Reference Manual for the QS-1 Train Control, Feature and Digital Sound-of-Power™ Module

Version 1.00

QSIndustries [illegible]

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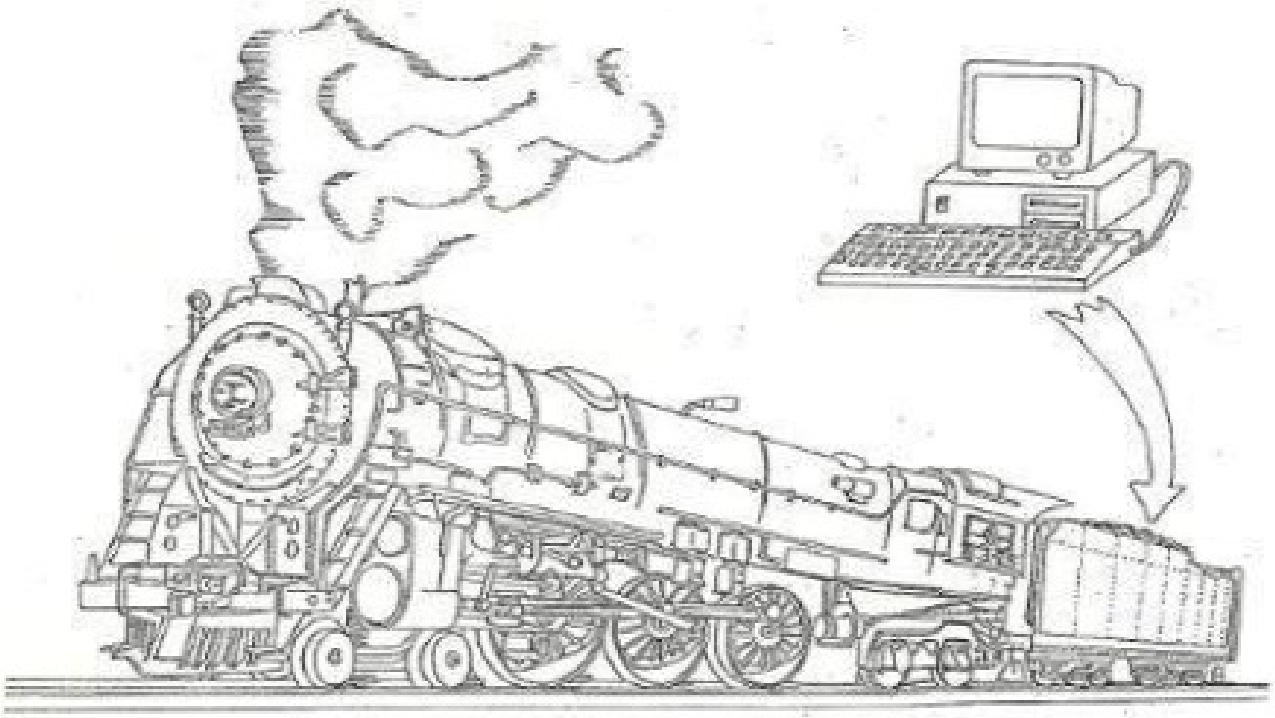
Instructions for the QS-1 Train Control, Feature & Digital Sound-of-Power™ Module

Congratulations on your purchase of the finest computer-based train-control and sound module available for three-rail locomotives. QS-1 is not simply an excellent sound system but a full featured train operation system as well. Because the system is so powerful, we often describe QS-1 as a Train Control, Feature and Sound system or T.F.S. for short and do not place undue emphasis on it remarkable sound capabilities.

There are so many ways to use and expand the QS-1 system that you will never tire of its possibilities. In spite of its capabilities the QS-1 system is easy to use and does not require anything more than a standard three-rail transformer with whistle button. You do not have to change your layout or equip all of your engines to use this system. In fact, your QS-1 equipped engine behaves like a normal three-rail engine; the special features are available only when you want them.

Getting Started - What to Read and What not to Read

If you have had the QS-1 unit installed by a service center, you can try out your engine's sound system immediately before reading any of this reference manual. The engine has the familiar "neutral-forward-neutral-reverse" directional sequencing and will behave like any engine on your layout that is equipped with a three-position reverse unit. If you want to run your engine right away, do not use the horn button when you first turn on the engine since the horn button has very special effects in this reset condition that will need further explanation. Feel free to use it once your engine is moving. Also, if your horn does not blow in forward or reverse, switch the leads from your transformer that go to the track. If you have trouble, turn the power off for three seconds (until the bell "dings" once), then interrupt the power. The more of this manual you read, the more you'll be able to do.

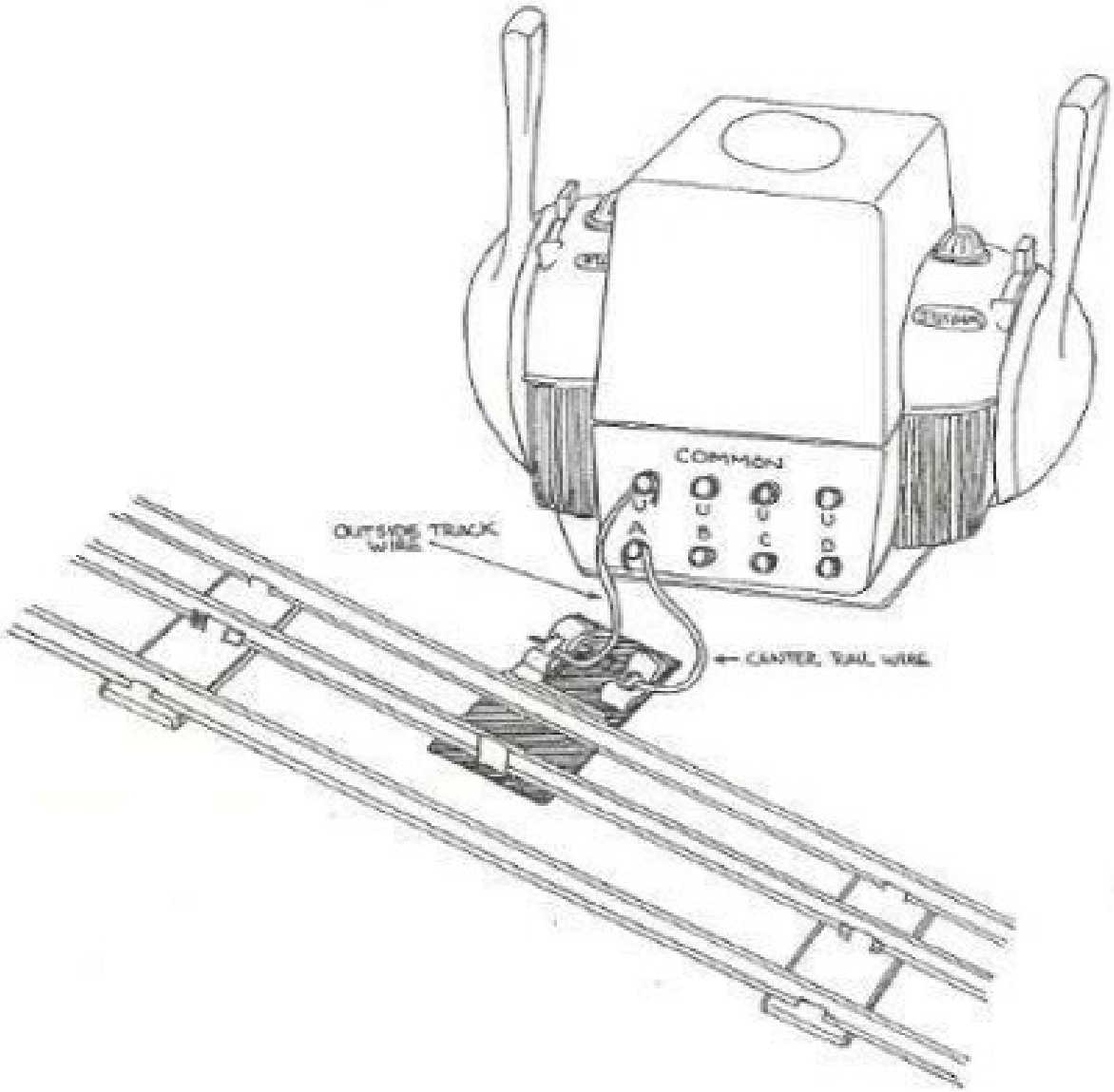


Installing A QS-1 In Your Locomotive Is Like Putting A Computer In Your Engine

Figure 1

If you are installing your own QS-1, you will need to read the section on installation

The following instruction manual is divided into ten sections: Basic System Description, Principle of Remote Control Operation, QS-1 Train Control, QS-1 Sound-Of-Power, QS-1 Features and Options, Installation, Future Expansion, Trouble Shooting, Warranty, Appendix.



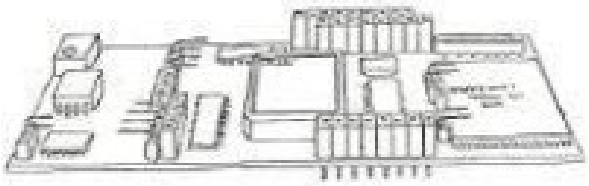
Important! Make sure the wires from the transformer terminals are connected to the correct track rail. Check the Appendix for the right wiring for your toy train transformer. If the wires are swapped, your engine will not respond to commands correctly. Your engine may go "dead", blow the whistle instead of the bell, etc.

Basic System Description

You have just bought a computer for your locomotive. Like any computer it has two distinct attributes: software and hardware. The hardware is shown in figure 2 and consists of a power supply board that provides a solid voltage for the system regardless of track voltage settings, a 12 Mhz microprocessor to actuate the features and produce the sounds, a non-volatile memory to store important data even when the power has been removed, 1 to 4 megabits of memory that contains the sounds and operating programs, a battery back-up system with charger and NiCd battery to keep the sounds going during power interrupts and an audio amplifier to reproduce the digital sound. Except for the monitor, the keyboard, and the floppy disk drive, the QS-1 system has the same compute power as many of the home computers that are available today.

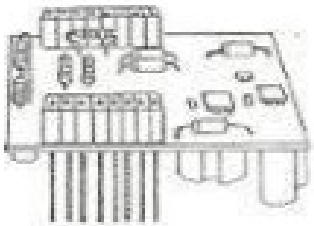
QS-1 Microprocessor Board

(Speaker not shown)



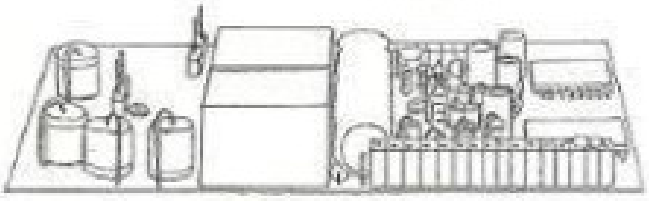
PS-1 Battery Charger / Power Supply Board

(Battery not shown)



QSI Electronic Reverse Unit

(Wiring not shown)



Installation is easy: the QS-1 Computer Board Plugs Directly Into The PS-1 Power Supply Board Which, In Turn, Plugs Into The QSI Reverse Unit

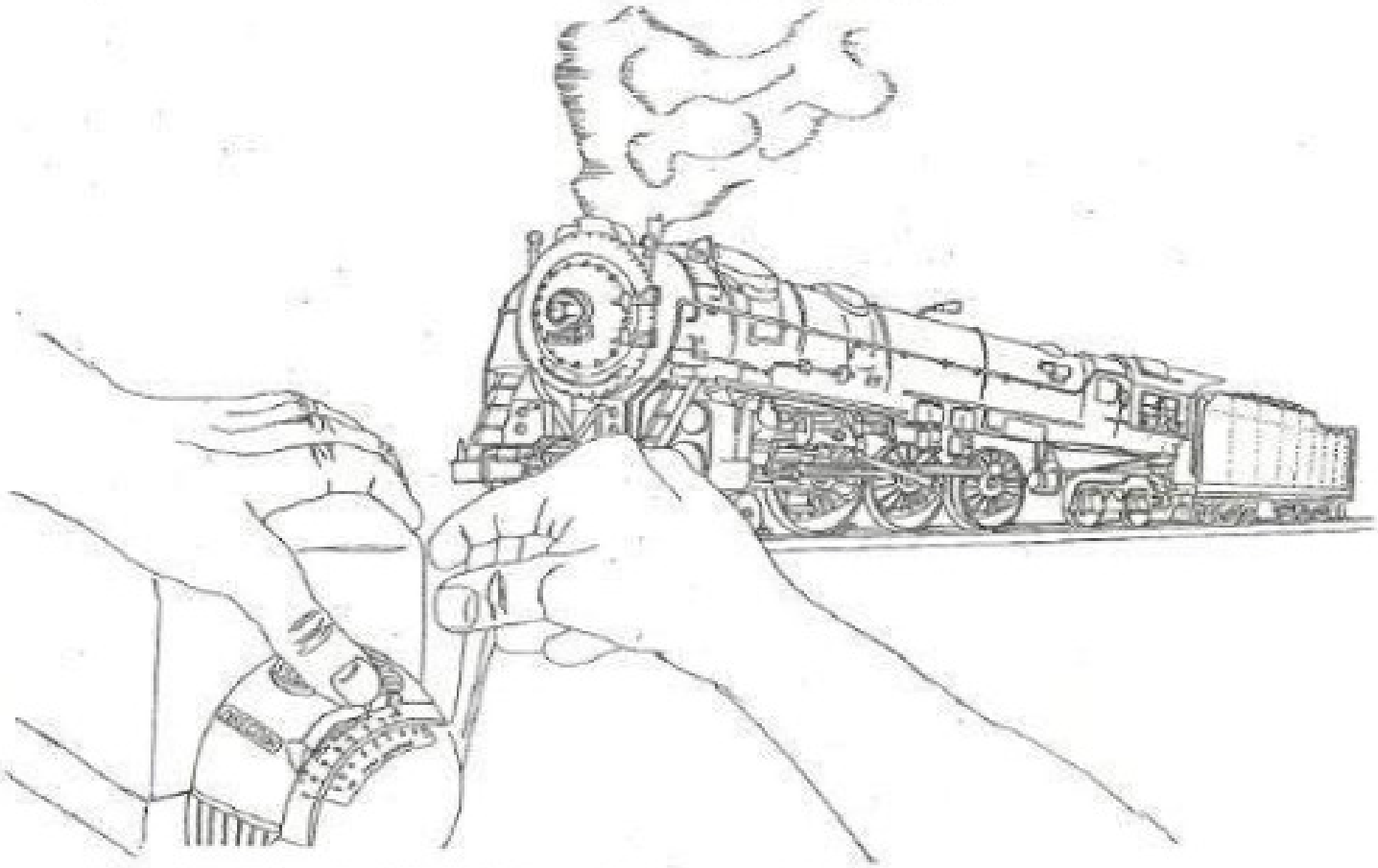
Figure 2

The software is stored in the memory chip and contains the intelligence of the system; the hardware has little character that is particular to operating a model locomotive but provides the means to express the intelligence contained in the software. For instance, there is no circuitry in the hardware that was designed to make a whistle sound. Rather, the whistle sound is made bit-by-bit by the computer hardware from digital information and instructions in the software program and reproduced through the audio amplifier. Simply changing the software could result in entirely new sounds and features; the hardware doesn't care - it will do anything it is told to do. In particular, software version 1.00 of QS-1 tells the computer how to construct the sounds, monitor the track voltage to determine if the horn button is being pressed, operate the different remote control features, monitor the motor to determine engine speed, accept operator remote control signals and store engine operating selections (like sound volume), etc. The remote control features in Version 1.00 include the following: individual engine selection, sound volumes, slave mode, reversal mode, E-unit lockout, engine ID assignment, chuff rate, lighting effects, remote uncoupling with our coil-wound coupler option plus

