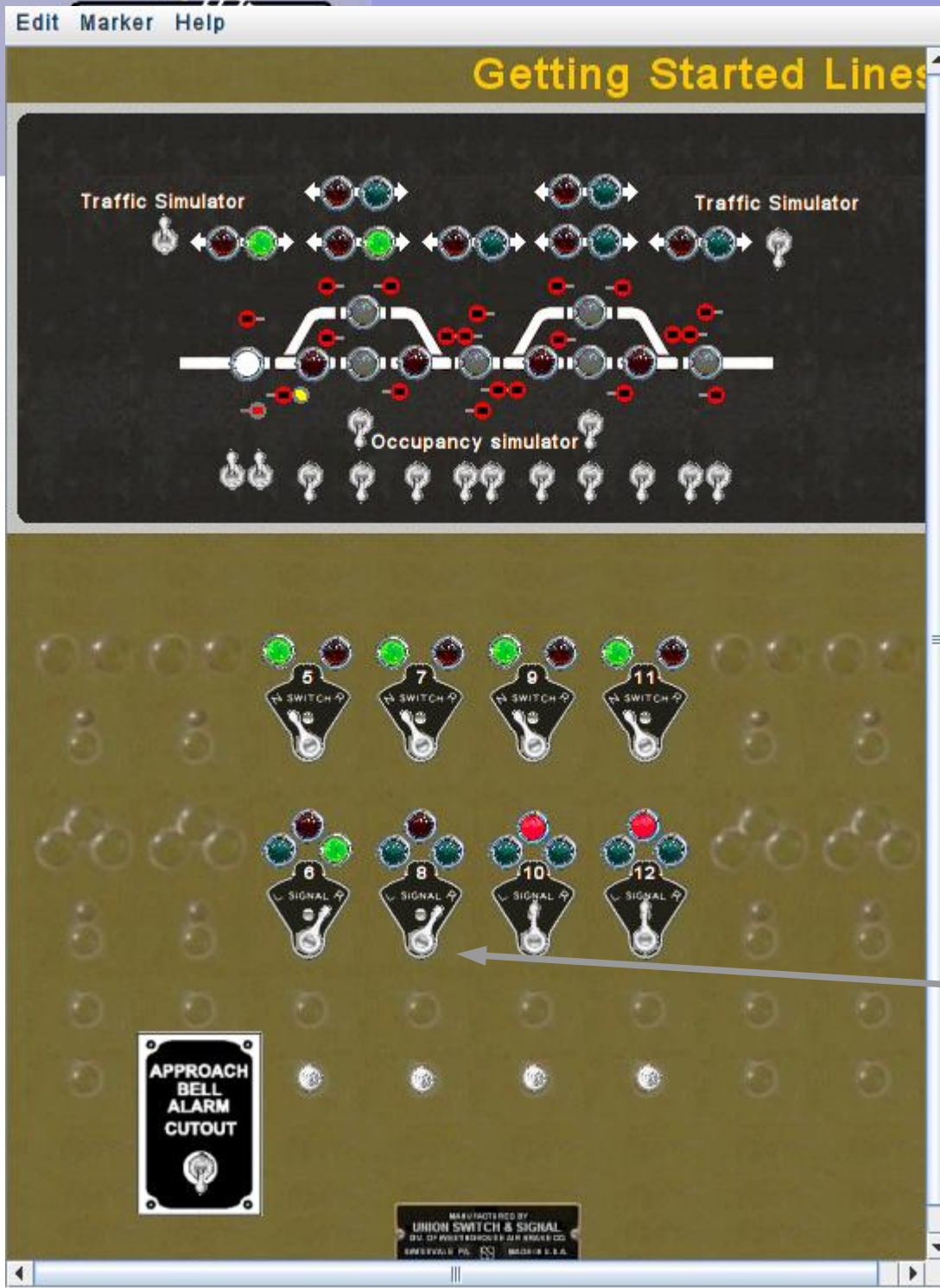
- The 'Signals Normal' light goes out, indicating that the operation is pending while the command is sent out to the signal plant.
- Once the plant 'clears' the signal it acknowledges to the CTC machine and the 'R' clear lamp illuminates.
- Note that the 'clear' in this case is actually an 'Approach', it just means the train is clear to go past the signal into the siding. (upper 'Y' signal indicates on the main)

CTC



CTC operation

- The Traffic Direction logic has also figured out that the main track has been reserved for righthand direction traffic. These lamps for the sidings are for clarification only, and do not normally appear on a prototype panel.



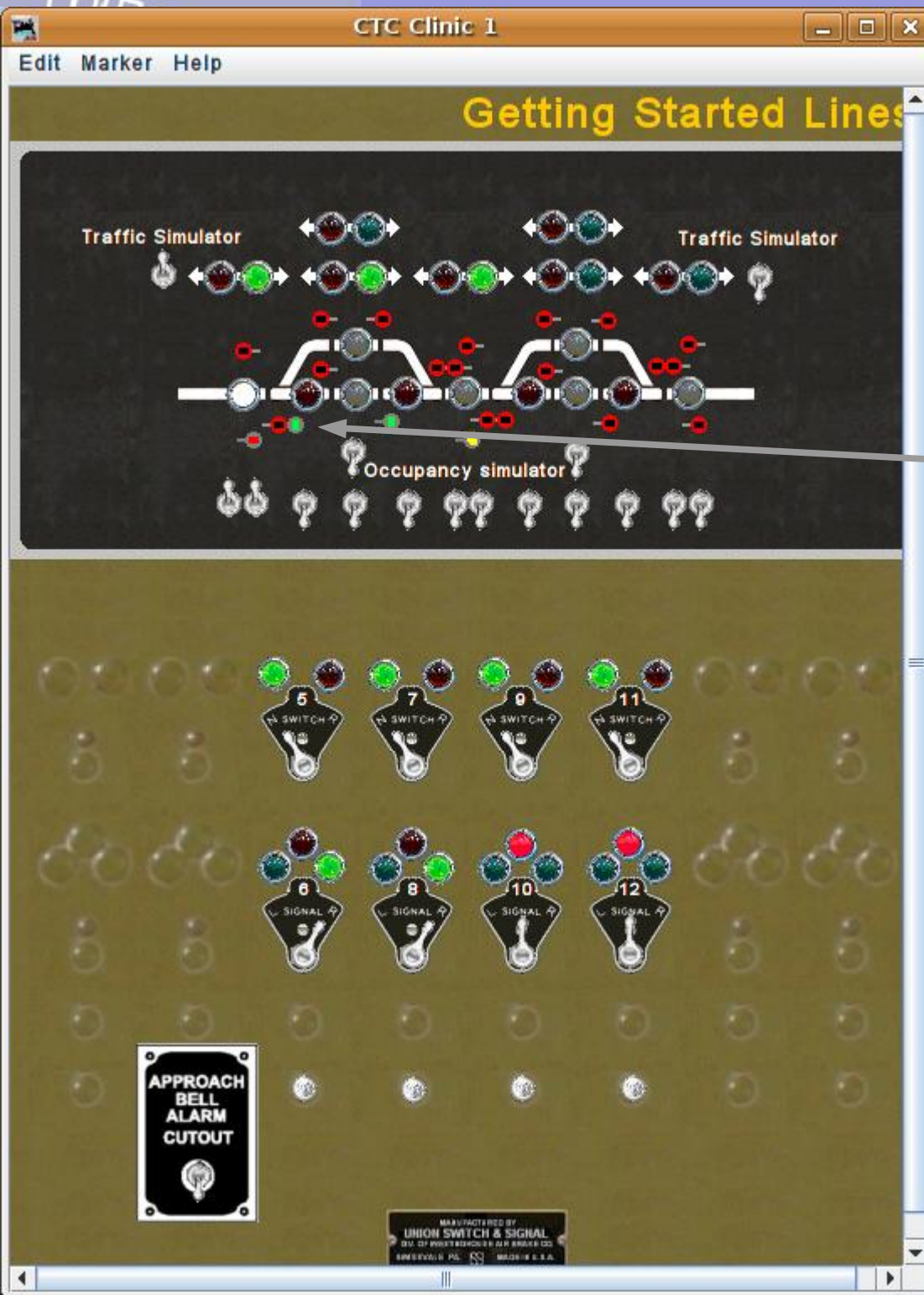
CTC operation

- The Traffic Direction logic has also figured out that the main track has been reserved for righthand direction traffic. These lamps for the sidings are for clarification only, and do not normally appear on a prototype panel.
- The train is getting closer, so the dispatcher clears the east end of his siding to let the train proceed into the next single track (also called intermediate) section without stopping.

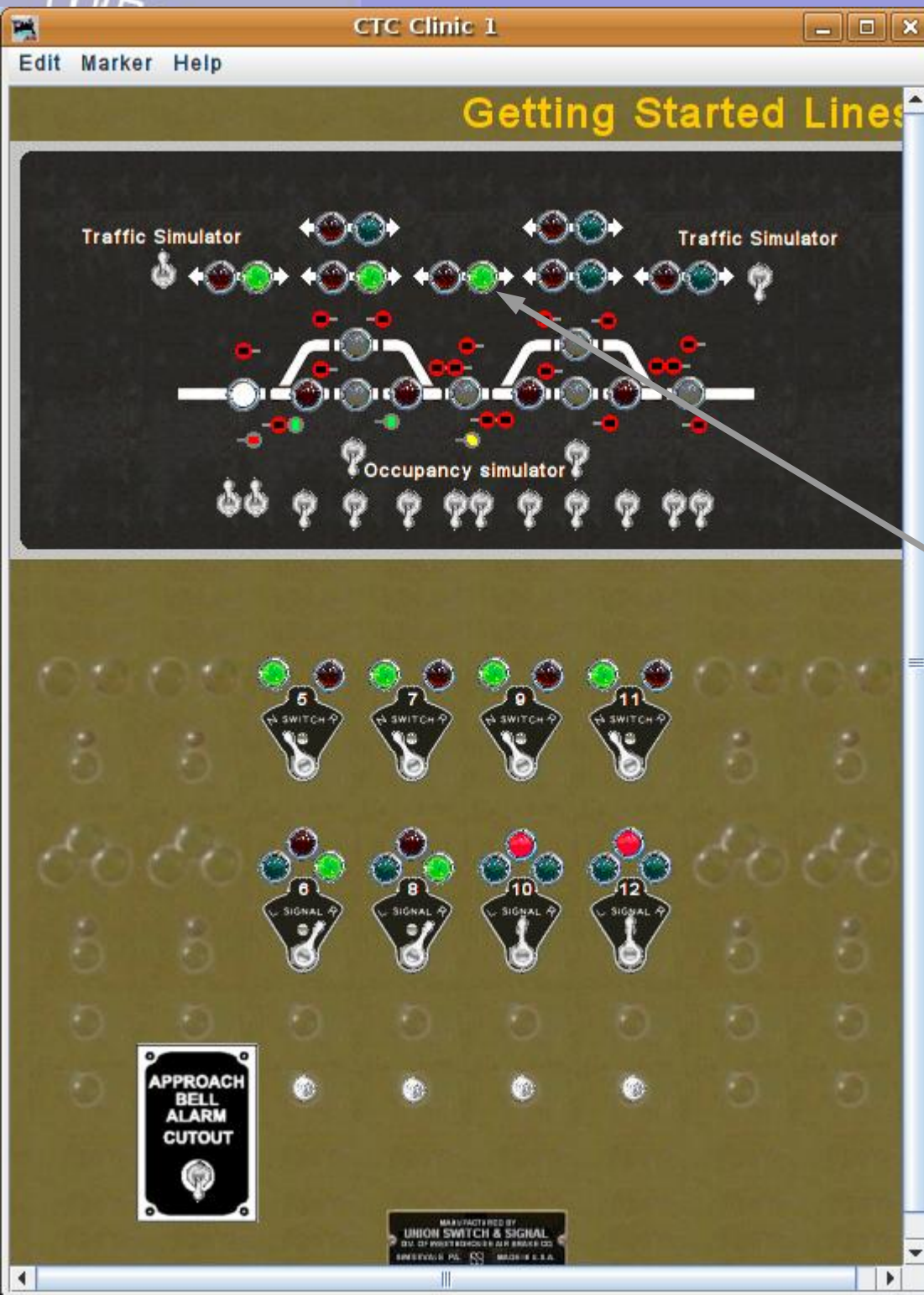
CTC

CTC operation

- The signals change to green, and the train is free to proceed to the end of the intermediate track.



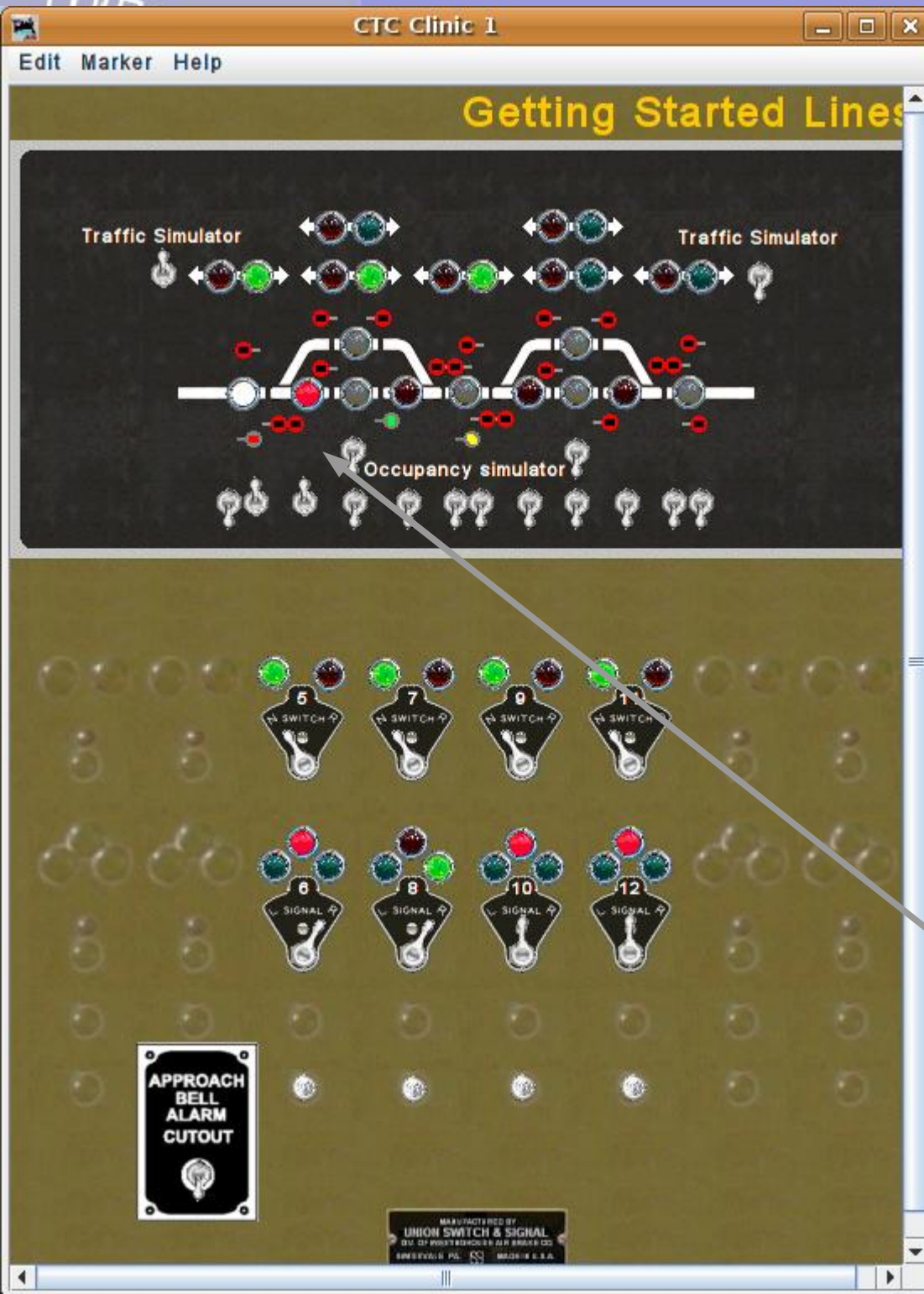
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- The signals change to green, and the train is free to proceed to the end of the intermediate track.
- The traffic direction lamp indicates the single track is reserved for eastbound. Many CTC panels did include the traffic direction indication for single track sections.