many other extras. The individual engine ID's and remote selection features allow the user to turn-on and operate different engines on a powered track section without the use of blocks. All of these features are fully explained in the reference manual. QS-1 comes with it's own power-control board (called PS-1). This board is necessary to provide the QS-1 computer system a stable source of power. PS-1 contains what is called a "buck-boost" switching regulator that takes the variable track voltage (4-35V AC) and delivers 5V to the computer and 9V to the audio amplifier. It also automatically turns on the 9V NiCd battery when the track voltage is below 4V AC, charges this battery when the track voltage is above 4V AC and turns off the battery when the track power has been off for more than 8 seconds.

Principles of Remote Control Operation

It may seem like magic to actuate so many different sounds and features by remote control when the standard three-rail transformer only has one horn button but it is actually quite easy. To increase the remote control options from a standard toy transformer, we use another remote control signal (throttle setting) along with the directional state of the reverse unit to select different remote control options. The horn button is then used to actuate the selected remote control option.



Remote Control Operation Of All QS-1 Features Is Achieved With Only The Horn Button (HS) And The Throttle

Figure 3

For instance, if you want to turn on the bell, put the engine in neutral and leave the throttle at a low setting. The horn button in this position does not blow the horn but turns the bell on or off. If the throttle setting is in a high position, the horn button will arm or fire the uncoupler circuit. After a reverse unit reset (the neutral state after the track power is turned off for three seconds), the horn button and throttle setting can control a number of options for the engine including engine addressing.

Because we need information about what state the reverse unit is in, the QS-1 system must plug directly into a QSI reverse unit as shown in figure 2. The connections between QS-1 and the reverse unit not only supply information to the QS-1 computer but the reverse unit also receives information from the QS-1 board to actuate various features that involve controlling the directional state of the engine such as E-unit lock-out, reversal, etc.

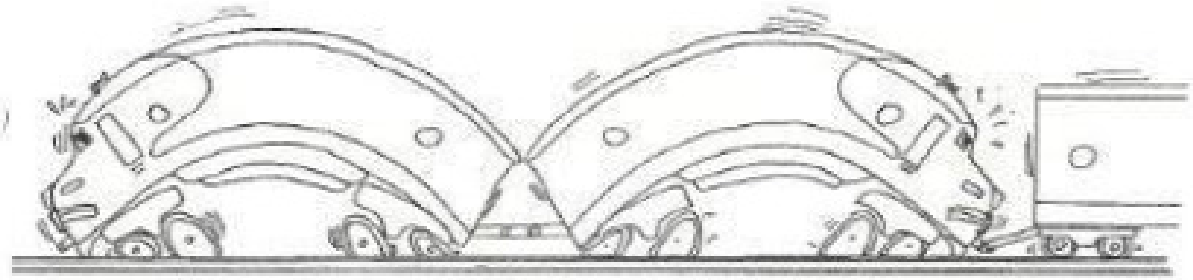
Note: It makes a difference how the transformer leads are connected to the track. If your horn button does not operate the horn or other features as described in this manual, try reversing the track ground and center rail connections.

Note: We will refer to the whistle button or the horn button as "**HB**." It is used as both a verb and a noun

Reverse Unit States:

There are five distinctive states in the QSI reverse unit: 1) reset 2) neutral before forward 3) forward 4) neutral before reverse and 5) reverse. The horn button and the throttle setting can have different effects in each of the these states. The most important state is reset.

All about Reset



Without Reset Locomotives Can Get Out of Synch

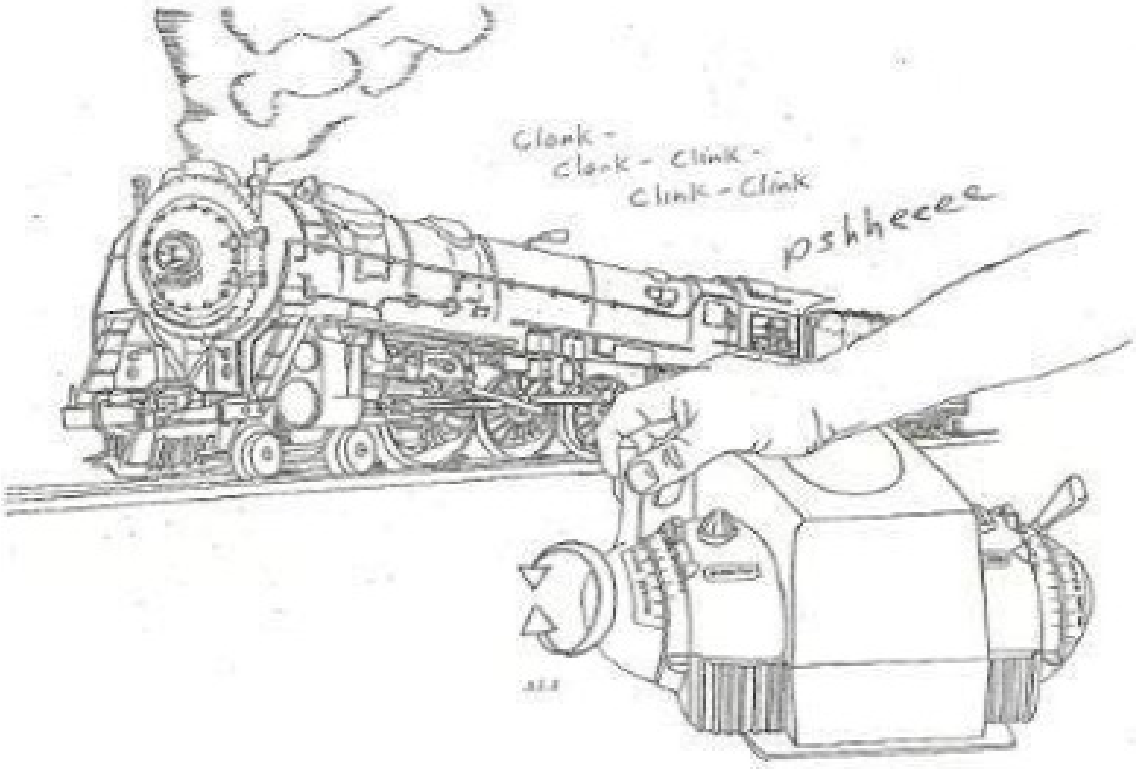
Figure 4

"**Reset**" is special. If you have purchased either the Weaver E-8 engines or the Lionel MU set, you already have some familiarity with the QSI reverse unit reset feature. When these Williams F-7 engines are turned off for three or more seconds, they come up in a neutral directional state and the next time the power is briefly interrupted, the engines will always go in the same direction. This way if the engines get out of sequence, leaving the power off for three seconds will always re-synchronize the engine's directional state and all engines will work together. This is very helpful when double heading engines or in the case of the Lionel MU's, it synchronizes the front and reverse lights on both the power and dummy units.

When QS-1 is used with a properly charged NiCad battery, the reset time out is taken over by the on-board QS-1 computer and will be exactly three seconds. As an aid to knowing when reset has occurred, a single "ding" sounds after the power has been off for the second time-out period; this indicates that the unit will be in reset when power is restored. If there is no battery or if the power has been off for more than about 15 seconds, you will hear a two "dings" in a row when power is re-applied. Without a battery, the reset time-out is done by the reverse unit and will not be as accurate.

Although the reset state appears to be a simple neutral directional state, it is interpreted as something special by the QS-1 computer in your engine. In this special "reset state" you can select engines, give new ID numbers to engines, change the sound volume, plus many other characteristics that determine how the engine operates. If you do not want to give your engine any special instructions

in reset, a brief power interruption will put your engine in forward and will thereafter act as a normal engine. Each of the selections in reset are called "reset options". Each option is selected by entering reset (by turning the power off for three seconds) and then moving the throttle up to the highest setting and then back to a low (but not "OFF") setting (about 6-8 V) . Be careful not to turn the throttle all the way to the off position during this operation. If you turn it "OFF", you will exit reset and proceed to run your engine in forward when power is re-applied. If you do this by accident, it is no big deal; simply re-enter reset by turning the power off for 3 seconds (till you hear the "ding") and then back on again. In reset, each time you move the throttle up to the highest setting and then back to a low (but not "OFF"), you will hear an air let-off sound like "pshhheee" which indicates that you have moved to the next "reset option". After 1.5 seconds in any reset option you will hear a a series of clanks and click sounds to indicate what position you are in. Because there are over thirty reset options available in reset, we included these audio feedback signals to simplify using these features.



In Reset, Moving The Throttle Up and Down Allows Different Operations to be Selected. Audio Feedback Helps You Identify the Option And Know the Selection

Figure 5

Before you try to actuate a reset option with the horn button, you should try moving through the different options on your engine - just to get the feel of it. Put your engine in reset and move the throttle up and down a number of times and hear the air let-off sound each time you do this. If you move the throttle up and down four times, you have selected the forth reset option. If you move it up and down twenty times you have selected the twentieth reset option. It's very simple. As we mentioned, we have also included a simple counter that gives sound feedback of where you are in the selections - just in case you lose count. For instance, if you stop after your third selection, you will hear three "clink" sounds and if you stop after your fourth you will hear four "clinks". If you get to five you will hear a single "clank" instead of a "clink" and at six you will hear one "clank" and one "clink", etc. In other words, each time you pass a count of five you will pick up another "clank"; nineteen would be three "clanks" and four "clinks" (3 X 5 + 4 = 19); twenty-one would be four "clanks" and one "clink" (4 X 5 + 1 = 21). Try this out yourself and get used to how it works. Don't worry about accidently making any changes in your reset options. All you are doing when you push the throttle up and down is to

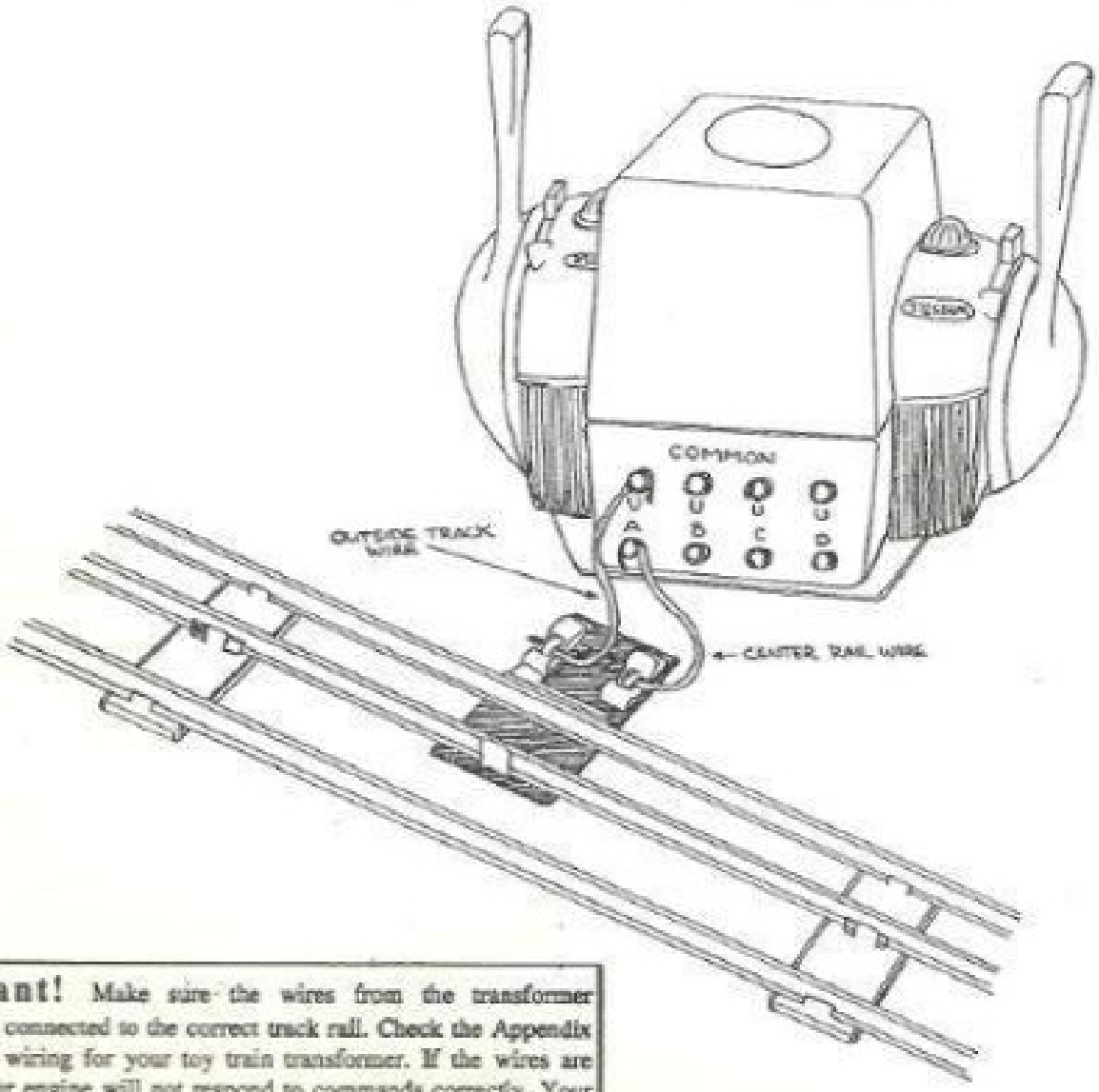
move through the different options - you are not actuating them; that's done with the horn button as described below. How fast can you move through the different reset options? - very fast - as fast as you can move the throttle up and down!

Once you have selected the option or feature that you want to operate, press the horn button. As an aid to knowing if the QS-1 system accepts the horn button, you will hear a single ding. This is a principle worth memorizing:

Each time HB is pressed, you will hear a bell "ding" as a feedback signal to indicate that the engine acknowledges that the horn button has been pressed.

In addition, there may be other sound feedback to indicate that this option has been selected.

Note: Before you use the horn button, please read the section on QS1 Options and Features to see what each option does. Otherwise you may put your engine into a state you do not recognize.



Important! Make sure the wires from the transformer terminals are connected to the correct track rail. Check the Appendix for the right wiring for your toy train transformer. If the wires are swapped, your engine will not respond to commands correctly. Your engine may go "dead", blow the whistle instead of the bell, etc.

Using the Lionel Horn Button

Since the horn button is such an important part of QSI remote control operation, it is important to understand how this button works. Most Lionel transformers have a horn button that applies a small amount of DC to the track to actuate the horn relay. When these transformers where designed, they did not have a convenient and inexpensive way of producing dc from the ac transformer output. The amount of dc that most transformers produce is far below what is necessary to reliably operate most electronic detectors. Also, the amount of DC that is produced by the whistle button is very dependent on the amount of current that is being drawn by the train.

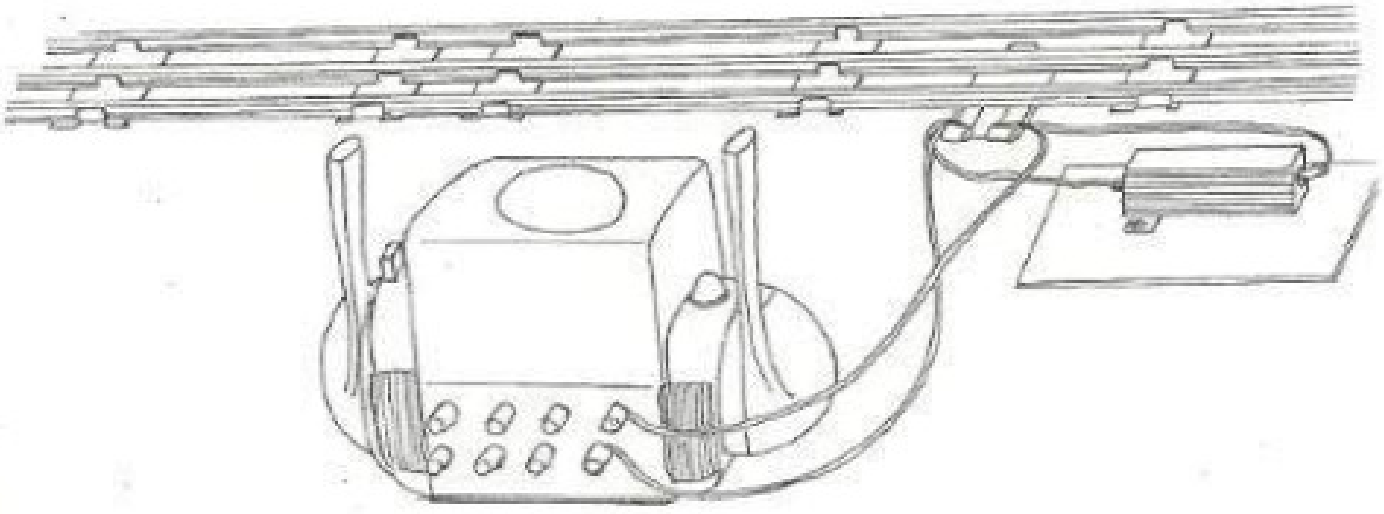
QS-1 has been designed to operate with only .350 volts of DC on the track and will work well with most transformers when the train is operated in forward or reverse. However, in neutral the response to the horn button may be sluggish and under some conditions may not work satisfactory. If your horn button operates inconsistently, try the following to get better operation.

1) Increase the current loading on the transformer by operating trains that have engines with operating headlights, smoke generators and lighted passenger cars.

2) When operating in neutral press the horn button in only part way and release when you hear the bell sounds. The Lionel horn button on early Lionel transformers has two positions it goes through as the button is pressed. The first position occurs when the button is pressed about half way. This position was only meant to be temporary but it produces a very strong DC signal along with reduced track power. The second position occurs when the button is pressed in all the way and produces an increase in track power but a very weak DC signal. (read the Appendix for a full description of the Lionel whistle button).

3) Increase the current drawn by the transformer by using a QSI ballast resistor (available from QSI and QSI dealers). Connections for this resistor is shown in figure 6 . The resistor is simply connected across the transformer terminals that go to the center and outside track rails.

It is important to mount the resistor on a piece of metal to help dissipate the heat and to place it in a location where it will not burn fingers that might touch it or burn other flammable materials on the layout.



Connecting the QSI Ballast Resistor

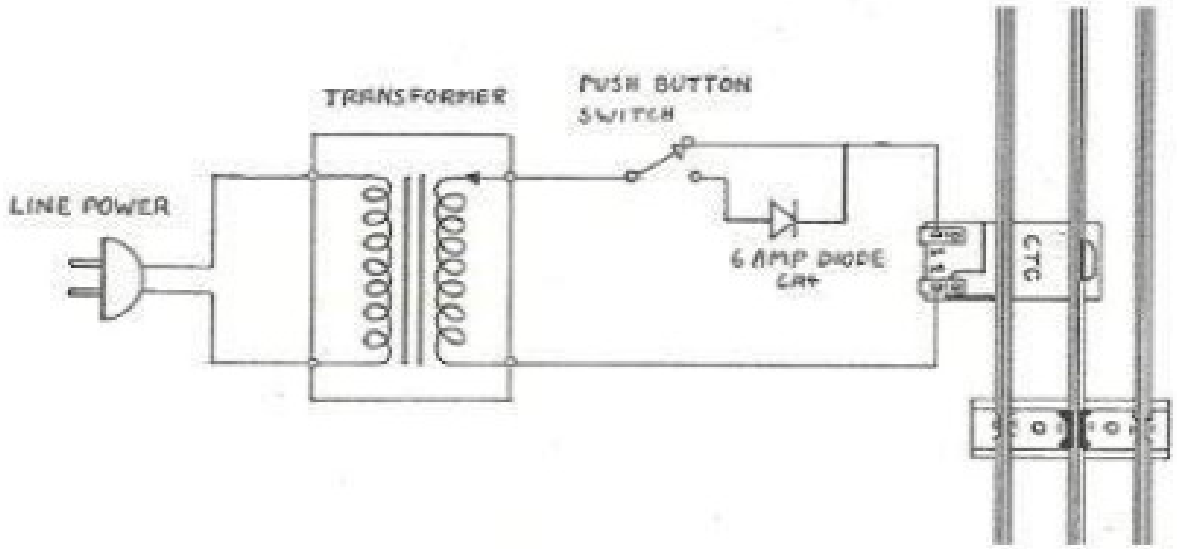
Figure 6

4) Use the QSI Whistle Master^{TM} (available summer 1992). Whistle Master^{TM} is a control box that fits between your transformer and the track. It is designed to make operation with your QS-1 unit very simple including train selection. In addition, it produces very clean whistle and bell signals that work reliably with QS-1.

5. Use a Lionel 167C Whistle controller or the new Lionel Bell button controller or the OTT sound controller box. All of these whistle controllers supply an adequate dc signal but also cause loss of power to the track. If they are used with a smaller transformer, there may not be sufficient voltage to operate some features on QS-1 that require the high throttle setting. Make sure that the controllers are wired to the track correctly to produce the correct polarity dc signal. If they do not operate correctly, try switching the two wires to the track. The QSI Whistle Master is the best choice.

> **Note:** When you use the OTT box or the Lionel Bell button, you will need to hold the button on for about a second and off for about a second to get it to operate properly

6. Connect a diode, switch and push button as shown in figure 7 . This is an effective and inexpensive technique for operating QS-1 features in reset and neutral.



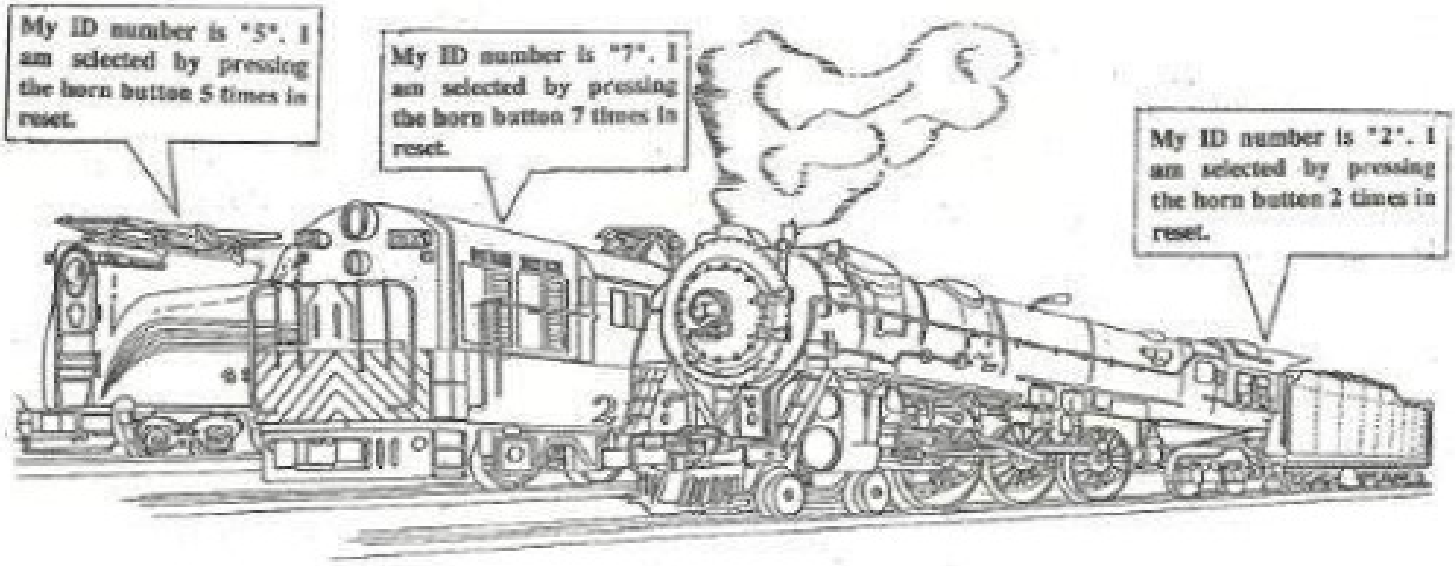
Simple circuit for Rapidly Actuating Reset Options

Figure 7

7. Use the QS-1 SW1 controller (Summer 92). This is an inexpensive controller that connects between the transformer and the track. It is very useful for actuating both the horn button (HB) and high throttle QS-1 options in reset and neutral. However, if it is used for operating the whistle or horn it will cause the train to slow down. This last comment also applies to methods 5 & 6 above.

More information about how the Lionel whistle and horn button operation be found in the appendix.

QS-1 Train Control



ID Numbers Can Be Assigned to Your QS-1 Equipped Engines

Figure 8

QSI train control is *not* command control. You will not be able to operate individual trains at the *same* time on the *same* powered track section with *two* different throttles. What you will be able to do is select different trains or engines on the same powered track section and then to operate each one separately while the deselected ones stay non-moving on the track. This allows you to operate your entire yard or certain sections of your layout without block control. QSI train control is simply a very easy way to turn your trains and engines on and off.

Operational Possibilities Using QSI Train Control

With the QS-1 system you can do almost all of the train operations normally done on prototype railroads. Some examples are:

1. You will be able to make up train consists by selecting each locomotive, one at a time, to bring up to your ready track. You will also be able to give each train its own ID number so entire train consists can have their own group ID numbers.

2. You will be able to break up train consists by selecting engines one at a time to move to your engine storage area.

3. You will be able to move a selected switcher through your yard to drop off and pick up cars on any track even though there are many engines occupying different powered track sections. All of these engine will stay non-moving.

4. You will be able to back selected helper engines down to connect to a stalled train on a grade without the stalled train trying to back down the hill.

5. You will be able to select a particular engine in a consist and have only its QSI coil coupler operate. This is useful when breaking off individual engines from a consist or when you want your consist to disconnect from its cars. You can also select individual engines to turn on their different features like their bells, whistles, or reset options such as slave or reversals without affecting these same features on other locomotives.

6. You will be able to use your switcher to push cars up to a waiting engines or consists without the consist moving and then select the consist to pullout without the switcher moving.

7. You can combine different consists temporarily to make larger trains with midtrain helpers or pushers and then break off these other engines when not needed.

8. You will be able to stop your train and push cars onto a siding that contains a deselected engine and not have that engine move during your switching operations. Alternately, you can stop your mainline engines after uncoupling your cars and select a separate switcher to switch your cars around the layout without the mainline engines moving.