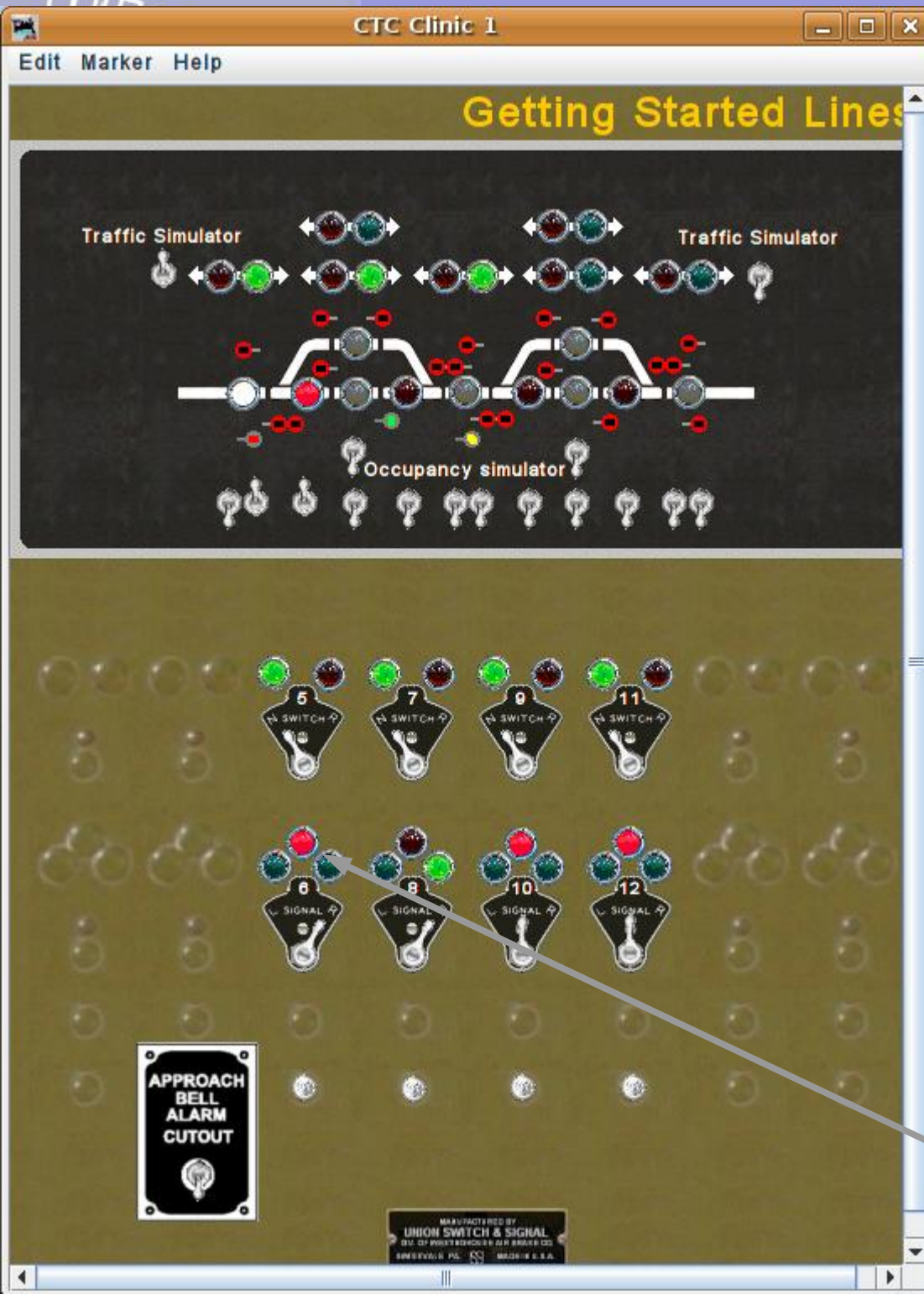
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- Our train finally arrives at the OS section. This rings the bell (unless it is cutoff) to alert the operator.

CTC



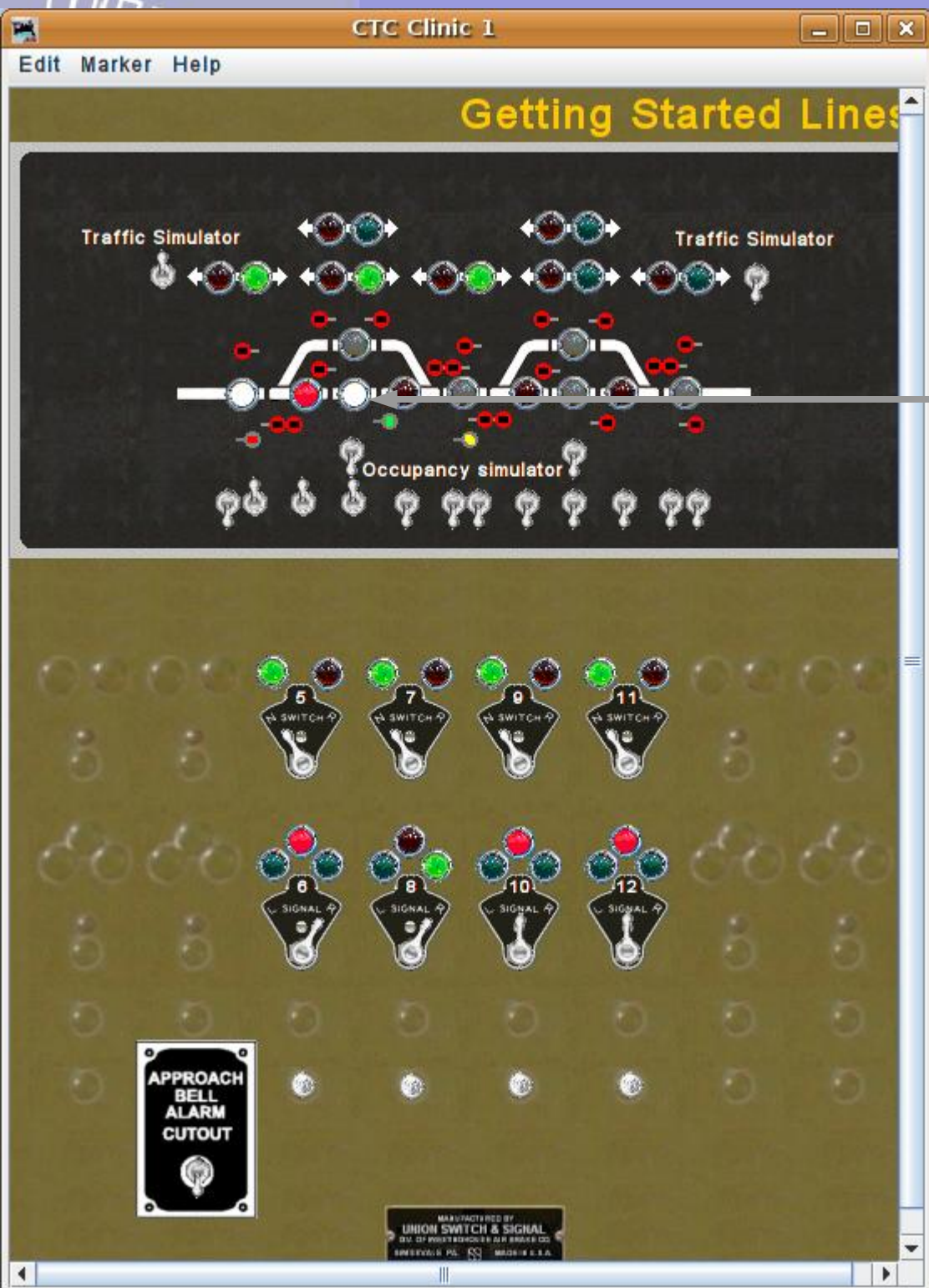
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- Signals revert to 'Normal'

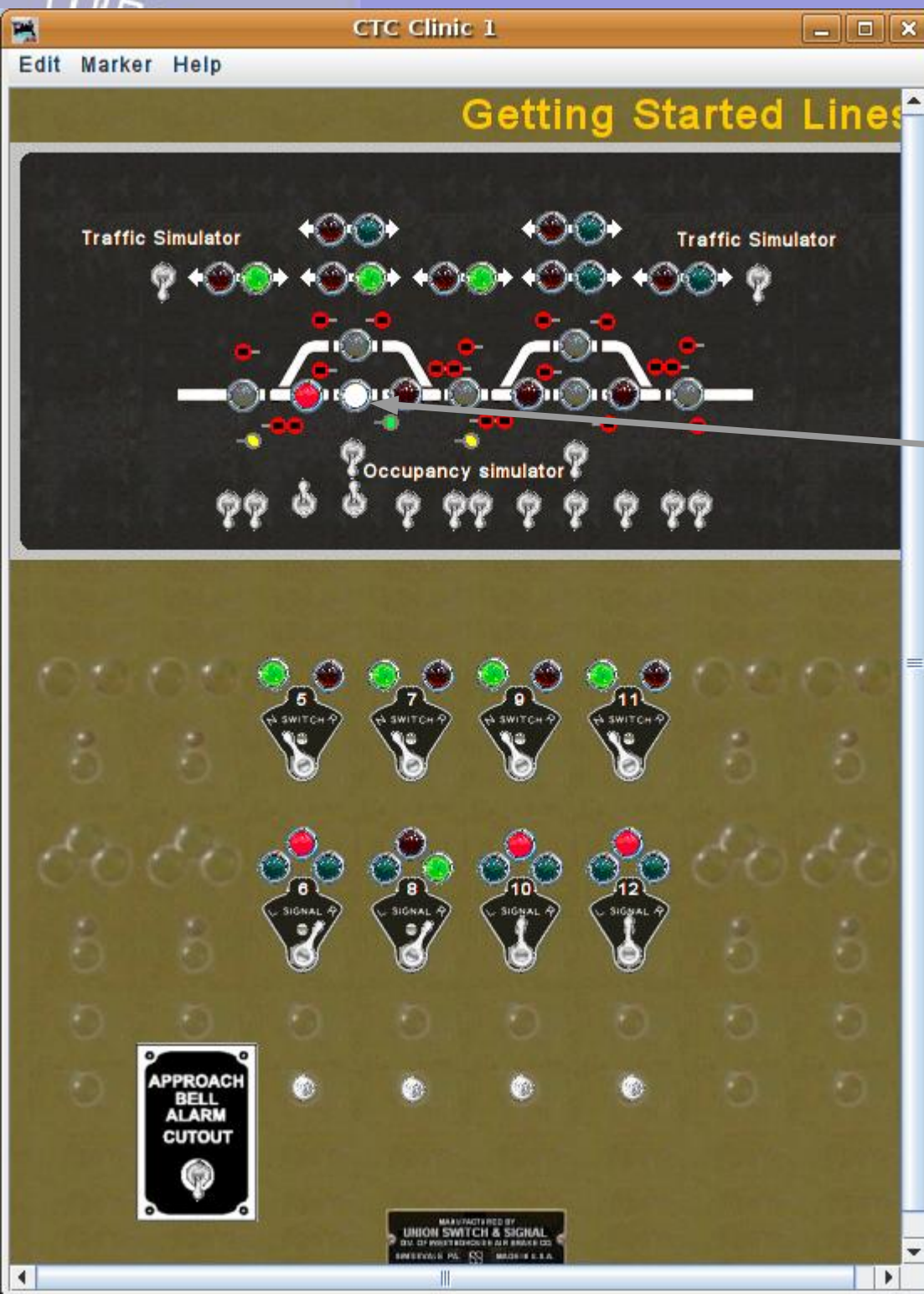
CTC

CTC operation

- The train moves on.