9. You will be able to stop your train and deselect you engine(s) to use operating cars that may need track power. Since the train is in a non-moving state, you can vary the power to your accessory cars and even turn the power on and off without affecting the engine motion.

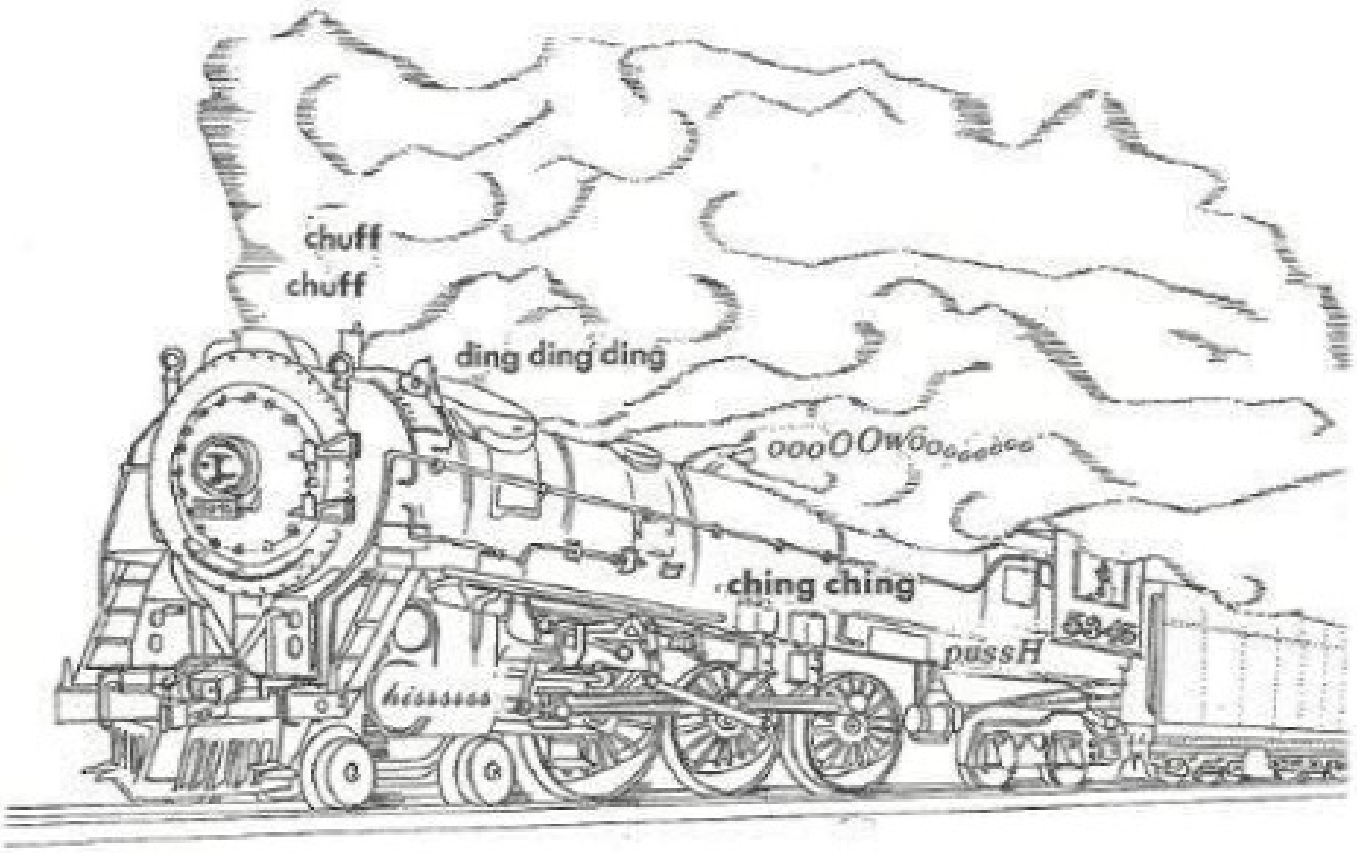
10. You will be able to lock-out your engines out on a siding with motors idling or steam compressors pumping and not respond to either direction changes or horn or bell signals. This is a great effect in an engine yard.

Using ID Numbers:

> **Note:** Make sure that the connection polarity between the track and transformer is correct.

ID numbers are assigned and accessed in "reset". Once an ID has been assigned, it is very easy to use the horn button to address an engine; you simply press the horn button the number of time equal to the assigned ID number. In order to make train operation as simple as possible we have included three ways to assign and use ID numbers called Road ID (RID), Engine ID (EID), and Temporary ID (TID). We have organized a way to assign ID's that we think is quit logical and intuitive but you can use the ID numbers in any way you choose. Please read the section on Reset Options and the examples at the end of this reference manual to learn how to use the QSI train control system.

QS-1 Sound-Of-Power™



QSI Steam "Digital" Sounds for the Ultimate in Realism

Figure 9

The QSI Sound System

The QS-1 **SOUND OF POWER™** sound system has a full sixteen bits of dynamic range which is the same as modern CD players. There are five sound channels available which means that one sound is not cut out when another one is played; the sounds occur simultaneously. Except for the steam hiss, the sounds are not synthesized, they are actual sounds from locomotives. In many cases QSI employees could be found late at night down at the train yards collecting sounds with a high quality field recorder and a shotgun microphone. Some of the sounds are only available from recordings which were purchased from Green Frog Productions and other sources. Some of the sounds can be used "as is", while others require considerable work in the QSI sound lab to become the sounds you hear. In particular, the **whistle** (or horn) requires considerable processing. The whistle you hear when you listen to a live engine is a single continuous sound. But to be used in QS-1, it must be dissected into many pieces and put back together in a special way. This is because a four second whistle blast would take up some half million bits of memory alone, if clever techniques were not employed. An important aspect of the sounds for QS-1 is that, because they are in software that can be changed, there are many sets of sounds that are available. For instance, a small steam engine is very different from a large one. The GS-4 has a

distinctive whistle that we offer. We also offer a distinctive mallet sound for many of the articulated engine that have become available to the three-rail model railroader.

The **Bell** comes from a single "ding-dong" (or in some cases only the "ding" or only the "dong") which is then repeated over and over as long as the bell is turned on. This provides a steady cadence to the bell, appropriate of a mechanically operated bell. Bells with the unpredictability of a hand-pulled bell will be offered at a later time. Some bells are small and have a relatively high pitch. Others are quite massive and produce a lower and slower sound.

The **Chuff** is another one of the more difficult sounds to get correct. The simple solution (used in some sound systems made by other manufacturers) takes a very short steam blast and simply puts long pauses between these steam blasts. This gives a very poor rendition of a steam locomotive chuff. Again, the techniques are proprietary, but the QS-1 chuff is complex, luxurious and charming. The quality of the steam chuff is perhaps the most distinctive sound feature.

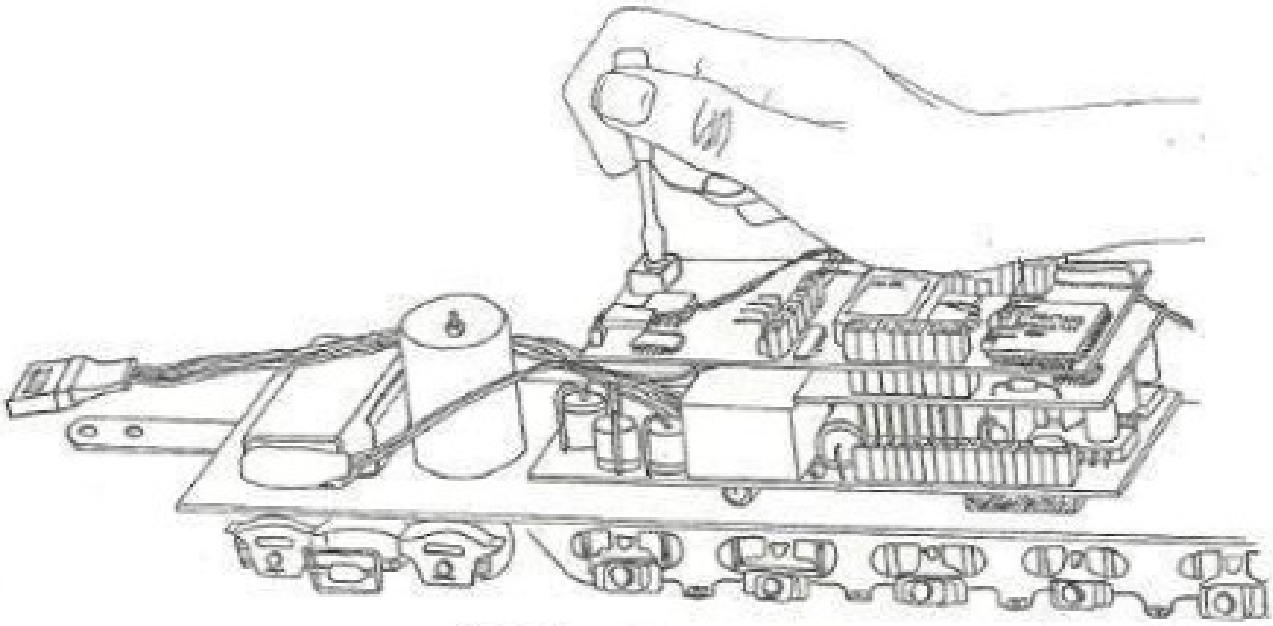
When the engine is brought to neutral, after a 2-second delay, the brakes are set. This is the air **let-off** that you hear. At this point, the **compressor** will start pumping at its maximum rate to build the pressure back up. After about 15 seconds, the compressor begins to slow down since the pressure is building up in the air tank. This variable-speed compressor is another distinctive feature of the QS-1. Added into the sounds is a complex, algorythmically-derived steam hiss that simulates the constantly varying texture of sound found in a live steam engine that is fired up.

The **uncouple sounds** come in two parts. Before a coupler can be opened, the **draw bar** must be raised. The raising of the draw bar makes a distinctive sound that anyone who has worked on a real railroad will immediately recognize. The reason we do this operation in neutral and with the power turned up to maximum is to store enough energy in the optional QS-1 uncoupler circuit so that uncoupling can successfully occur even when pulling the engine slowly away from a set of cars. Once the draw bar has been raised, the coupler is "armed" and ready to uncouple. When the uncoupler is activated, you will hear the heavy mechanical sounds of the couplers separating, followed by the sound of the air hose breaking. To get your couplers to actually open, you will need to purchase the QSI Uncouple Option for your QS-1.

To provide a way to know where you are in the **reset** options, QS-1 will provide feedback consisting of two mechanical sounds. The low "**clank**" indicates a count of 5 for each "clank". The higher "**clink**" indicates a count of 1 for each "clink". Thus, reset position four is **#4** "clinks". **Reset position #18** is 3 "clanks" + 3 "clinks".

There are a set of **test tones** that are provided (reset position #35). The sounds heard here are to assist your QSI dealer to align or repair the QS-1 sound hardware, should that ever become necessary.

In addition to the ability to control the volume of the chuff (or diesel motor) sound independently of the other sounds, there is an *overall* **volume control** on the QS-1 board. This control is a potentiometer mounted on the top electronic circuit board, see Figure 10. You will need to remove the cab from your diesel locomotive or steam tender to adjust this control using a small screwdriver. There is extraordinary range to the volume. If you are taking your QS-1 to a trade show in a deafeningly noisy environment, you may wish to turn the volume control up to maximum; otherwise, maximum is way too loud for most layouts. Our experience is that we tended to enjoy the sound more when the volume is set to an "easy to hear" but moderately low setting. But, feel free to set it as you prefer. The sound is much louder and has a lower resonance when the cab is on, than it does with the cab removed. So, be sure to audition the setting on the volume control you chose before you secure your cab with screws.



QS-1 Volume Adjustment

Figure 10

While QS-1 is much more than "just a sound system", we are very proud of the quality and subtlety achieved in Version 1.00 of the **SOUND OF POWER™**. We put so much effort into it so you would not become bored or irritated with the sound. As mentioned before, it is even possible to lower the volume of the chuffing (reset position #6) for those who find the prototypically-correct volume, we set it at, a bit too much for them to take for extended periods of time is a small room. We sincerely hope you enjoy the sound effects of your new QS-1. We look forward to hearing from any of you who have suggestions on how to improve the sounds we have included.

(We would also like to hear from anyone who has good recordings of trains and would like to loan them to us for possible inclusion in later versions. These sounds need to be *isolated*. That is, one at a time - not mixed together, as in a typical "run-by".)

QS-1 Features and Options

Besides our train control operation and excellent sound system, QS-1 also provides a number of features and options that can all be selected by remote control. Since many of remote control options also depend on the state of the reverse unit, we have grouped these options by the directional state of the locomotive.

Reset Options

The following list of reset options is a brief but complete description; in order to become proficient at using any of these features you should read the examples of train operation included in this manual. In particular, the section for engine selections and ID setting is covered extensively. Do not worry if you do not fully understand the brief descriptions given below.

There are a number of selections where no option is offered; these auxiliary options are for future expansion and are labeled RESERVED. The selections are labeled by how many times the throttle is turned up and down. In other words, the first option in reset is called reset option "0" since the throttle has not been used. The first time the throttle is turned up and down is called reset option "1" etc. The air let-off occurs only for selected engines except for the first one, since all engines must be responsive to the selection process. Actuating each selected reset option is done by pressing the horn button (HB). Reset options are divided into two groups. The first group (#1-#17) is called user settings and the second (#19-#35) is called user preferences. The latter group are parameters that are set for the operating characteristics of your particular engine and are seldom changed once they have been set. The first group are engine parameters that you may change quite often like the temp ID, slave, volume, etc.

User Settings:

0. Road Selection or Engine Temporary Selection: If either a Road Identification (RID) or a Temporary Identification (TID) has been assigned to your engine, press the horn button (HB) to select this engine. Each time HB is pressed, you will hear a single bell ding. When the number of HB's equals either RID or TID, your engine is selected and you will hear the compressors come on in your steam engines or the motor start in your diesels. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the selection of your engine. Only an engine with this RID or TID will be operational. The engine comes from the factory with both RID and TID set to zero and will always be selected to operate regardless of how many times (HB) is pressed in this "0" reset option. TID takes preference over RID if TID is set to anything other than zero (cleared).

> **All Select**: It is possible to select *all* of your QS-1 equipped engines on your powered block from reset position #0. An All Select can be done is position #0 by pressing HB and holding it for 3 seconds. The All Select can only be done on the *first* pressing of HB (i.e. it won't work on the second, third, etc. pressing of HB). And remember this only works from reset position #0.

> **All De-Select**: It is possible to de-select all of your QS-1 equipped engines on your powered block from reset position #0. An All De-Select can be done is position #0 by pressing your Bell Button (BB) at any time in reset.

1. Engine Selection: If you push the throttle up and down one time, you will hear an air let-off and will be in Engine Selection. After entering this reset option, you will hear a single "clink" to identify that you are in the first option. Each engine also can

have an Engine Identification (EID) in addition to its RID or TID. If you have selected the correct RID or TID in the "0" reset option or if RID and TID are equal to zero, then you can also select an individual engine by pressing HB the number times equal to the EID. Each time HB is pressed, you will hear a single bell ding. When the number of HB's equals EID, your engine is selected and you will hear the compressors come on in your steam engines or the motor start in your diesels. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the selection of your engine and only an engine with the RID or TID and the EID will be operational. The engine comes from the factory with EID set to zero and will always be selected to operate regardless of how many times (HB) is pressed in the this "1" reset option unless the RID, TID or EID have been set to a non-zero value.

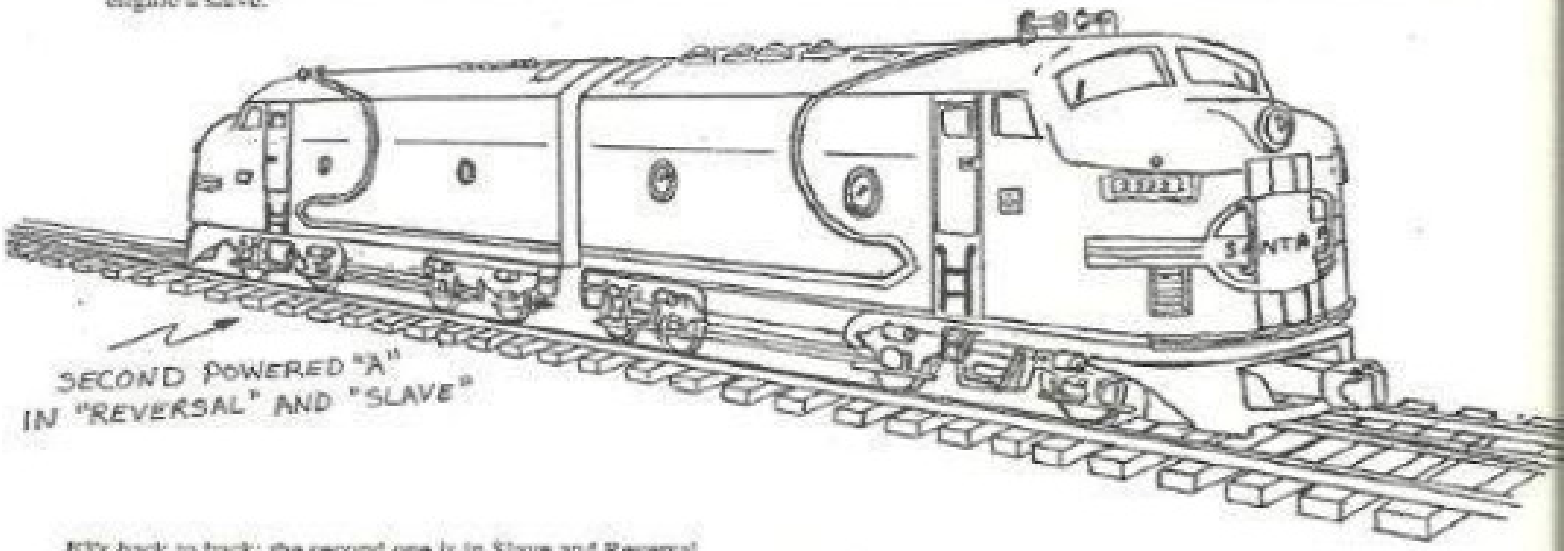
2. **Temp ID Set:** Two clinks. In this position, the number of HB will set in a new temporary ID number. You will hear a single "ding" each time the HB is pressed. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the new setting of your engine's TID. If you do nothing in this reset option, the old TID will be retained.

3. **Temp ID Clear:** Three clinks. Pressing HB will set your temporary ID (TID) to zero. The first time you will hear a single ding when HB is pressed and another ding to indicate it has cleared. Successive pressing of HB will ding the bell but will have no further effect.

4. **Slave:** Four clinks. There are two modes: slave and normal. Pressing HB will set the engine into slave mode; this will turn off the whistle or horn, bell and uncoupler features. You will hear a single ding when this happens. Pressing HB again will return the engine to normal. When the engine enters "normal" you will hear a brief horn or whistle blast to indicate that you have the whistle or horn feature turned back on. The slave option is set to "normal" from the factory.

The slave feature allows the operator to make up multiple-headed trains with only one of the engines having the whistle or horn and bell feature functioning.

5. **Reversal:** One clank. Pressing HB toggles between "start in reverse" and "start in forward". If you enter "start in forward" you will hear a single short whistle or horn blast. Factory setting is "start in forward" so if you press HB for the first time, you will set it to "start in reverse". The "start in reverse" option is confirmed by the sound of a single bell ding. "Start in reverse" means that the engine will reset to "neutral before reverse" rather than "neutral before forward". This option allows you to make up multiple headed consists where you may not want all of your engine to face the same way. For instance, you may want to run your F3's or E8's back to back. In this case you would set your second diesel unit to be in "reversal" so it will start in the reverse direction to be synchrony with the lead engine which is set to start in forward. You might also make the trailing (i.e. reversed) engine a slave.



F3's back to back: the second one is in Slave and Reversal

Figure 11

6. Chuff or Motor Volume: One clank and one clink. When you press the HB, you will hear a ding. For steam engines, HB will result in the usual ding followed by the "chuff sound" coming on at an average chuff rate but the engine will not be moving. For the diesels the motor or cooling fan sound will come on. The available volume settings are 100%, 50%, 25%, and 0% (or off). Each time the HB is pressed, you will hear a ding and the volume will decease by one volume setting until it reaches 0% and then will increase one volume setting with each HB press until it reaches 100%, and then will decrease one volume setting with each HB press, etc. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the last setting of the chuff volume. The factory setting is 100% volume. (Arduino volume has 2 settings - on & off)

7 - 14 are reserved: You will still hear the position indicator (clank and clinks) and will still hear the bell "ding" sounds when you press HB but they will not have any effect.

15. Road ID (RID) Set: Three clanks. In this position, the number of HB will set in a new road ID number. You will hear a single "ding" each time the HB is pressed. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the new setting of your engine's RID. If you do nothing in this reset option, the old RID will be retained.

Note that setting a new RID does not clear TID. To select an engine with either a new or old RID, you must clear your old TID by going to reset option #3. Factory setting for RID is #0.

16. Engine ID (EID) Set: Three clanks and one clink: In this position, the number of HB will set in a new Engine ID number. You will hear a single "ding" each time the HB is pressed. Either moving to the next reset option with the throttle or interrupting the power to put it into forward will finalize the new setting of your engine's EID. If you do nothing in this reset option, the old EID will be retained. Factory setting for EID is #0.

17. ID Clear: Three clanks and two clinks: This position is for clearing (or "de-assigning") the RID or EID of you engine.

Action:	Result:
Press once	RID is set to #0 and bell dings once
Press twice	TID and RID are both set to #0 and bell dings twice

Successive pressing of clear will ding the bell but will have no further effect.

Note that TID will not be cleared by clearing either RID or EID.

18. Operational Clear: Three clanks and three clinks: Pressing HB will ding the bell and return all reset options #1 through #17 to their factory settings. In other words, this will clear all ID numbers and replace them with #0, set the engine to normal (not slave), set the engine to start in "neutral before forward", etc:. but will not affect any of the user preferences, #19 through #35. You will get a distorted bell sound after the usual ding.

User Preferences:

19- 24 are reserved: You will still hear the position indicator (clank and clinks) and will still hear the bell "ding" if you press HB but it will not have any effect.

25. Exchange Whistle and Bell: Five clanks: Each time the HB is pressed, you will toggle between having the bell turn on function operate in neutral or having the whistle or horn operate in neutral (see "options in neutral" below). Normally, the whistle or horn only works in forward and reverse since the neutral directional state is reserved for operating the bell and coil couplers. Many users already have a Lionel bell button available and would therefore like to have the whistle or horn work in neutral. The coil

coupler operation remains unchanged. The factory setting is to have the bell operate in neutral. After pressing HB you will either hear a single ding or a short whistle toot. The single ding means you have selected the bell to operate in neutral and the short whistle hoot confirms that you have selected the whistle to operate in neutral.

26. Reserved: Five clanks and one clink.

27. Chuff Threshold: Five clanks and two clinks: When you press HB, you will hear a ding and the engine will go into the forward directional state and you will hear it chuff as it moves. Find a level piece of straight track on your layout and reduce the engine speed until the locomotive just stalls or is barely creeping. Press the HB once to lock in this setting where the chuff will be "just" off; you will hear a short whistle blast to indicate that this setting has been accepted..

The QS-1 system does not need special cams to determine how fast engines are moving; rather it uses information from the motor to determine locomotive speed. Since different engines have different types of motors, gearing and mechanical smoothness, it is important to tell your QS-1 unit when the engine is just at the point of not moving. This is called the chuff threshold setting. When this is set properly, the engine will not have inappropriate chuffing sounds when it is not moving nor will it be without chuffing sounds when it is moving.

28-31. Reserved: Five clanks and three clinks.

32. Sound Feedback: Six clanks and two clinks: Pressing the HB will toggle on/off the sounds in reset that are used for sound feedback. These include the "pshhheee" steam let-off sounds when the throttle is turned up and down and the "ding" when the HB is pressed. The clank and clink sounds that identify the reset option positions are not affected.

The feedback will not be necessary when operating QS-1 with special control boxes that will do the selection of the different reset options, engine ID's, etc. In fact, these control boxes will be much faster than you can operate the throttle or horn button and the sound feedback would just be an annoyance and it would be preferable to simple turn them off.

33. Reserved: Six clanks and three clinks.

34. Reserved: Six clanks and four clinks.

35. Test Tones: Seven clanks: These are special tones used to test the sound system and are not part of the train operation. Each time HB is pressed, you will hear a ding and one of five different test sounds including "silence".

Neutral Options

The two neutral states, "neutral before forward" and "neutral before reverse" can also be used for special options. In Version 1.00 we do not distinguish between the two neutral states and have the same features in both. Also, there are only two features available: the bell and the coupler.

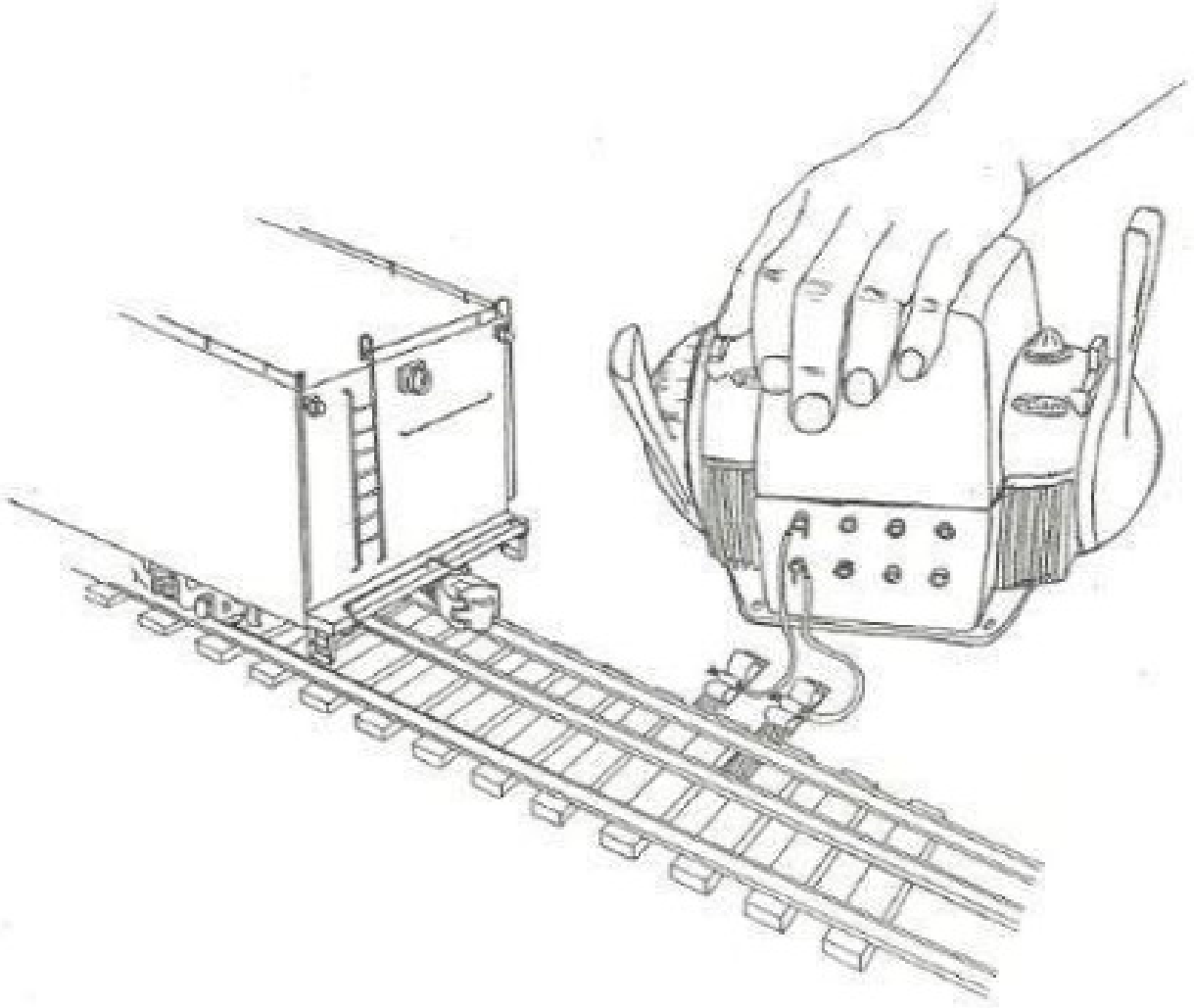
1. Bell On/Off: The bell sound is toggled between on and off by using HB when the voltage setting on the throttle is low (below the 12 volt mark on a ZW). Once the bell is turned on, the bell sound will continue through all directional state changes until you enter neutral and turn it off with HB at the low voltage setting or when a reset occurs. If you do a reset, and the bell was on, it will continue through the three second reset period but will go off when the single reset warning bell sounds; i.e. you will probably hear a double ding at three seconds and then silence except for the compressor sound. When you turn the power back on, the bell will be off and will also be off in all directional states until you turn it back on in neutral with HB and low voltage setting. Note: If you have a Lionel bell button, the bell can be activated at any time, (except in reset), by pressing the bell button. It is possible to connect your transformer up to the track "backwards". That is, the leads are reversed from normal. In reset, if you press HB, the engine goes silent and nothing further happens even with repeated pressings of HB or HV-LV cycles - just silence. In any directional state except reset, if you do not get the bell to toggle on and off in neutral with HB and low voltage and instead the horn or whistle sounds, then the Whistle/Bell reset option has been set to the Whistle position, or you have wired your transformer backward (just swap the wires). The way to tell that the transformer is backward is as follows: If pressing HB toggles the bell on