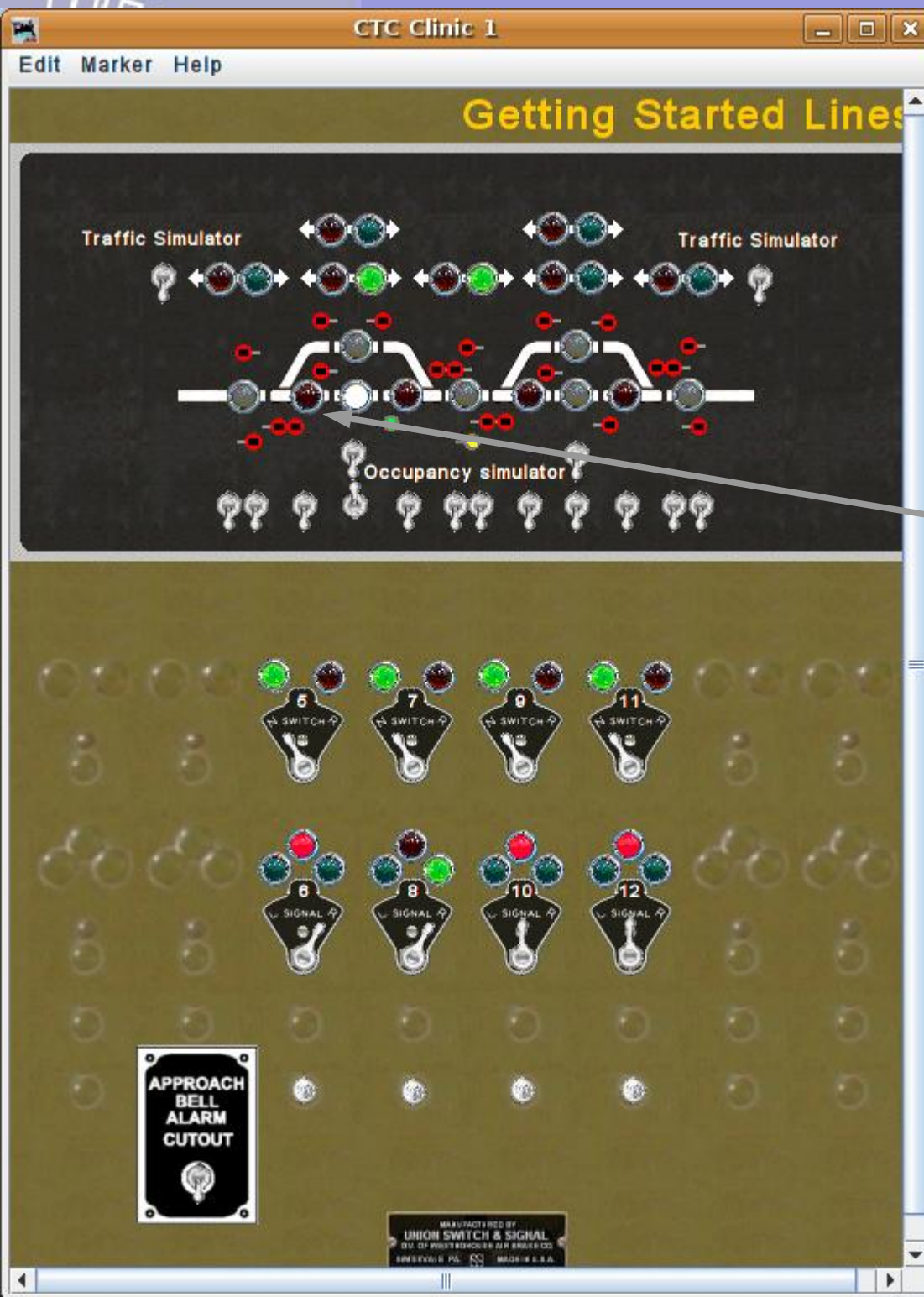
CTC



CTC operation

- The train moves on.
- And on.

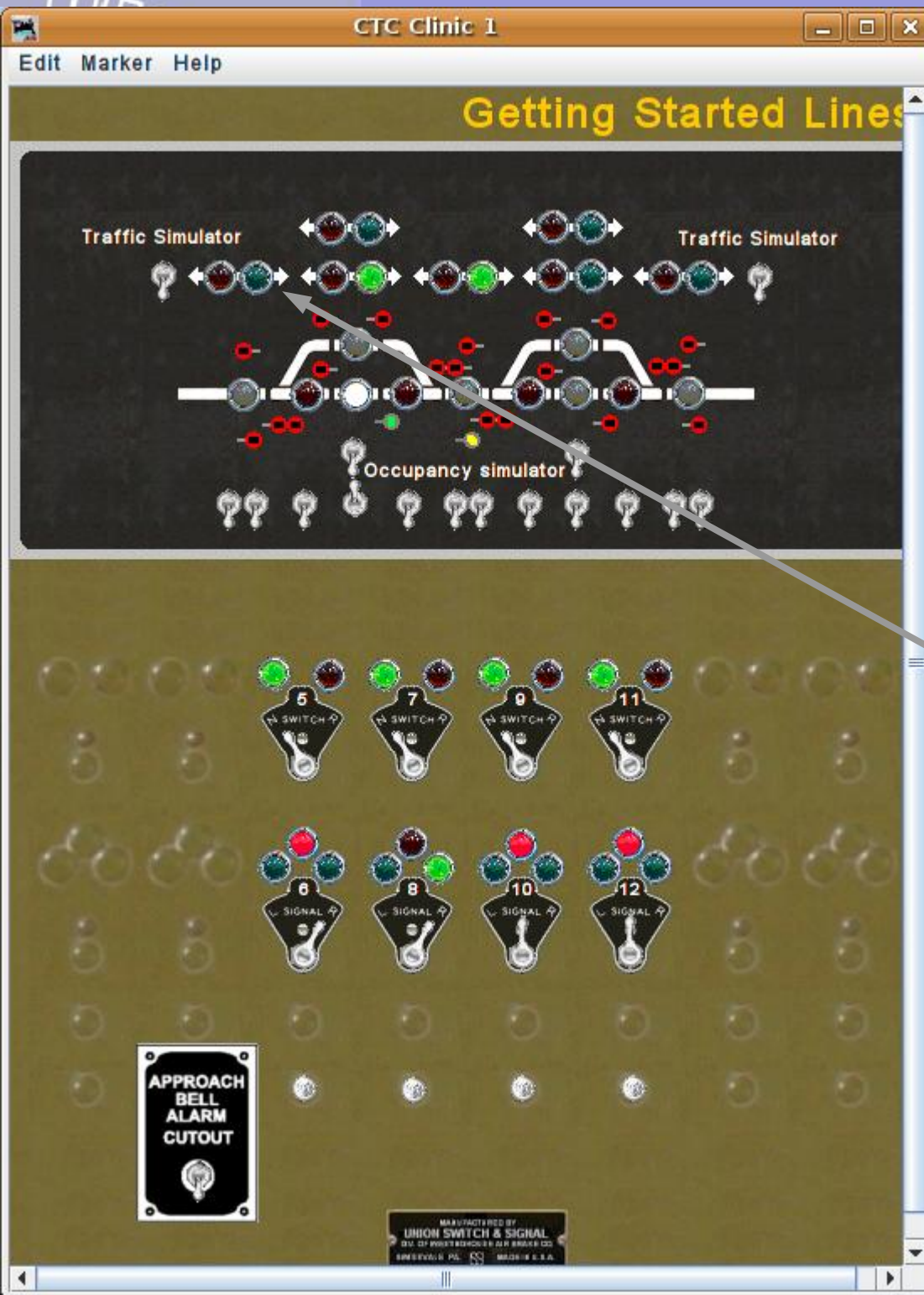
CTC



CTC operation

- The train moves on.
- And on.
- Finally clearing the OS.

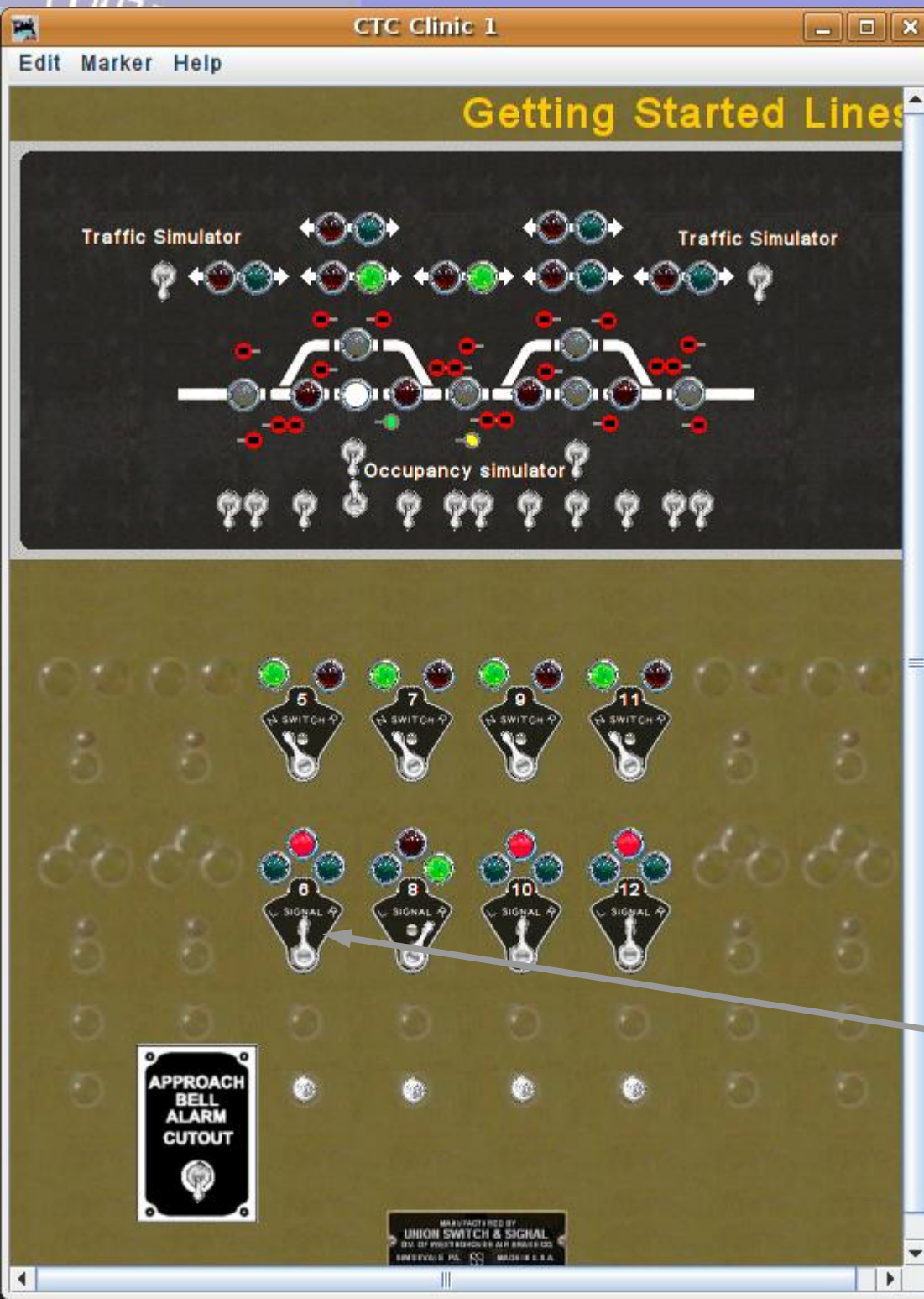
CTC



CTC operation

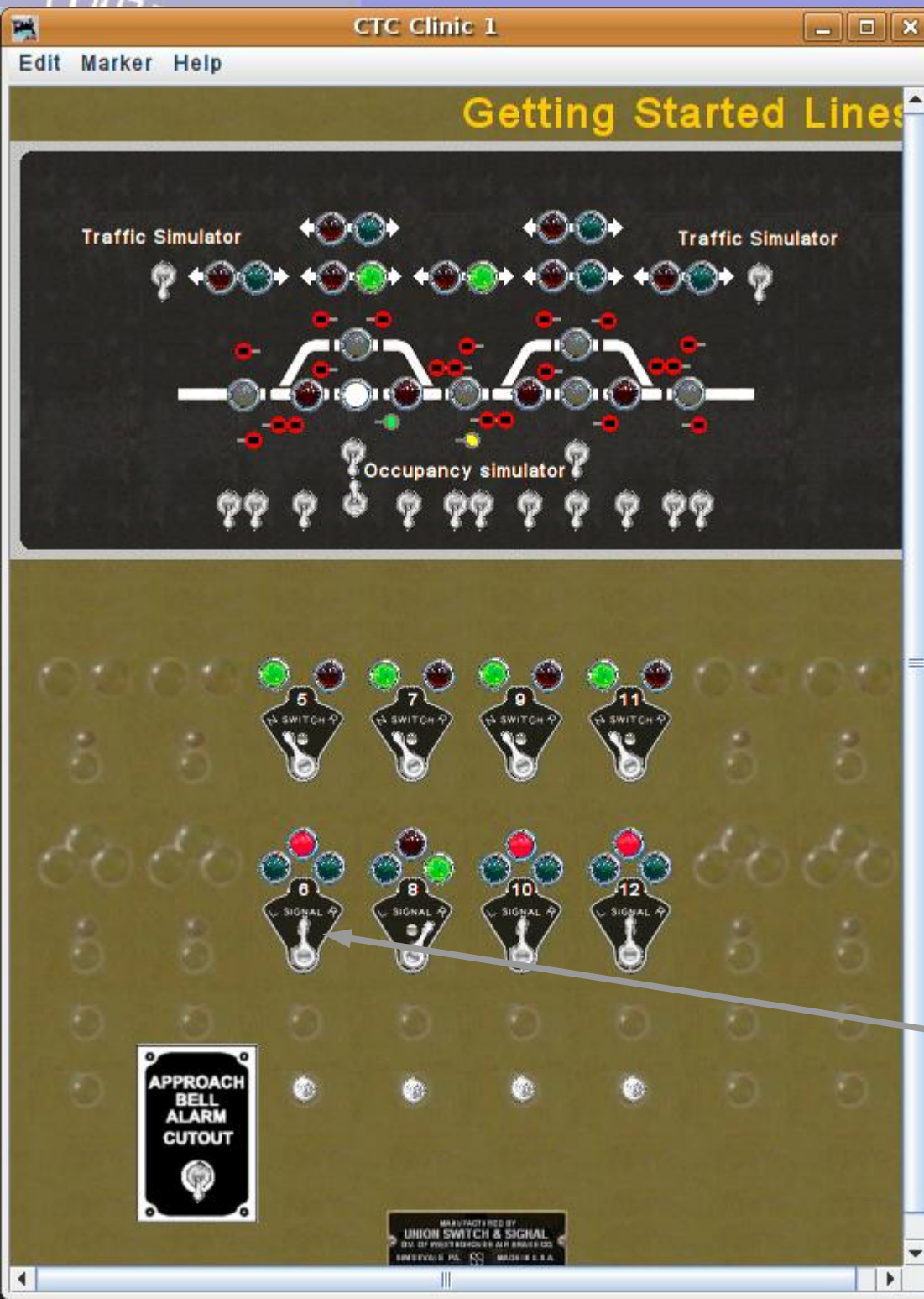
- The train moves on.
- And on.
- Finally clearing the OS.
- Note, the OS is considered part of the preceding block (in either direction) and the traffic direction does not release until the end of the train is past the OS.