and off in all states (forward, neutral, and reverse), then you need to reverse the connections between your transformer and the track. If your transformer is wired correctly, then.. Return to reset option position to exchange the whistle option to the bell position.

2. Uncouple and Uncoupler Arm: QS-1 is equipped with uncoupler sound effects and a plug connection for the optional QSI coil uncoupler circuit board. If you have the QSI coil couplers, you can ARM the couplers by setting the throttle at high voltage and pressing HB; you will hear the mechanical sound of the coupler lift bar being raised. Once armed, you can now operate the coil coupler in any directional state by pressing HB at any throttle setting. When you do this the knuckle will open and you will hear the sound of a real train knuckle open up and the sound of escaping air to simulate the sound of the brake-line air-hose coming apart.

> **Note:** When arming the coupler circuit, it is a very good idea to have the throttle setting at its highest value. The uncoupler circuit stores energy in the uncoupler electronic circuit board to operate the coil solenoid and the energy storage is highest when the coupler is armed at the highest voltage setting. This way the coil coupler will have sufficient voltage to operate even if the engine is moving slowly in forward or reverse with the throttle set low.

If you do not have the QSI coil coupler board, you will have all the arming and firing operation with sound effects but, of course, the coupler will not open. However, you can time the operation of a standard magnetic uncoupler track to coincide with the with pressing HB for the armed coupler sound effects. This can be a very impressive operation but does require some skill to have the two operations occur together. When you have the optional QS-1 uncoupler installed, the coupler will open anywhere on the layout you please.



Pressing the Horn Button (HB) in Neutral When the Throttle is Set High Will Arm the Uncoupler Circuit. Then, Pressing HB in Any Directional Will Operate the Coupler. Sound Effects Are Included

Figure 12

3. There are no other options available in neutral in Version 1.00.

For right now, we will assign TID numbers to only three engines and we will make up a consist of two engines for our heavy passenger train. Let's say you have the three following engines and you have chosen the following TID numbers that you would like to assign:

Engine	TID #
Williams S.P. GS-4 Daylight	#1.
Lionel S.P. Black Widow F.M.	#2.
Lionel S.P. NW-2 switcher	#3.

List of Locomotives Using Train ID Assignments

Table 1

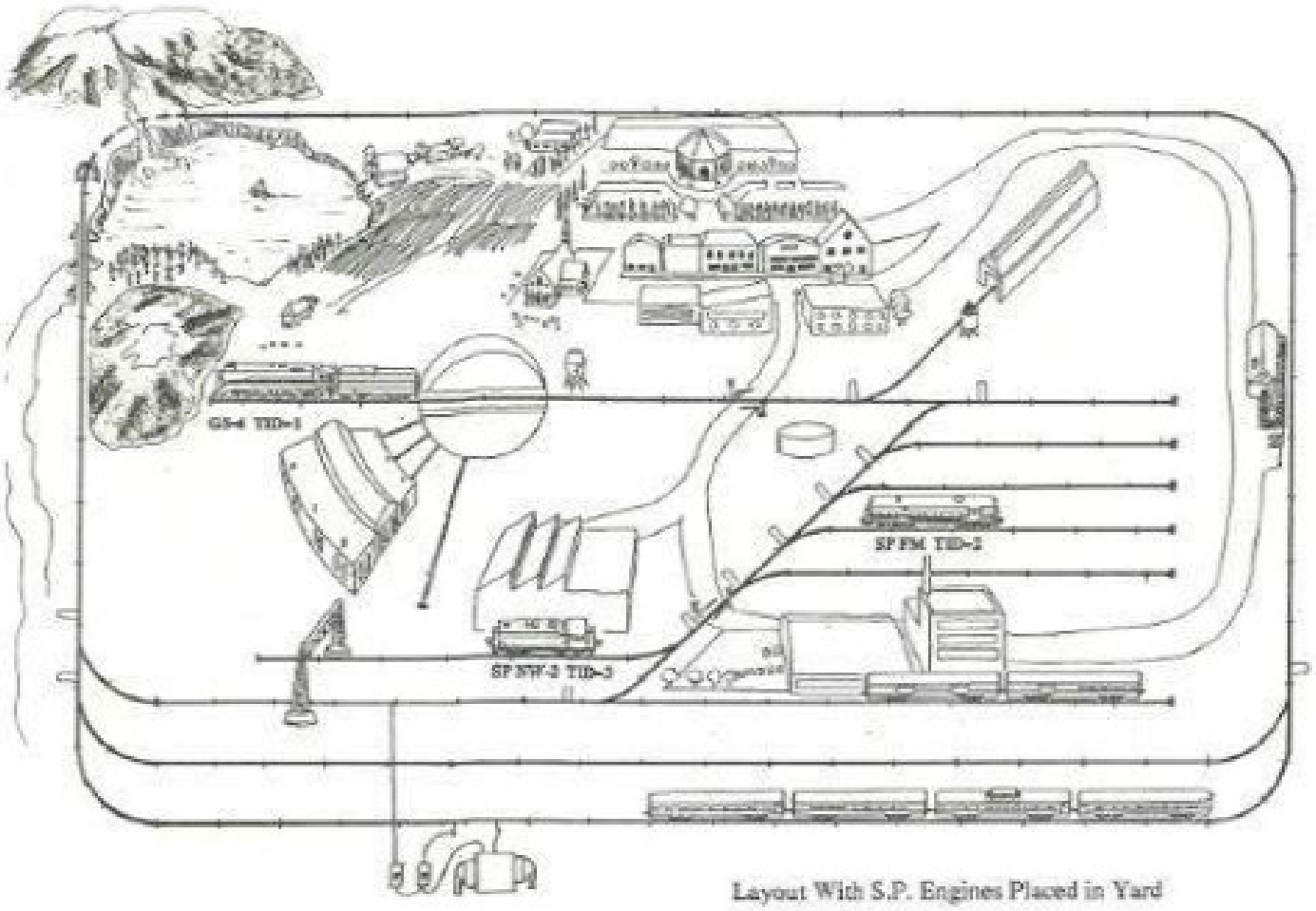
Since the QS-1 units come from the factory with no ID assigned, you will need to place your engines one at a time on the layout to give them initial ID numbers. When engines have had their ID's cleared or when they are direct from the factory, the engines will always power up no matter which ID number is used to select an engine. After an ID number has been assigned, engines can be left on a powered layout without interfering with other engines since each can be de-selected as we will describe below.

We place the first engine, the GS-4 Daylight on the layout and turn on the throttle. You will hear a double ding that means two things: 1) that this engine has not had power for at least two minutes 2) that this engine is in reset. If the engine had already been running, we would turn the power off for three seconds. (Note: A single ding always occurs after the power has been off for three seconds indicating that the power could be turned back on for a reset to occur). When the power is turned back on we hear a fast pumping sound from the air compressor indicating that this is a selected engine (i.e. this engine will run). We now turn the throttle up and down two times and we hear an air let-off each time the throttle goes through this up and down motion. We also hear two "clinks" after a brief wait indicating that we are in the second "reset option" position. This reset option is "Temp ID SET". To give your engine a TID number, press HB the number of times equal to the ID number. In the case of the GS-4, we only press HB once and we hear only one ding. To check that we have done this correctly, we do a reset and press HB once. We hear a single "ding" and the fast pump indicating that this engine is selected. If we press it twice, the engine falls silent since it is not engine 2; if we press HB three times it remains silent because it is not engine 3, etc. This is how you turn on and off any engine that has a TID number. We refer to an engine that is turned off as "de-selected" and any engine that is turned on as "selected". Once an engine has been selected, it will remain that way until it is deselected. In the case of the GS-4 in our example, it is now de-selected. If we did another reset, the engine would come up silent and would not respond to power interrupts that normally would make it move into forward. To select this engine, we do a reset and press HB once; it comes to life. We interrupt the power once to put it into forward and move it to a track beside the roundhouse and de-select it. How do we do this? Very simple; we do a reset and press HB to select any engine *other than* # 1.

We can now put our second engine, the S.P. FM, on the track and follow the same procedure. We give this engine a # 2 for its TID and move it to storage track in the yard. Next, we bring up the S.P. NW-1 switcher, assign it a TID of #3 and park it on a storage track. Our layout now looks like figure 14 .

We are now ready to begin our yard maneuvers to make up this passenger car set. We first want to select the switcher and connect a combine and baggage cars to our passenger cars. We turn on the power and select our NW-1 switcher by pressing HB three times; the diesel fan indicates that this engine has been selected. The other two engines on the layout are silent.

We now run the switcher as a normal engine and use it to pick up the two waiting passenger cars. Pull them out to the mainline track (figure 15) to connect them to the rest of the train.



Layout With S.P. Engines Placed in Yard

Figure 14

This switcher engine is returned to its storage track and we do another reset. This time we select our Daylight GS-4 with a single HB press. This automatically de-selects the NW-1 switcher. You will hear the fast pump start up on the GS-4 and the NW-1 will fall silent. Now the throttle is used to move this engine down to the ready track as shown in figure 16 .

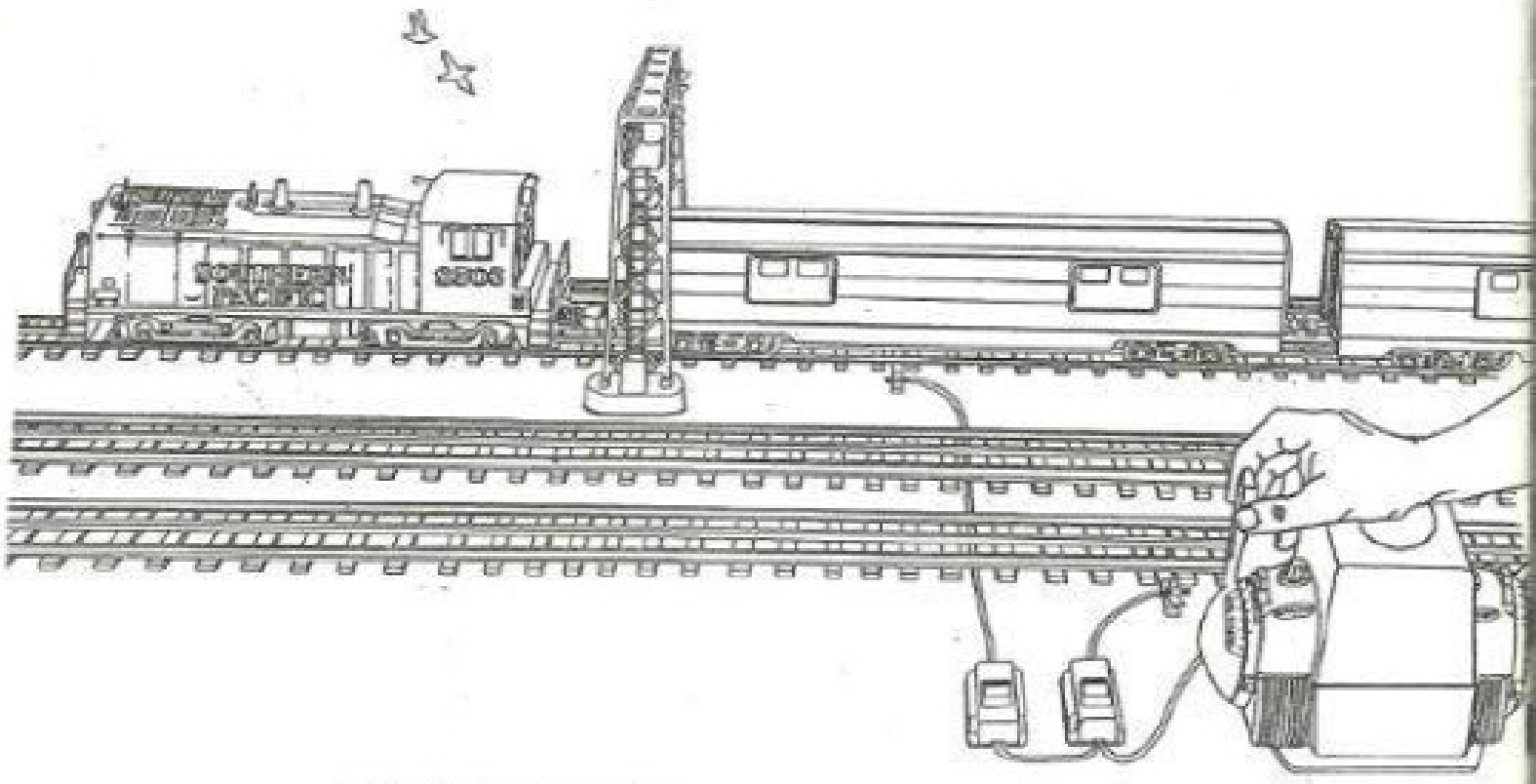
It should be clear that every time we select an engine we deselect another engine. This allows us to run any single engine we want while the others rest in silence. This is a principle worth remembering:

When you have many engines with different ID's on the same powered track section, and you use HB in reset to select an engine, only one engine ID will be selected at a time (i.e. selecting one engine's ID will de-select the other engine ID's).