CTC



CTC operation

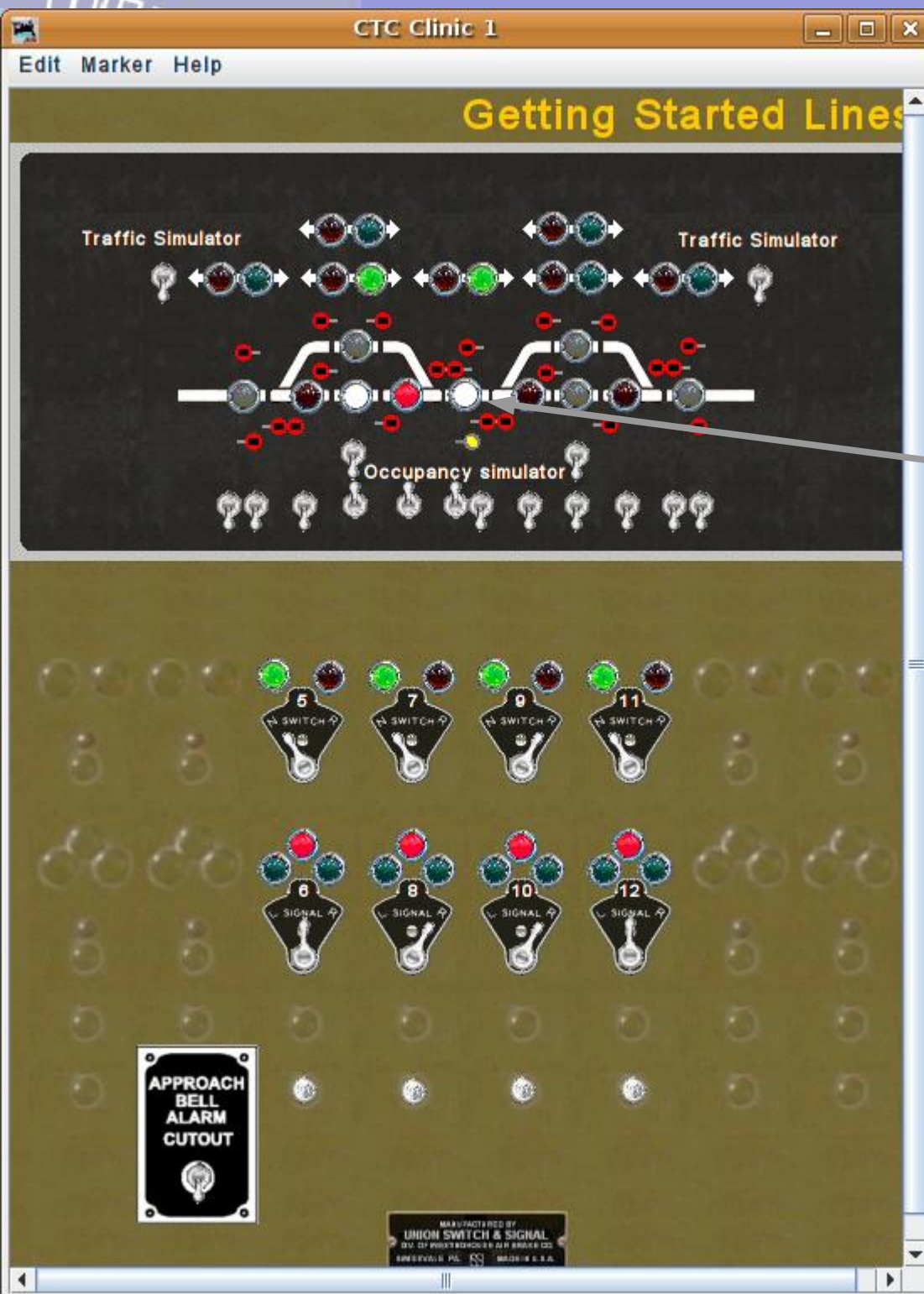
- The train moves on.
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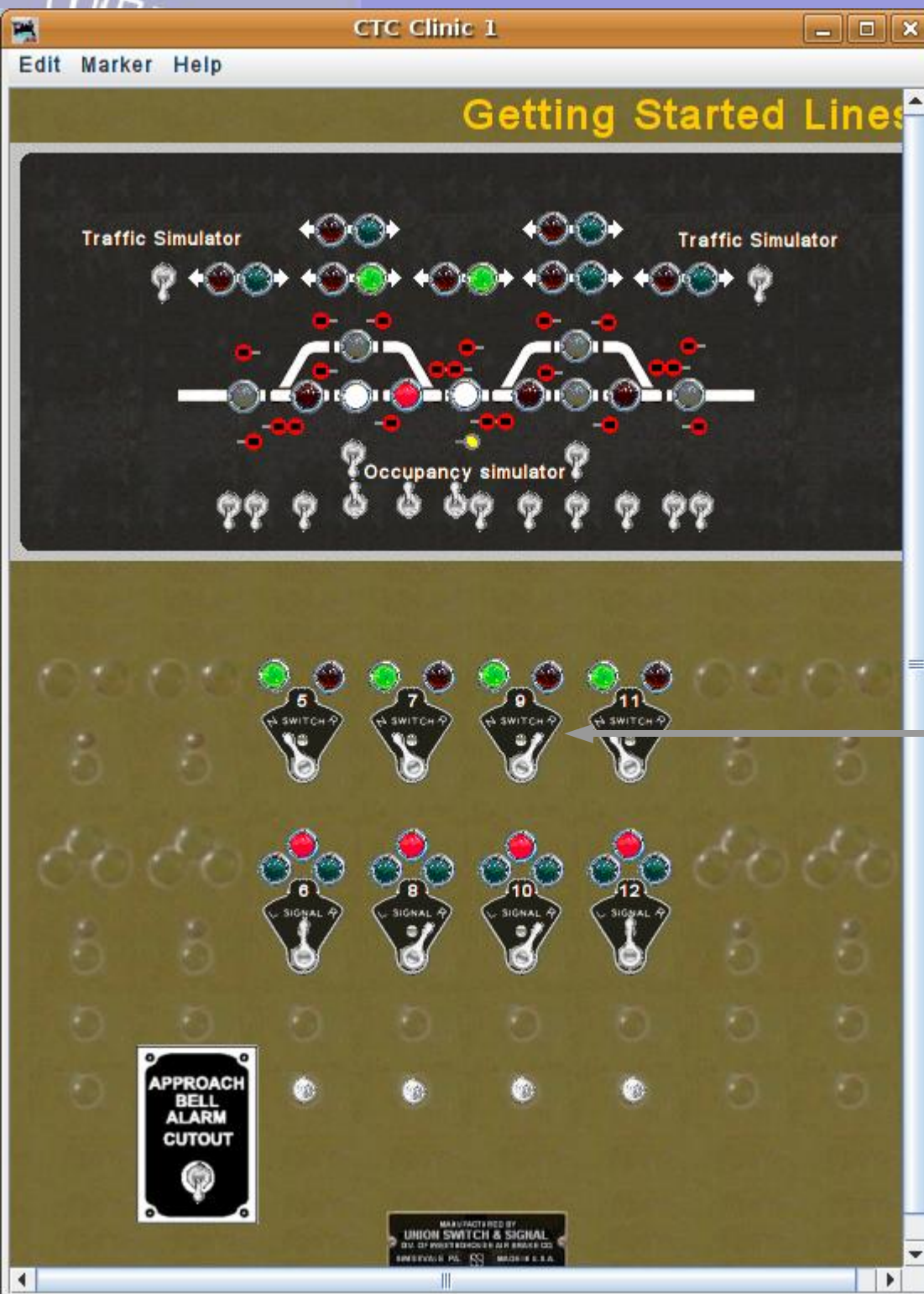
CTC



CTC operation

- Speaking of event driven, our train is on its way, and we need to setup a meet with a westbound.

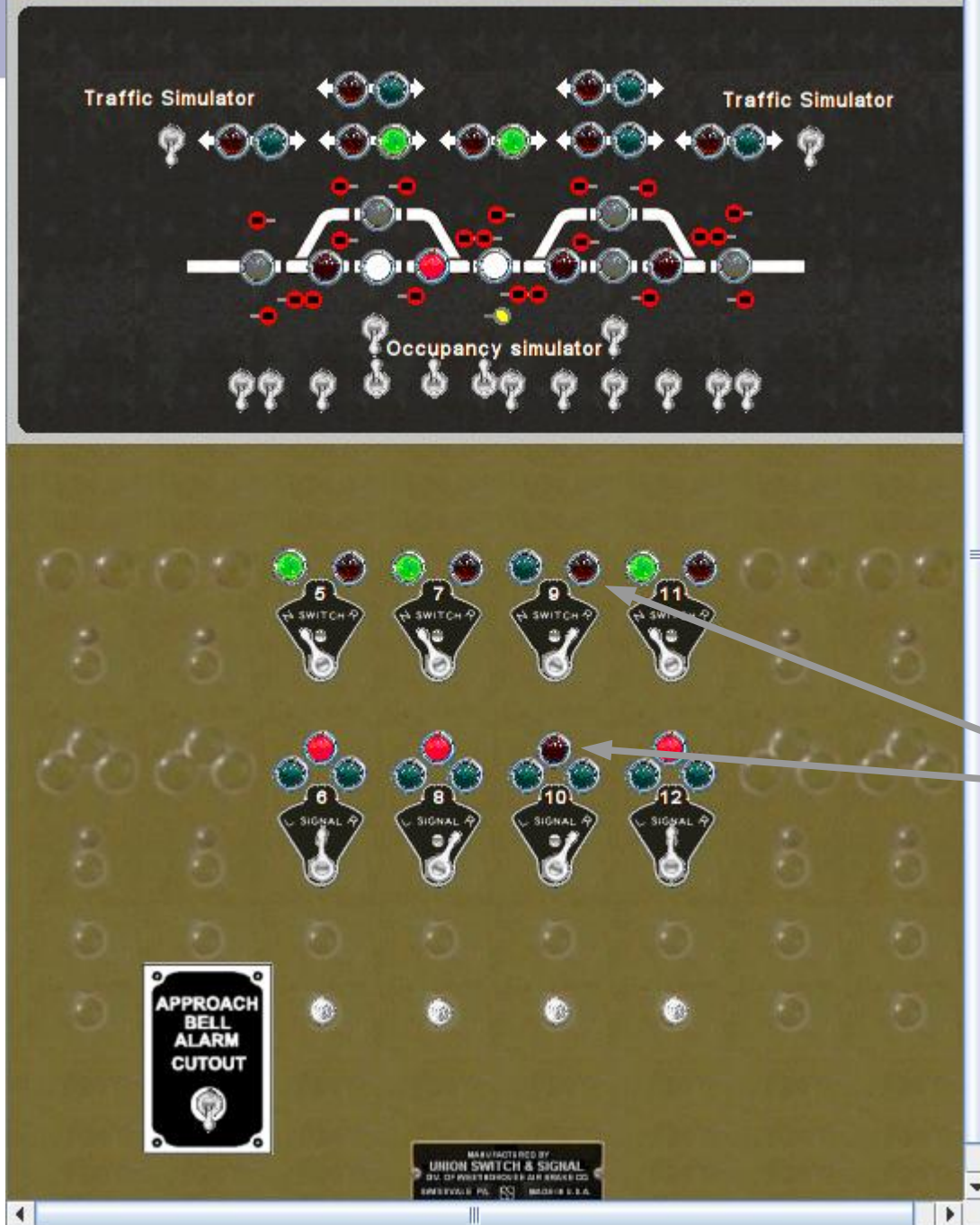
CTC



CTC operation

- Speaking of event driven, our train is on its way, and we need to setup a meet with a westbound.
- The westbound has priority, so we will send the eastbound into the hole to wait.

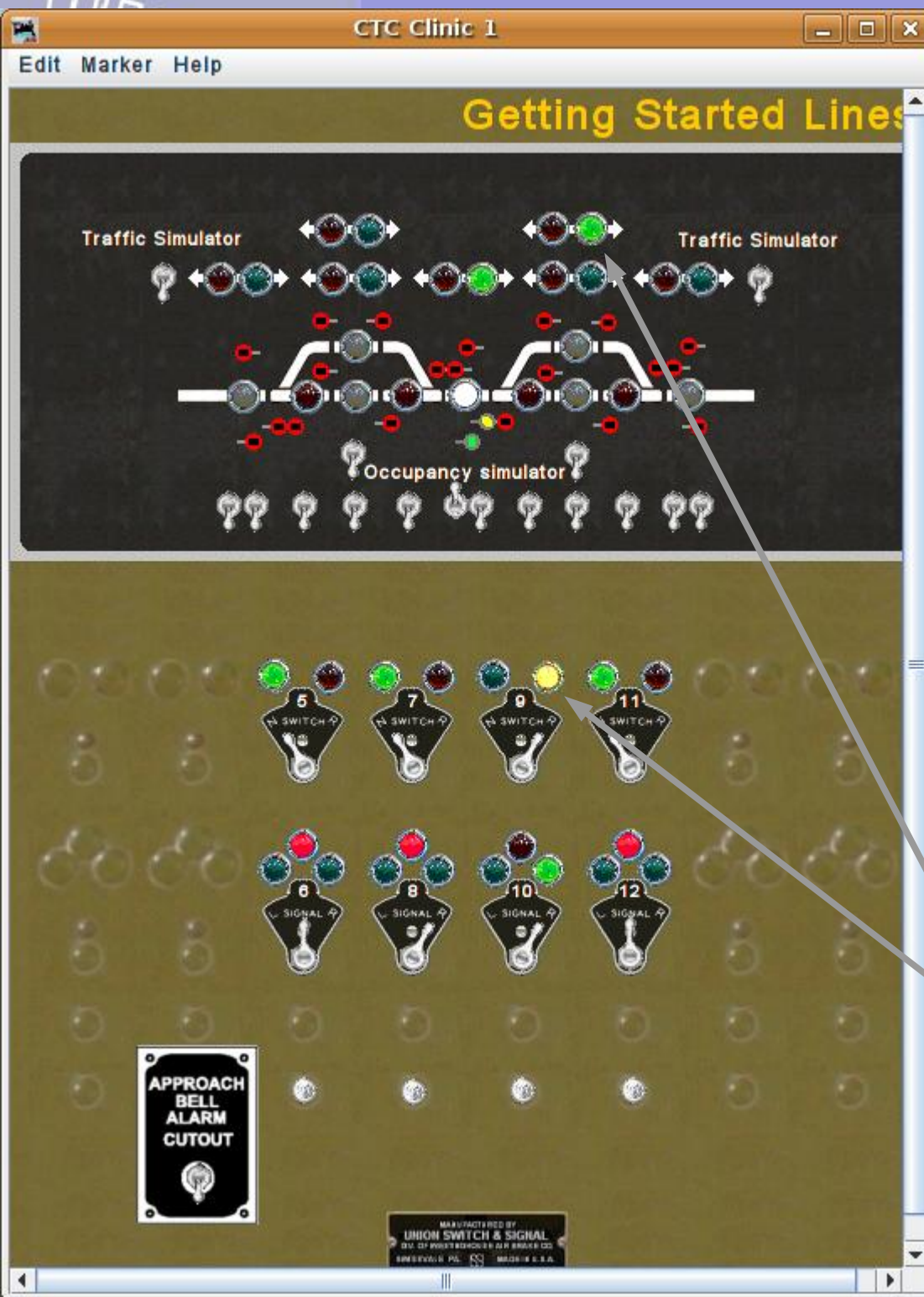
Getting Started Lines



CTC operation

- Speaking of event driven, our train is on its way, and we need to setup a meet with a westbound.
- The westbound has priority, so we will send the eastbound into the hole to wait.
- Both sets of indicators go dark until the plant replies with new status information.