Two corollaries to this principle are:

If two engines have the same ID, both will be selected or both will be de-selected at the same time.

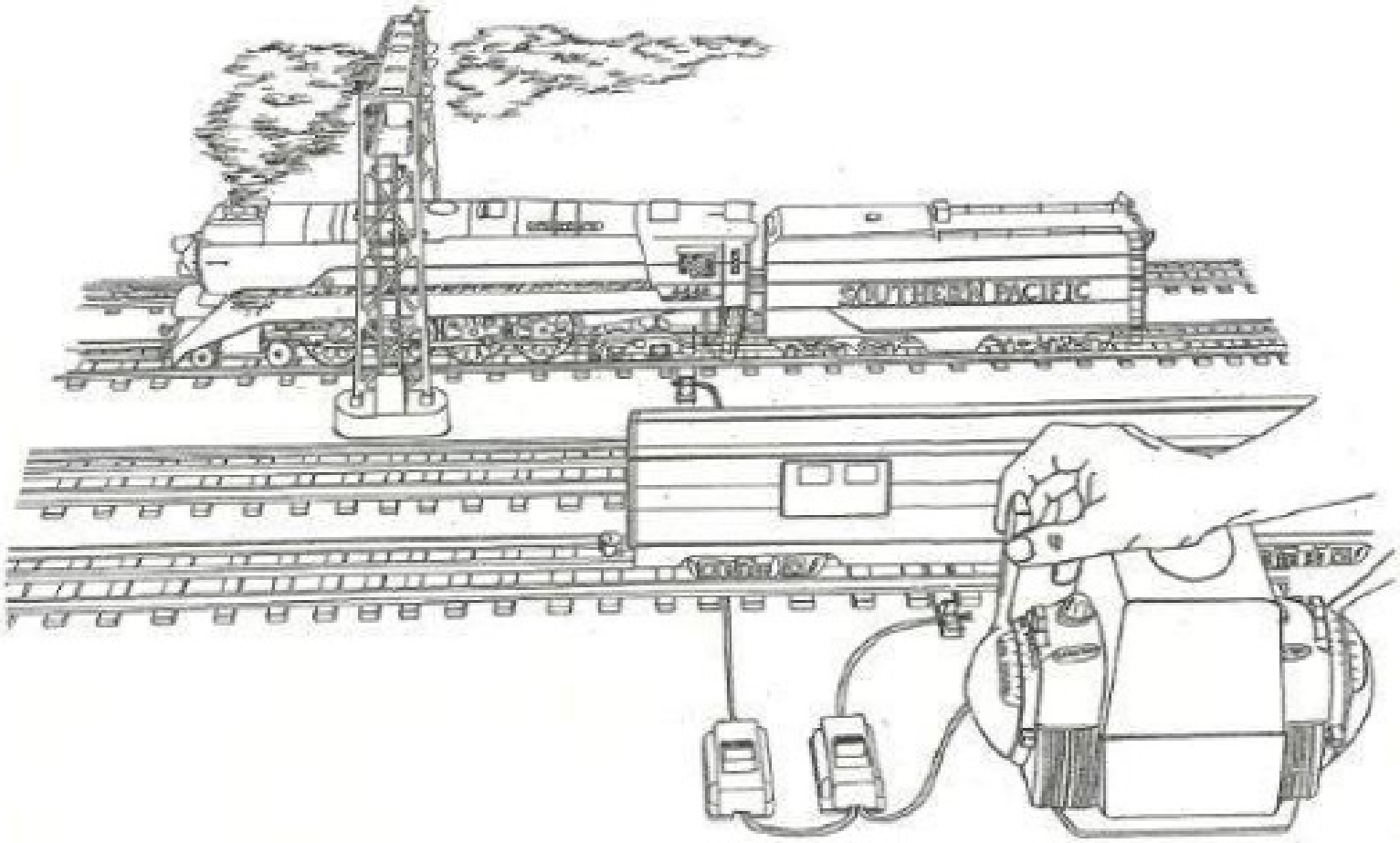
Once an engine is selected it will remain selected until de-selected and a selected engine will operate like a normal engine until it is de-selected.



Switcher Moving Passenger Cars
(Only the Switcher is Selected)

Figure 15

Let me make this principle very clear. If you have a selected engine and you do a reset, you will notice that it "comes on" when the power is restored and will start right out with the first press of the direction button. If you turn off the power until your engines goes silent and completely shuts down, you will notice that it comes back on when the power is restored. If you go out and have dinner, you will notice that the same engine is selected when you return to play with your trains; the next morning when you turn your layout on, the same engine is still selected. If you take your engine off the layout and put it in a box and store it away; it will still be selected when you put it on the layout again. If you give the engine to your son or daughter, and he/she gives it to their son or daughter, the engine will still be selected when it is put back on the layout. Even if you do not power up your engine for 99 years, it will still remember that it is selected. If you want to deselect an engine, you must return to reset and use HB to press any number except its ID number. If the number you use is not assigned to one of the engines that are on the powered track, then all engines will be silent (de-selected). I think I've laboured on this point long enough so lets get back to the yard.



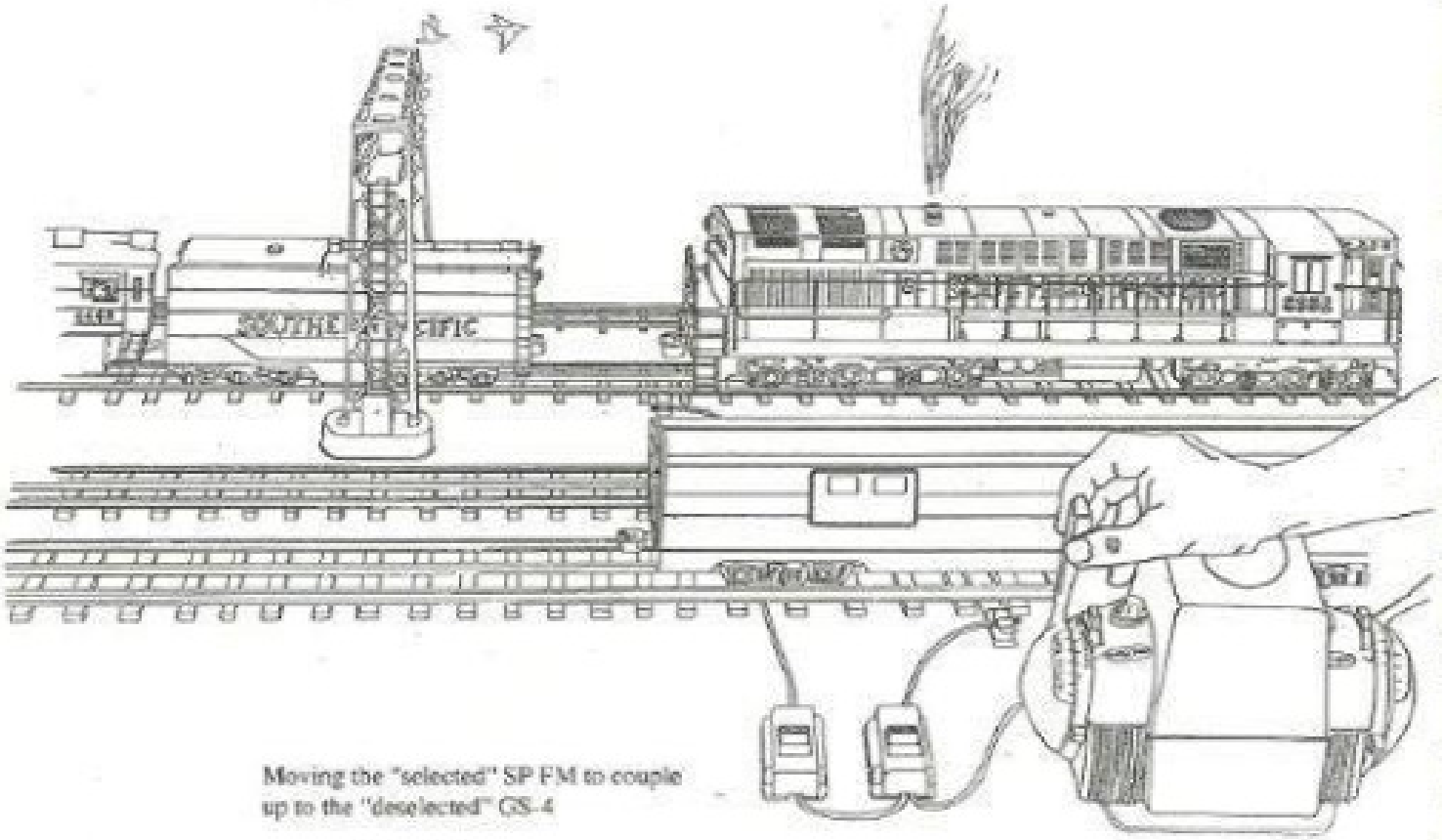
Moving the "selected" GS-4 Daylight on to the "Ready Track"

Figure 16

We want to run two engines together in a single consist (the GS-4 and the FM) that have different ID numbers. This is a problem since we will de-select an engine when we select another. How can we get two selected engines on the same powered track with different ID numbers? There are two ways to do this using only the TID's: one with no separate block sections and one with a separately powered "ready track".

Method #1:

We can select the FM and give it a new TID. This is simple enough: we do a reset, press HB twice to select the FM and then move the throttle up and down twice to access the second reset option (TID set) and press HB once to give it a new TID of #1. We can now use the direction button to put this engine into forward and move this engine to couple up to the waiting GS-4 as shown in figure 17.



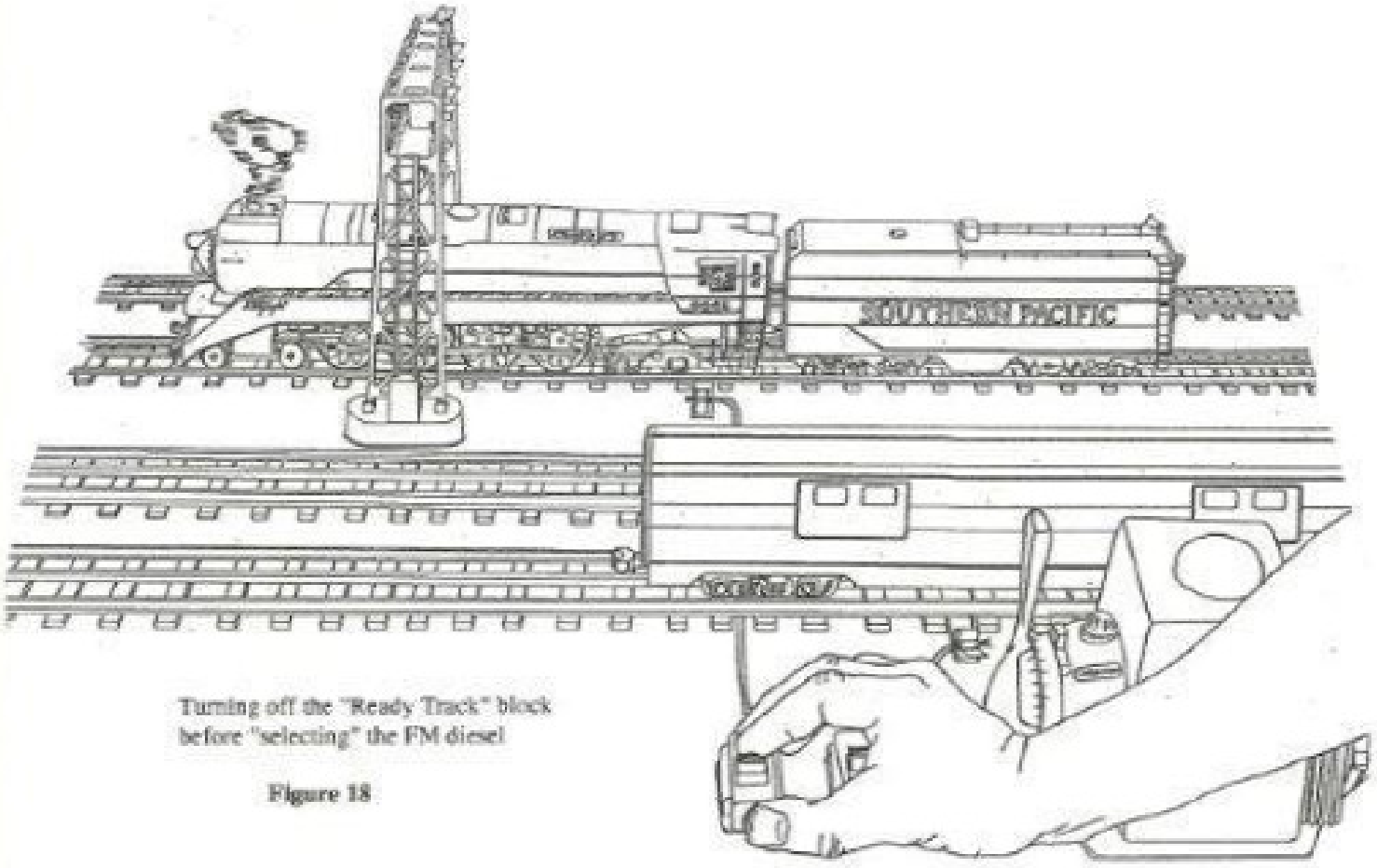
Moving the "selected" SP FM to couple up to the "deselected" GS-4

Figure 17

You may wonder why the GS-4 did not move since it has the same TID as the FM (#1). Remember that we selected the FM while it was still number #2 so the GS-4 was never turned on. Anyway, now that we have both engines coupled together, we can do a reset and select #1. Since both engines are #1, they will both turn on with a single HB press and both move out as a consist. We can now couple up to our waiting cars and pull our train out of the yard as shown below.