CTC



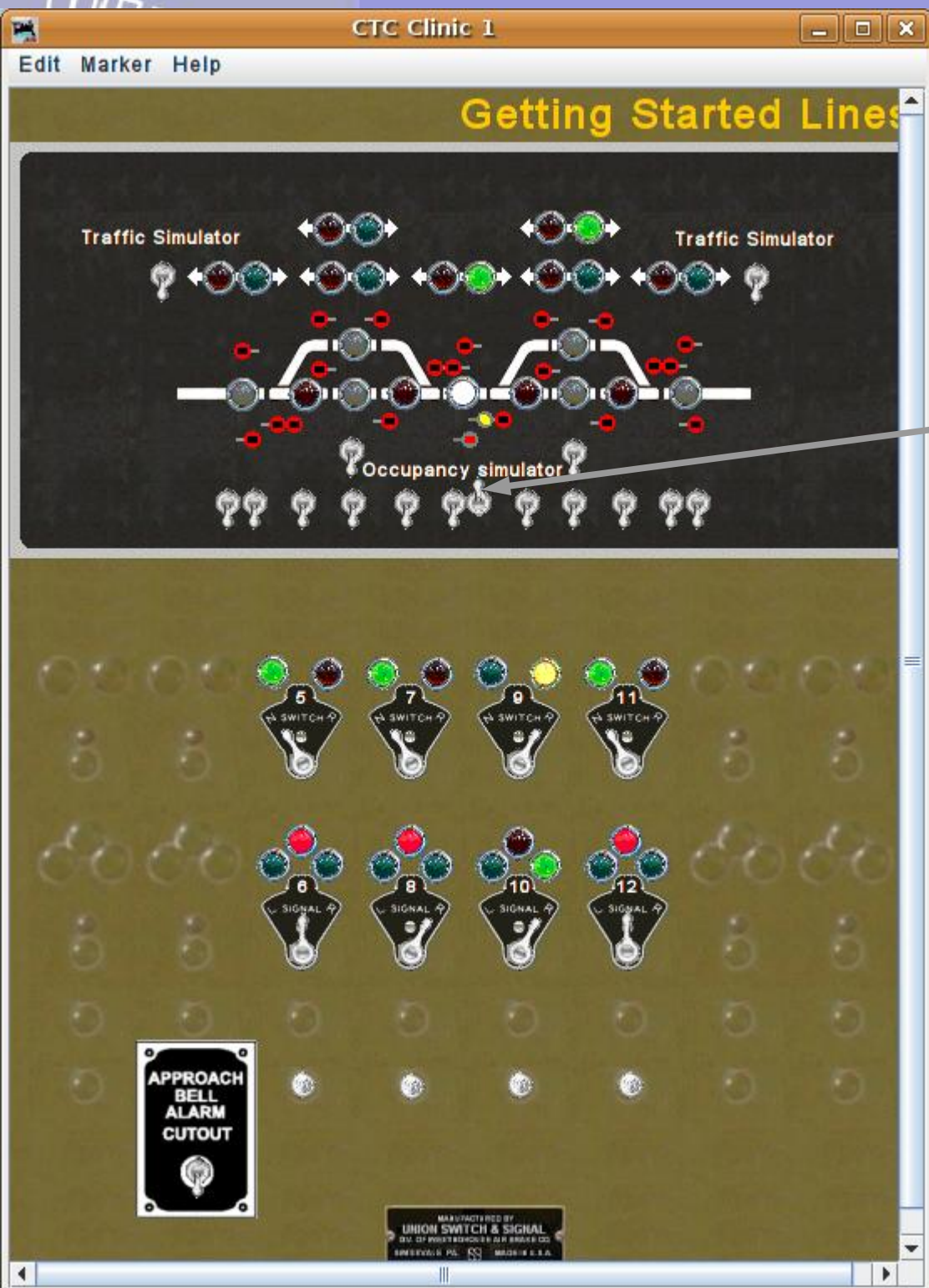
CTC operation

- Speaking of event driven, our train is on its way, and we need to setup a meet with a westbound.
- The westbound has priority, so we will send the eastbound into the hole to wait.
- Both sets of indicators go dark until the plant replies with new status information.
- The passing siding turnout is indicated and the siding is reserved for eastbound traffic.

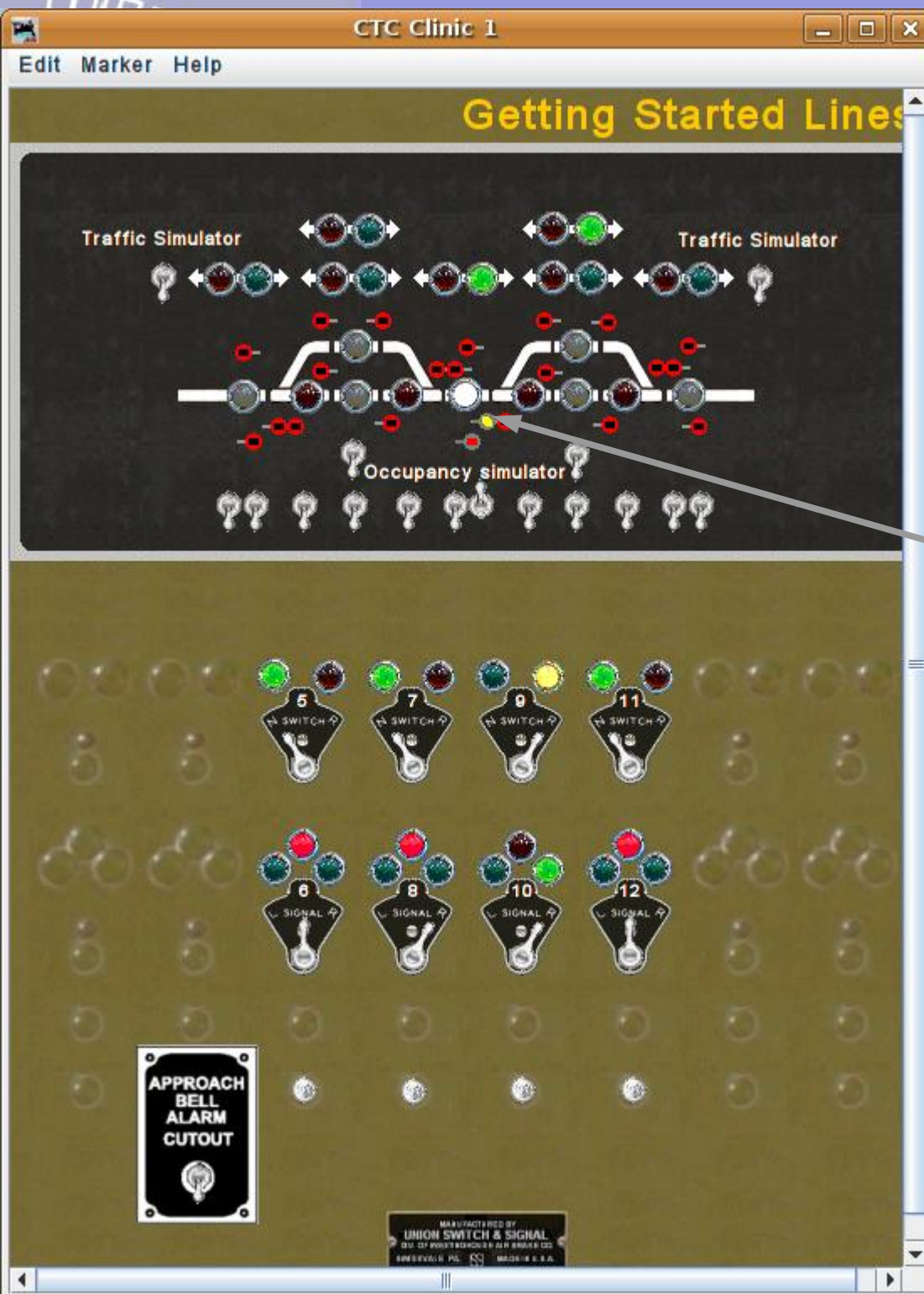
CTC

CTC operation

- All in fine time to not stop the progressing train.



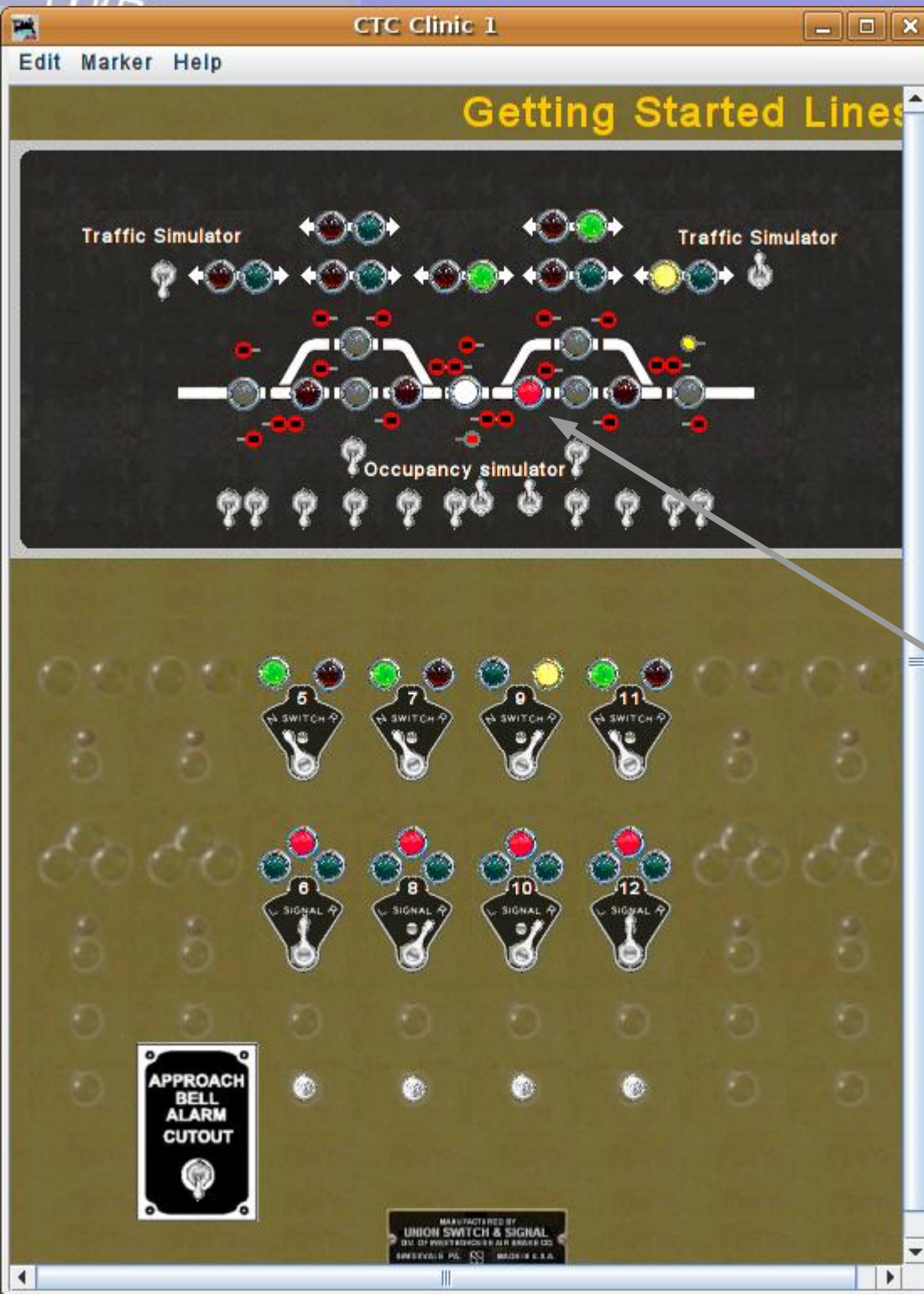
CTC



CTC operation

- All in fine time to not stop the progressing train.
- The lower head 'Y' signal indicated that this train needs to enter the siding.

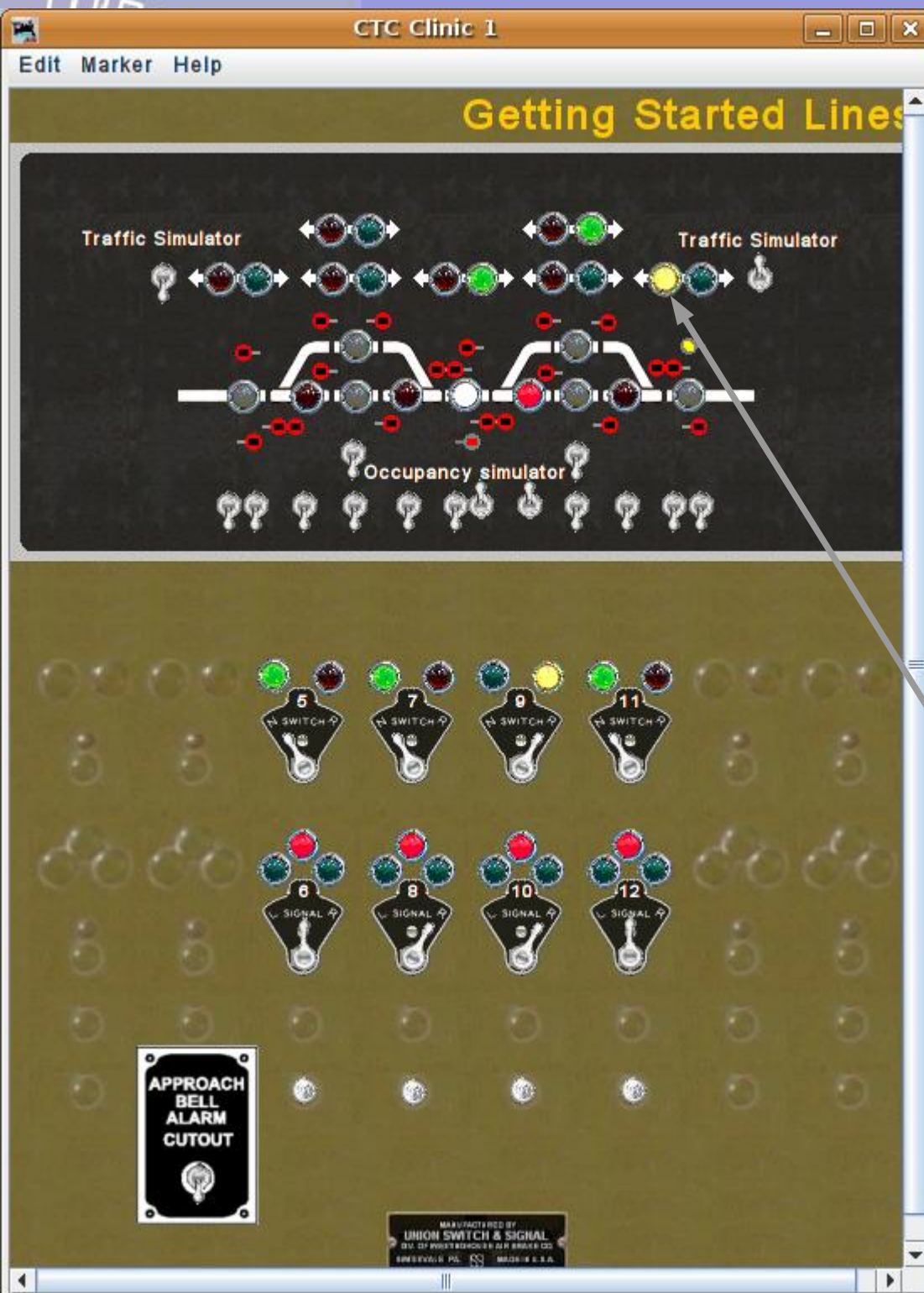
CTC



CTC operation

- All in fine time to not stop the progressing train.
- The lower head 'Y' signal indicated that this train needs to enter the siding.
- The bell rings to alert the operator that this train has reached the OS.

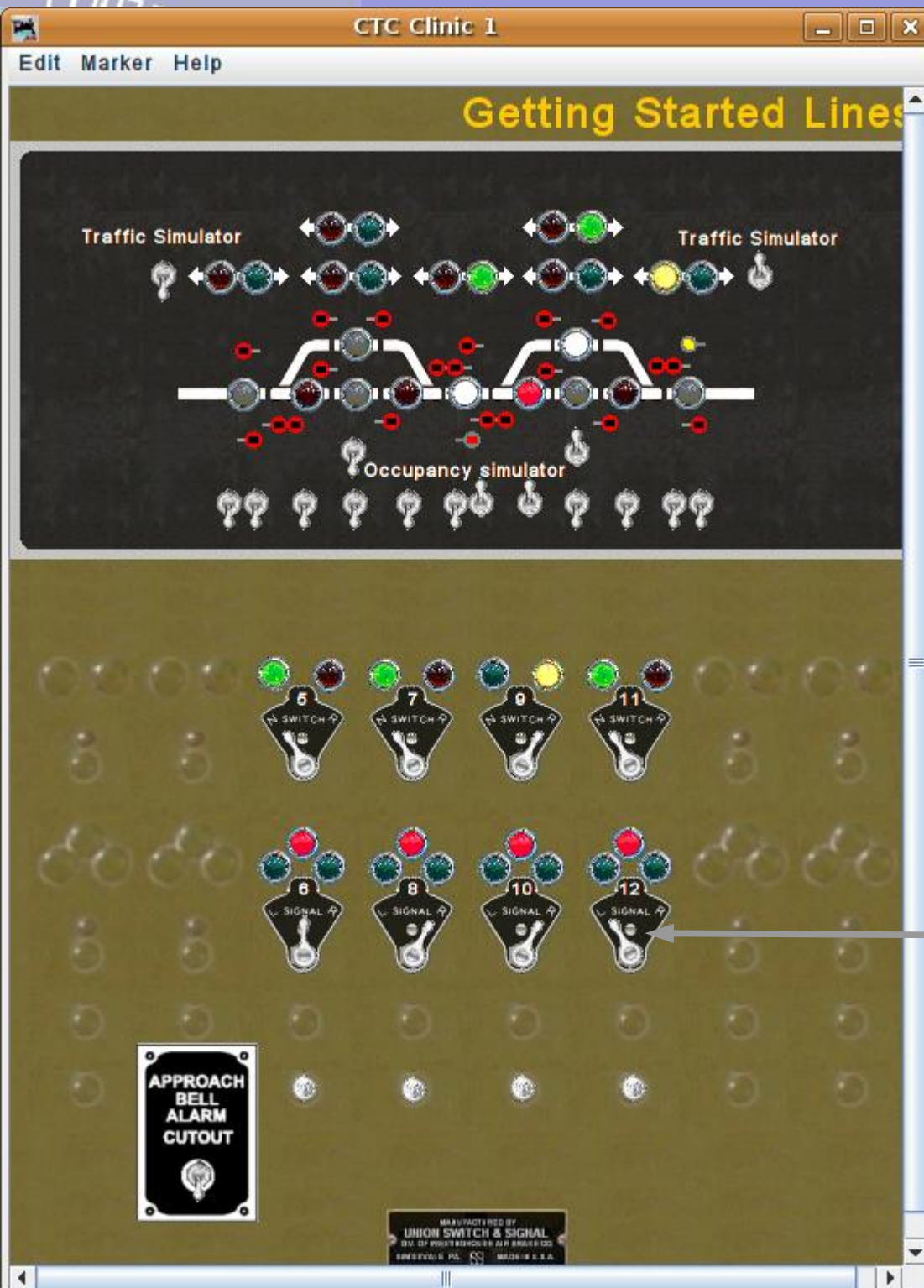
CTC



CTC operation

- All in fine time to not stop the progressing train.
- The lower head 'Y' signal indicated that this train needs to enter the siding.
- The bell rings to alert the operator that this train has reached the OS.
- None too soon, as we note that the westbound traffic direction indicator has just come on.

CTC



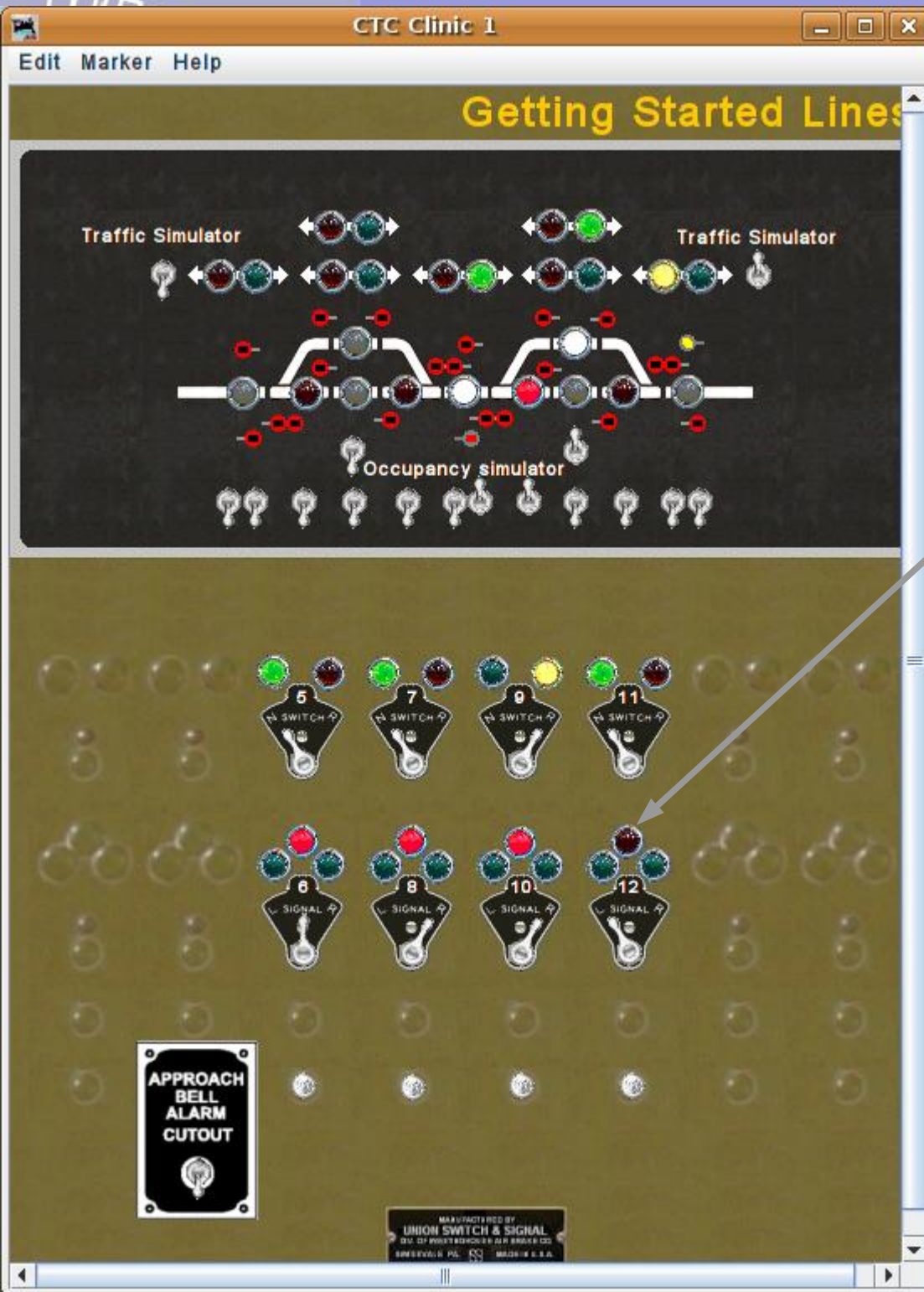
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- The lower head 'Y' signal indicated that this train needs to enter the siding.
- The bell rings to alert the operator that this train has reached the OS.
- None too soon, as we note that the westbound traffic direction indicator has just come on.
- Time to set plant 12 to left to accept the westbound train.

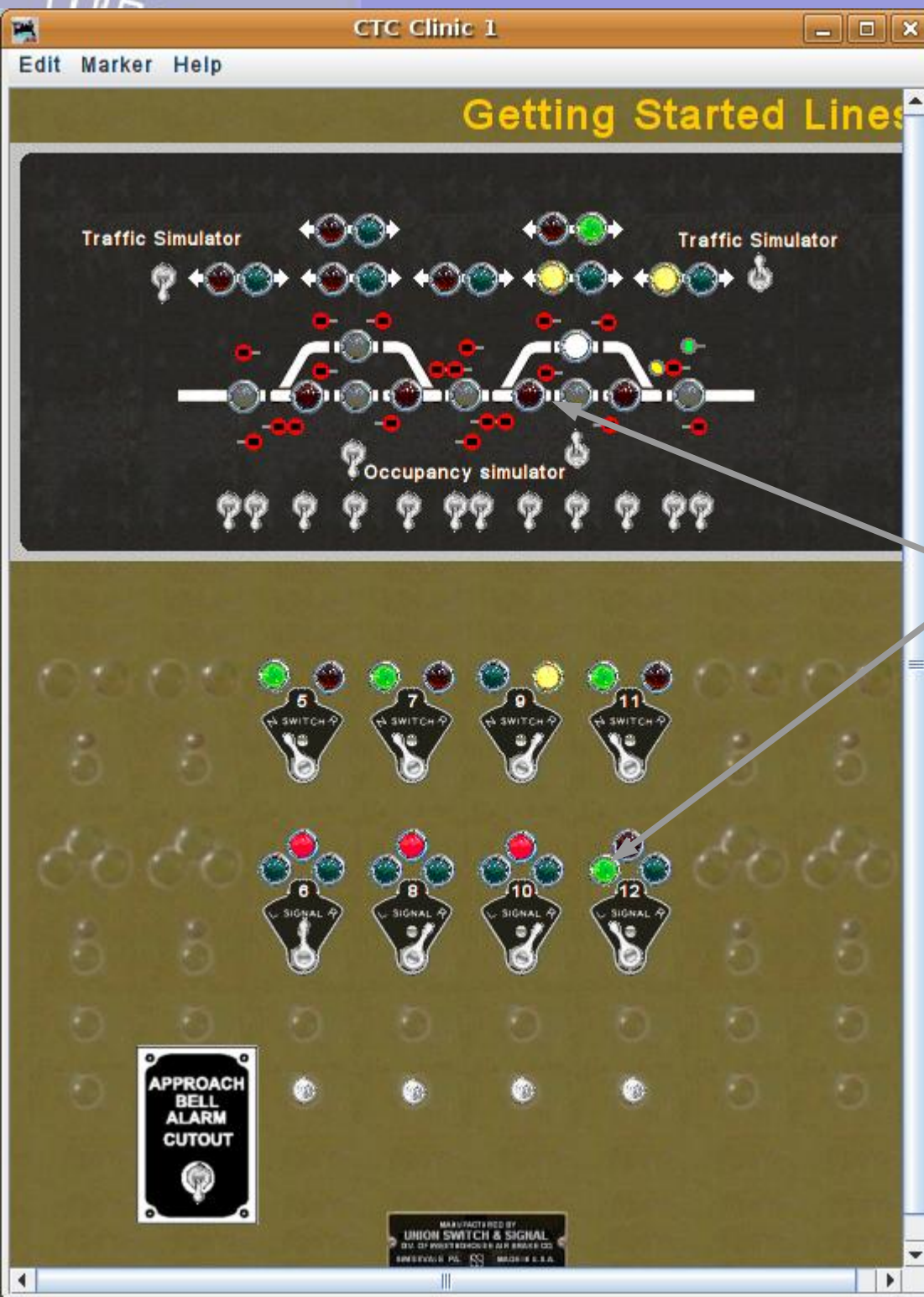
CTC

CTC operation

- 'Signal Normal' goes out.



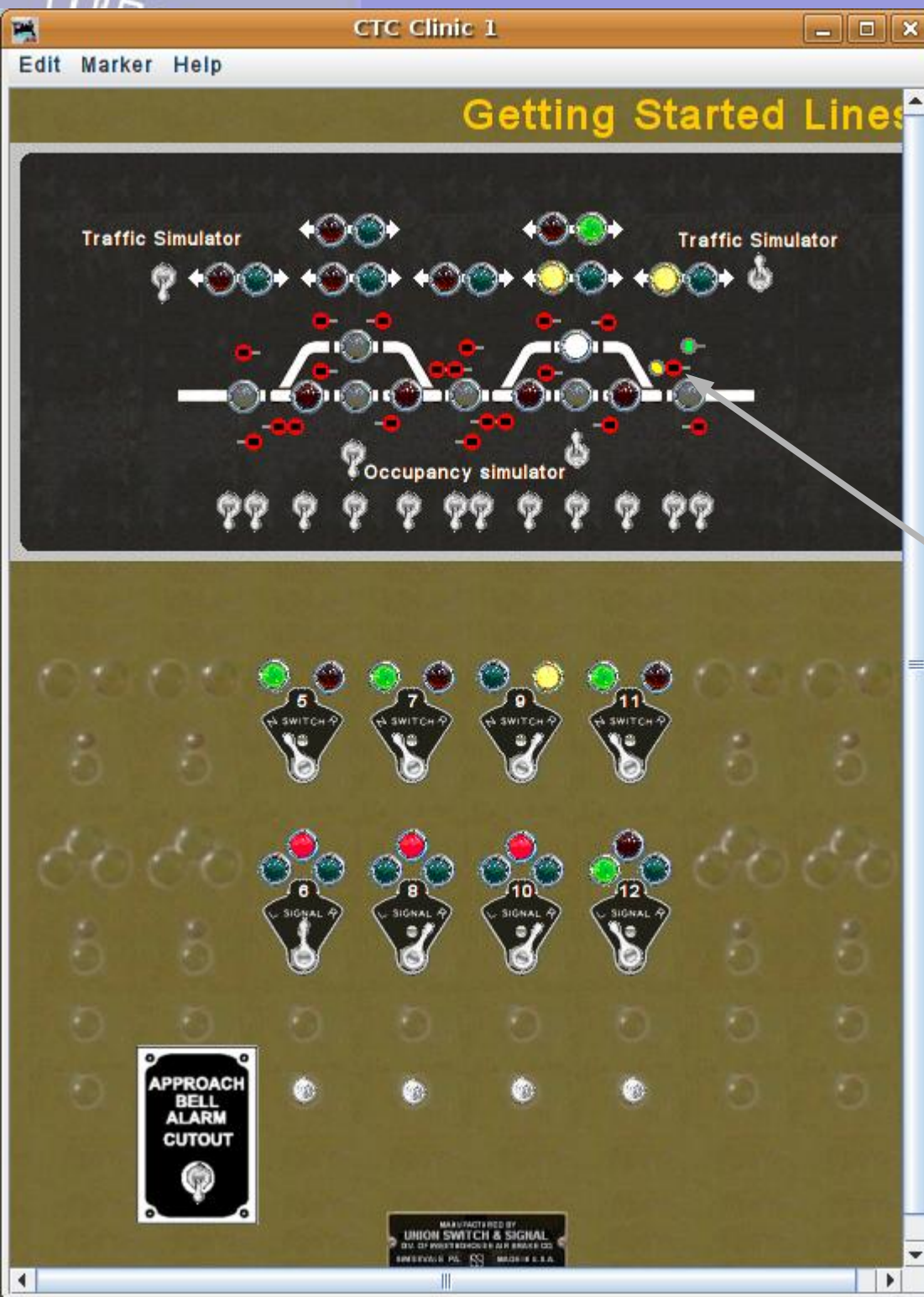
CTC



CTC operation

- 'Signal Normal' goes out.
- But the westbound signal does not actually clear until the opposite OS has cleared.

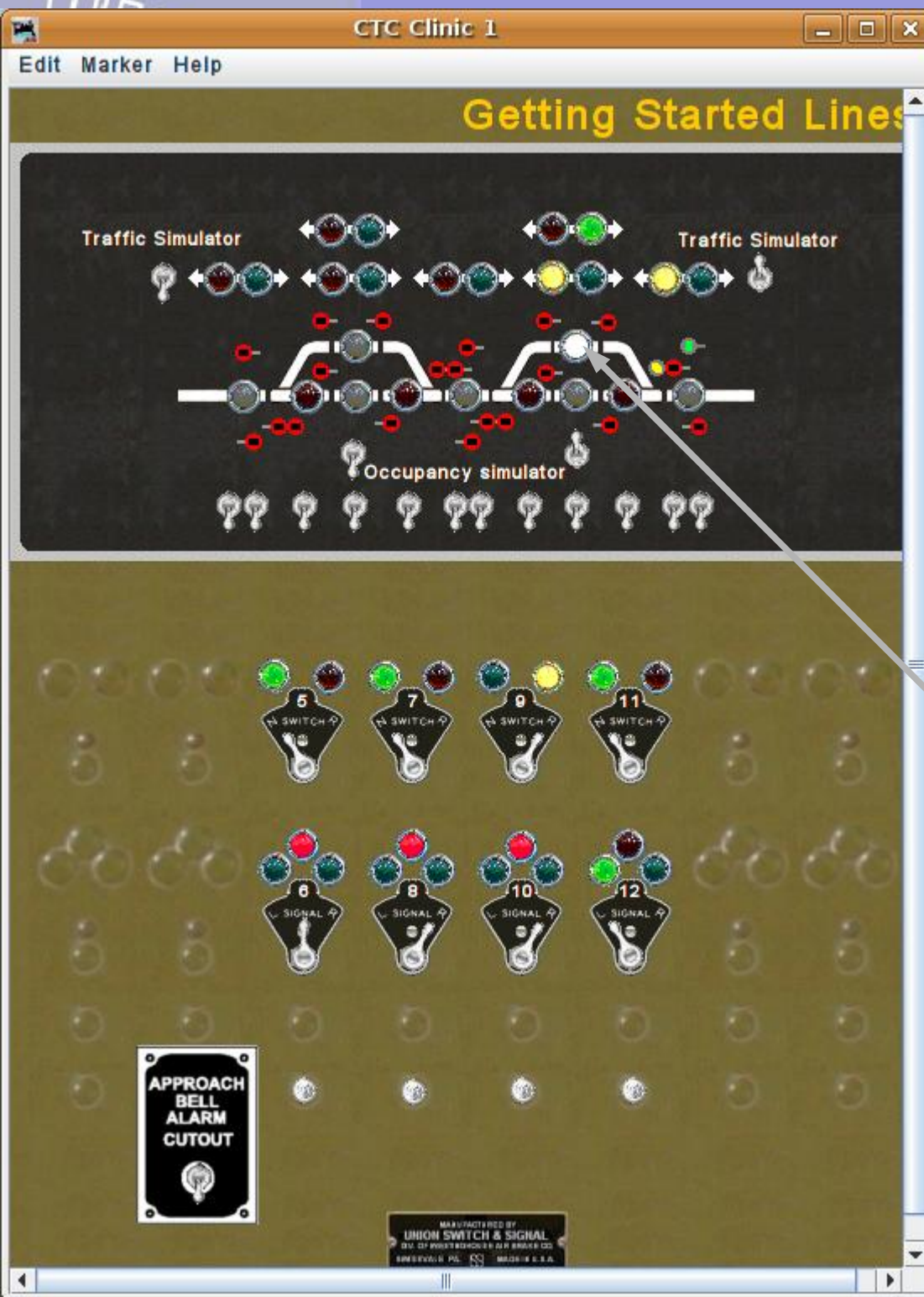
CTC



CTC operation

- 'Signal Normal' goes out.
- But the westbound signal does not clear until the opposite OS has cleared.
- **This is an error in my Logix.** Maybe we can locate it later.

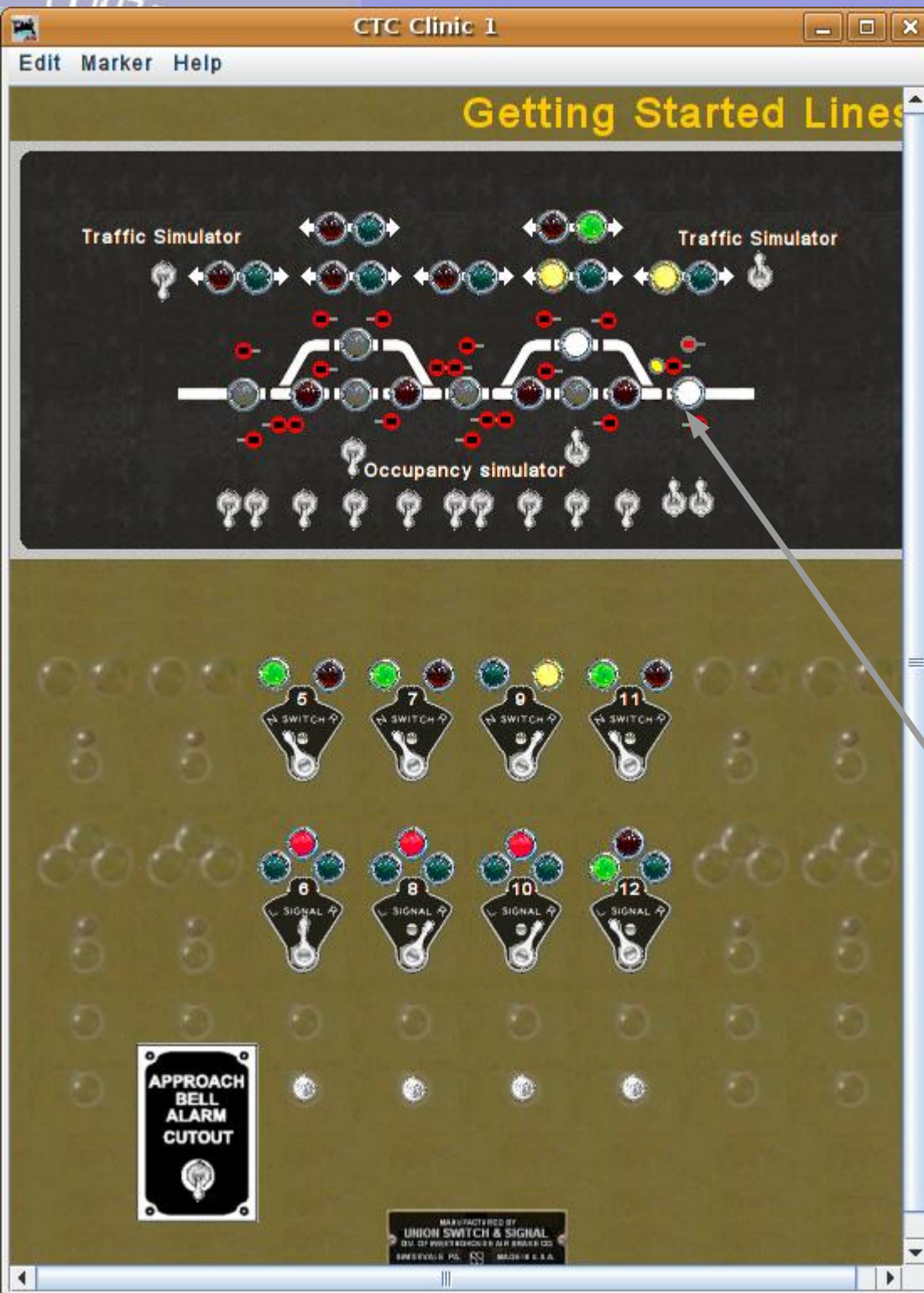
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- 'Signal Normal' goes out.
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- The eastbound is safely in the hole.

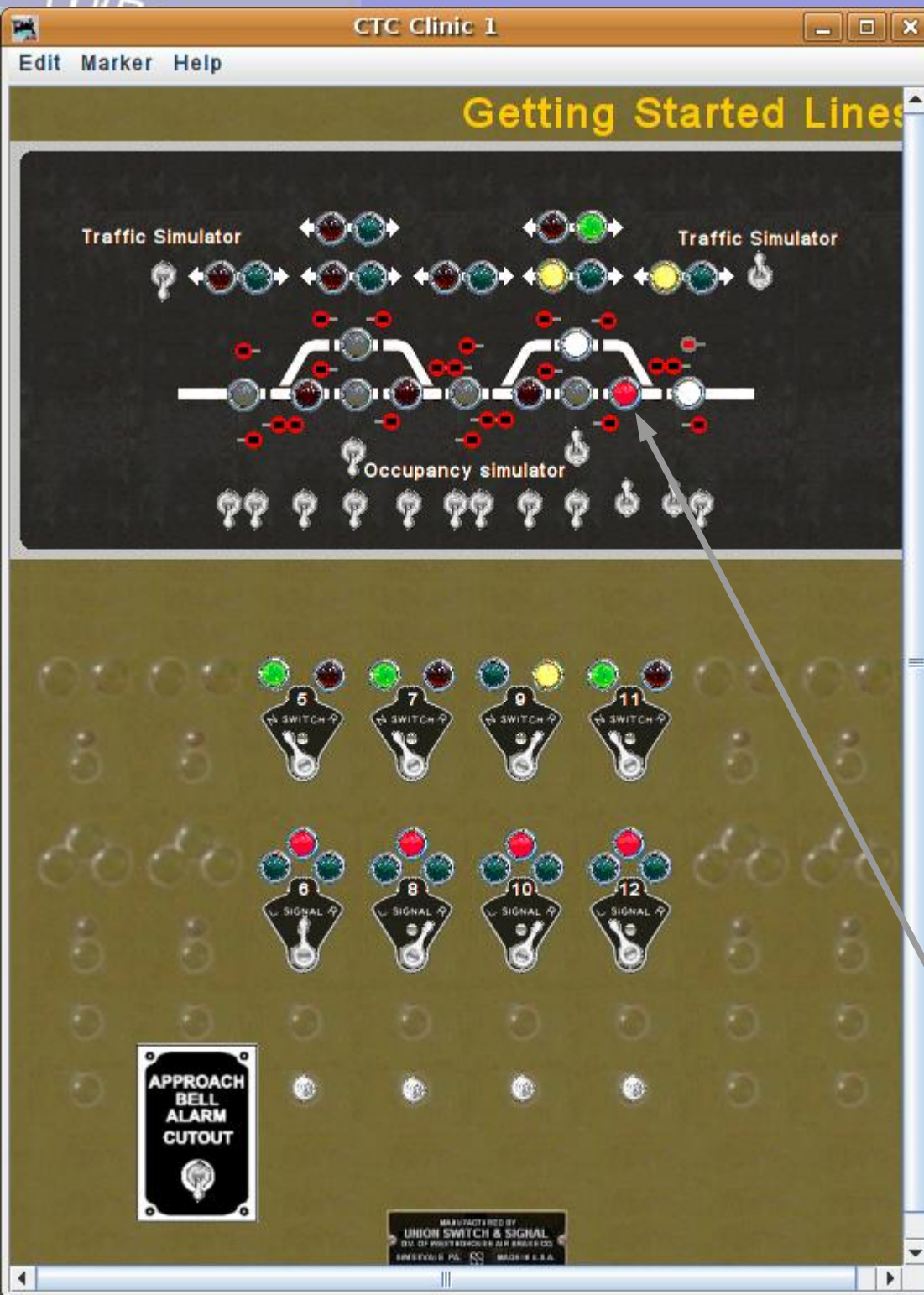
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- The eastbound is safely in the hole.
- The westbound is getting close. It has moved into the second intermediate block.

CTC



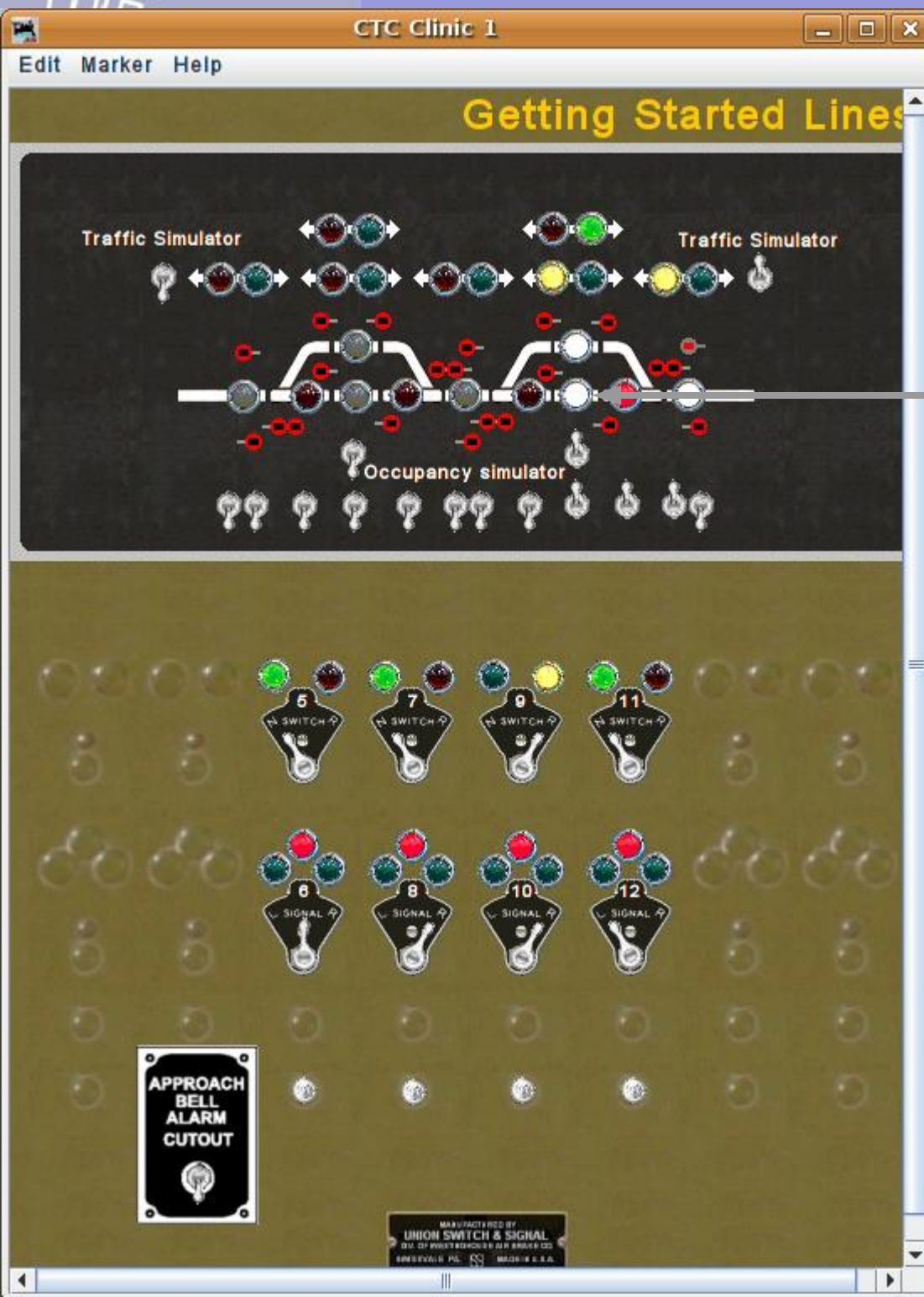
CTC operation

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- **This is an error in my Logix.** Maybe we can locate it later.
- The eastbound is safely in the hole.
- The westbound is getting close. It has moved into the second intermediate block.
- Now it reaches the OS, ringing the bell.

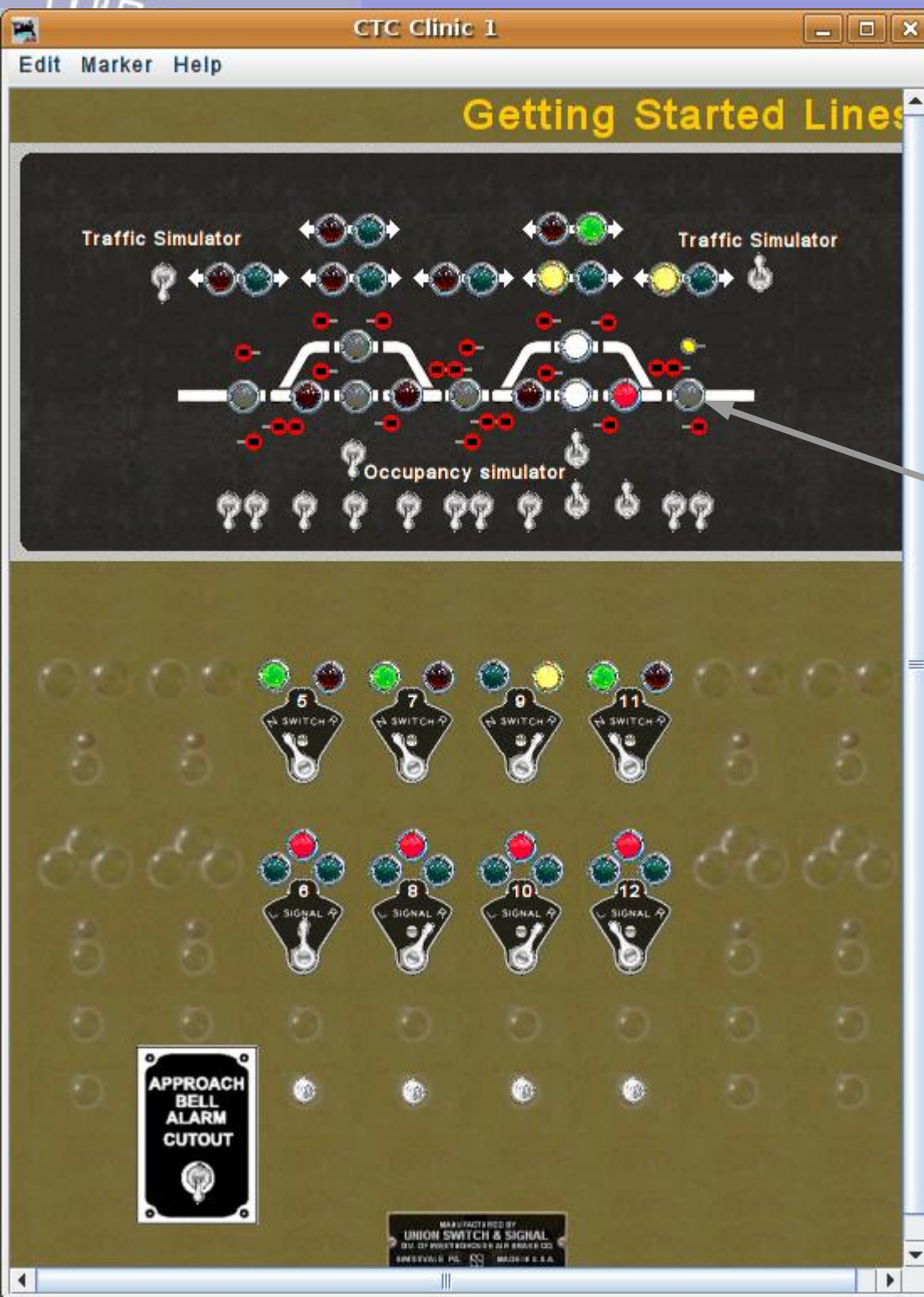
CTC

CTC operation

- And on into the main track of the passing siding.



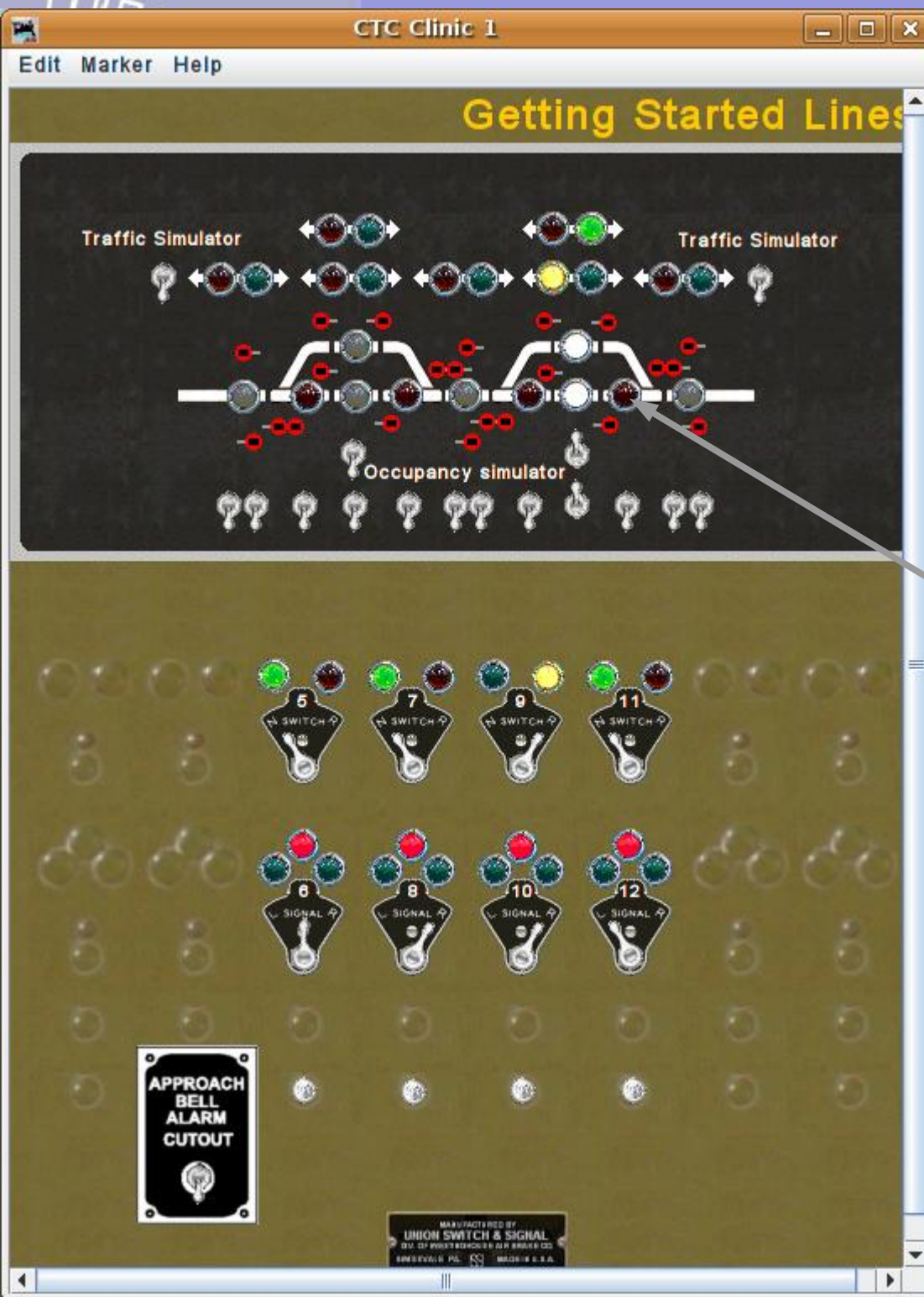
CTC



CTC operation

- And on into the main track of the passing siding.
- Clear of the intermediate track.

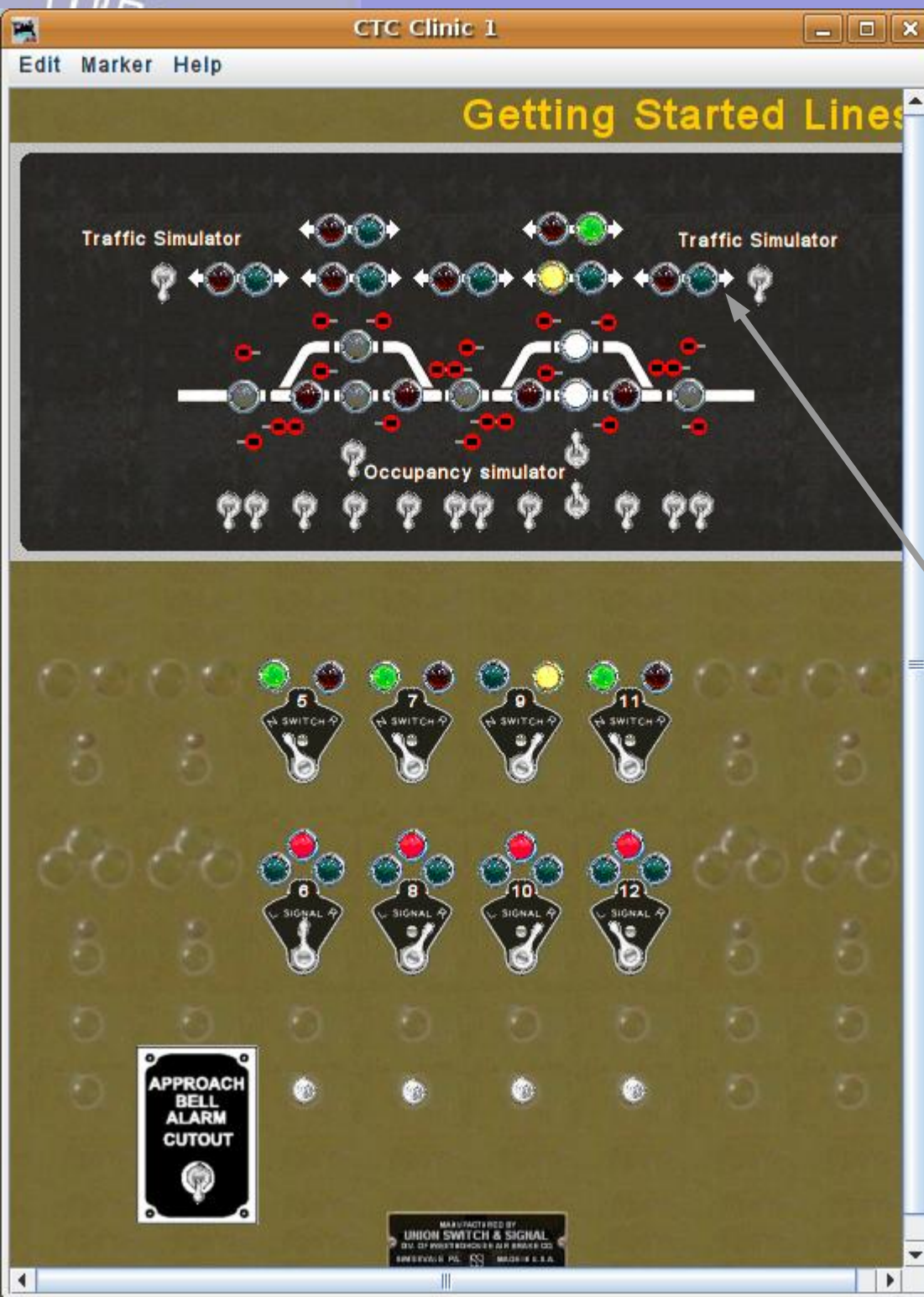
CTC



CTC operation

- And on into the main track of the passing siding.
- Clear of the intermediate track.
- Clear of the OS.

CTC



CTC operation

- And on into the main track of the passing siding.
- Clear of the intermediate track.
- Clear of the OS.
- Dropping the traffic direction indication.

SSL (Simple Signal Logic)



- What we have covered so far:
 - CTC Panel operation detail (CTC-clinic-1)
- Where we are going next:
 - CTC Panel Logix (CTC-clinic-2)