A problem with this method of making up consists occurs after our return trip. When we uncouple the passenger cars and return our engines to the ready track, we would like to put our two engines back in the yard, one at a time. Since both engines have the same TID (#1), it is not possible to select one engine only. The next technique solves this problem.

Note: You may want to put the FM in "slave" mode. This will prevent the horn from blowing or the bell from ringing in the FM and only the lead engine, the GS-4, will have these sound effects. Putting an engine in slave is easily done when the engine has been selected. Simple move to reset option #4 and press HB; the single "ding" tells you that this engine has been slaved. In the example above, we would have moved to the slave reset option right after we selected the FM and had given it the new TID number (#1). We would not have done another reset before we put the FM is slave since both engines would be #1 and both would have been slaved at the same time.



Turning off the "Ready Track" block before "selecting" the FM diesel

Figure 18

Method #2:

Suppose that we return to the point where the selected GS-4 is pumping away on the ready track and we want to select the FM. Since the GS-4 is selected and we do not want to deselect it when we make another selection, we turn the power off to the ready track, as shown in figure 18 . We then do another reset for the rest of the engines in the yard (the NW-1 switcher and the FM). Pressing HB twice selects the FM. We use the direction button and throttle to move this engine down towards the GS-4. As we approach the ready track, we turn the power back on and the GS-4 comes to life (remember - it is still selected). However, since the GS-4 came up in reset, it is in "neutral before forward" which allows us to couple the moving FM to the GS-4 tender to form this two engine consist.

Now both engines are selected even though both have different ID numbers. If we wanted to, we could turn off the ready track again and select the NW-1 switcher to form a three-unit consist of three selected engines, all with different TID numbers. However, we only need two engines for our consist so we will stay with the GS-4 and the FM.

We do a reset to put both engines in "neutral before forward" and use the direction button and throttle to pull both engines out as a single consist to connect up to our passenger cars. Now, on our return trip, we do not have a problem with putting engines away, one at a time. We simply do another reset and select the FM with two HB presses. After opening the coupler, we move this selected engine off to its storage track. Next, we do another reset and move the GS-4 off to the round house. If we want, we can now select the NW-1 to switch the passenger cars around for the next train assignment.

The above method works very well but does require a special powered block section and has the disadvantage of remembering to turn this block back on as your approach it with each new engine for the consist. We have a better technique without using blocks at all and will still allow you to have separate ID's for your engines. However, we do urge that you play with the simple TID concepts until they become "second nature", otherwise, the next section might be confusing.

Example 2: Road ID and Train ID:

We have two other ways to name your engines besides TID which we call Road ID (RID) and Engine ID (EID). This expanded naming system gives you the added flexibility needed for complex yard switching maneuvers plus the ability to select a larger number of engines on your layout without having numerically big ID numbers that require many pressings of HB. It is also very easy to use and remember.

Road ID (RID) is used to identify your engine as part of a road name like New York Central, Pennsylvania RR, Union Pacific, etc. Once you assign a Road ID to your different locomotives, you will select all engines within that road name simultaneously when you call up your RID. To select individual engines within a road name, you will use your Engine ID (EID). For instance, all of your N.Y.C. locomotives may be assigned to RID # 5 and you have also assigned your N.Y.C. Hudson as EID # 6. To call up this engine, you would first do a reset and then press HB five times to "wake up" all of the N.Y.C. locomotives. What you would see is that all N.Y.C. engines would come to life with all the steam engine compressors working and all the diesels idling. Next you would move the throttle up and down once. The air let-off sound would tell you that you have moved to the first reset option which is train select. Pressing HB six times will select your #6 N.Y.C. engine which is your Hudson. All other engines will be silent. This is a very simple and quick operation.

So why do we have a temporary ID number (TID)? Temp ID (TID) is a convenient way to make up train consists that can be referred to by a single name even though all engines have different RID and EID's. This way you can have a train with five engines that you call train #1 (TID #1) and another train with, say, three engines that you call train #2 (TID #2). In fact TID can also be called Train ID if you like, since the initials are the same. The reason it is called Temporary ID is because it temporarily replaces the RID number. When you enter a TID # in reset option position #2 (TID set), your engine RID number will be stored and the TID number will temporarily replace it. When you do a reset and use HB to select your engine, it will respond to the new TID number and not the old RID number. When you clear your TID number, the TID number is purged from memory and the old RID number takes its rightful place again.

Clear:

This is probably a good time to discuss the concept of clear. There are four "clear" operations in our system. The first is TID clear which is reset option # 3. In this reset position, pressing HB will clear your Temp ID number. When this happens, the RID number

takes its place. If you want to write in a new TID number, you do not need to clear out the old one; just go to reset position # 2 and write in a new TID number.

Engine ID's (EID) and Road ID's (RID) are cleared in reset position 17. In this position, when you press HB once, you will hear one ding and RID will be cleared. If you press HB again, you will hear two dings and both RID and EID will be cleared. Again, you do not need to clear your RID and EID numbers to assign new ID's; you can simply go to reset positions #15 and #16, and change your RID and EID directly.

Clearing your RID and EID numbers is equivalent to assigning "0" as your ID number. A "0" ID can only be assigned with a clear since there is no way to press HB zero times in any of the "ID set" reset option positions. When an engine has a "0" ID, it means that it will always be selected no matter what number you use when selecting your engines. In other words, if you had an engine with an ID # 4 and another with ID # 0 (a cleared engine), then when you try to select # 4, the # 0 engine would also be selected. If you tried to select any engine at all, the # 0 engine would still be active. The ID number "0" is like a wild card since it stands for any number. Since there are three ID numbers that can be assigned, we have a "clear" operation for each one. A TID clear operation applies only to TID. A clear operation on RID applies only to RID. A clear operation to EID occurs only after an RID clear has occurred - and so, the EID clear operation will clear both RID and EID. If you clear the TID, the engine can still be selected or deselected when your address either RID or EID. You would need to clear all three numbers in order for the engine to be selected under all conditions. This is how the engine comes from the factory; it operates under all select conditions. The principle of "clear" is worth committing to memory:

A "clear" applied to any ID type will assign a number "0" for that ID which is equivalent to always being selected for that particular ID type. If all three ID types are cleared, the engine will operate under all select conditions.

As an example of using TID, RID, EID and clear, assume your engine had a RID of 1 and a EID of 2. This engine could be selected by: 1) resetting and pressing HB 1 time and interrupting the power to go into forward, or 2) by resetting and pressing HB 1 time, moving to reset option #1 with the throttle and pressing HB 2 times and interrupting the power to go into forward. If you now wanted to give this engine a temporary ID of #3, you would select this engine and move to reset option # 2 (Temp ID Set) and press HB three times. Now this engine would be selected in the same two ways as above but you would need to press HB three times after resetting; in other words, it looks like your engine has a RID of #3. However, when you clear your Temp ID number by moving to reset option #3 and pressing HB, your old RID number (#1) is back in place. If you wanted this engine to always select directly after a reset, you would need to move to reset position #17 and press HB once; this will clear RID only. Now when you do reset and press any number, your engine will start up. If, however, you use the throttle to move to the next reset position (EID select) and press HB, your engine will deselect. If you press HB again, your engine will come back to life. Remember, you did not clear your EID in position #17, only your RID and since this engine has an EID number of 2, your engine is now selected. Of course, if you pressed HB one more time, it would deselect. If you wanted this engine to always select no matter what ID number or type you used, you will need to go back to reset position #17 and press HB two times. The double ding indicates that both RID and TID are cleared.

Now that you know about TID, RID, EID and Clear, let's return to our layout example and use all three ID numbers to make these ideas really clear. We will throw in a bunch of U.P. engines so that we have another road name present. Our roster includes the following:

Engine	RID#	EID#
S.P. engines		
Williams S.P. GS-4 Daylight	3	1
Lionel S.P. Black Widow F.M	3	2
Lionel S.P. NW-2 switcher	3	3
U.P. engines		
Weaver F.E.F. 4-8-4 steam	4	1
Lionel F3 AA set	4	2
Lionel U36B	4	3

List of Engines With Different Road and Engine ID Numbers Used in Second Example: a Total of Six Separate Locomotives Under Two Different Road Names

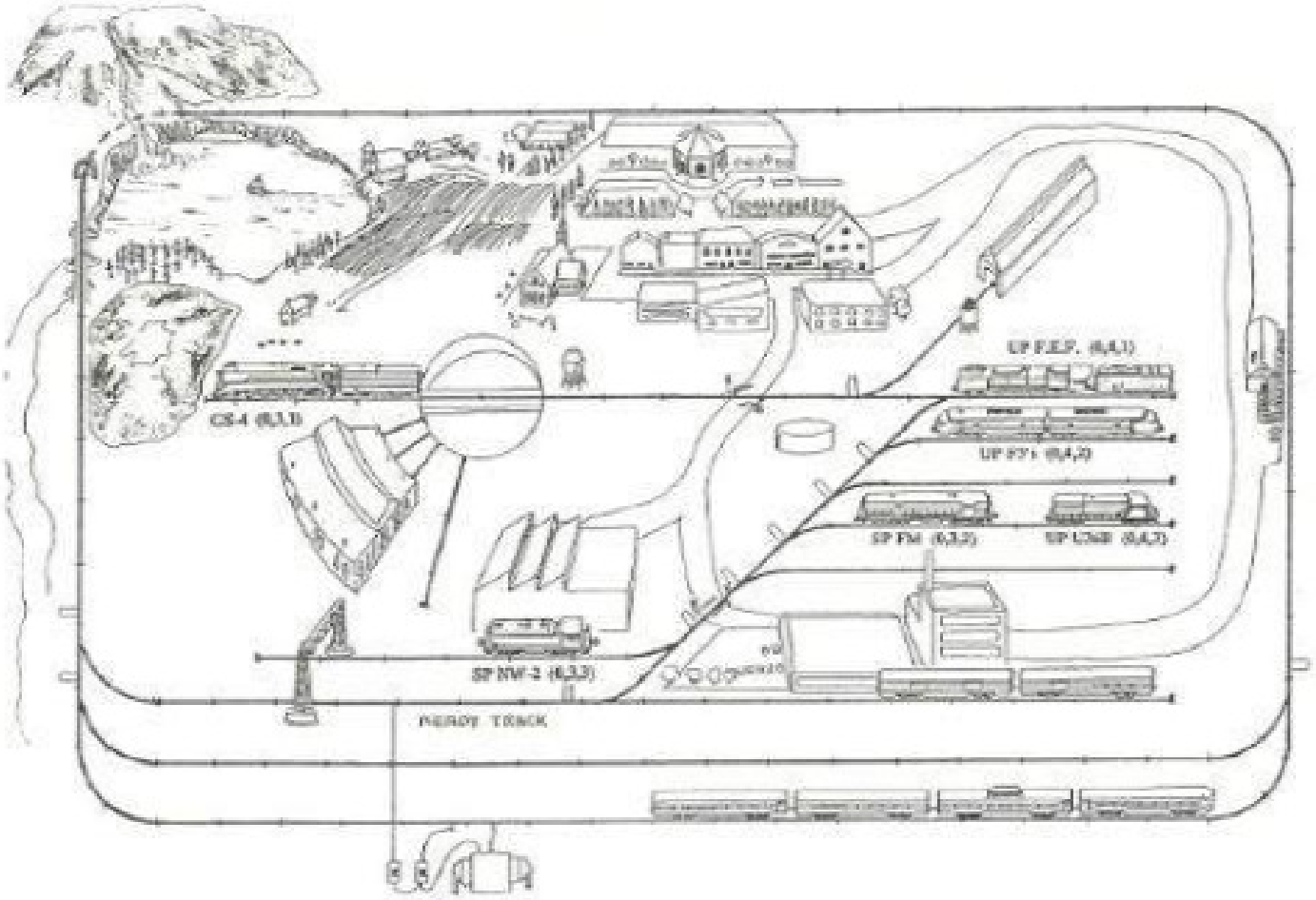
Table 2

In order to give each of these engines their respective ID numbers, you will need to place each engine on the layout one at a time to give them their new ID numbers. This assumes that they are all fresh from the factory and have had all of their ID numbers cleared.

Our task in this example is the same but this time we are going to make up a multiple unit diesel set using the UP U36B and the SP FM to pull our passenger cars around the track. We first place each engine on the layout one at a time and assign the RID numbers and TID numbers listed above. We have chosen RID # 3 for all SP engines and RID # 4 for all of the Union Pacific Engines. As an example, lets give ID numbers to the Union Pacific U36B. We place this engine on the track and turn on the power. We assumed that this engine is cleared and that it will come on with motor sounds right after the double "reset" ding. We now proceed to move to the fifteenth reset option position using the throttle. The three clanks tells us we are at the correct reset option. We press HB four times to give this engine its RID # 4. We then move the throttle up and down once to advance to reset option # 16, which sets the EID set, where we hear three clanks and one clink. We press HB three times to give this engine a EID # 3. All of the engines are given their own ID's and are placed on the layout as shown in figure 19 (next page).

We can now call these engines up one by one to bring out to the ready track. To bring out the S.P. FM, we do a reset and press HB three times to turn on all the S.P. engines. We then use the throttle once to move to the next reset option and press HB twice to select engine #2 from the S.P. roster. All other engines go silent since they will all be de-selected. Before we move this engine to the ready track, we move to the next reset option position (TID set) to give this engine a Temporary ID (TID) equal to #1. This will allow us to make up a consist that we can refer to with a #1 TID. When we select the next engine, the UP U36B, we also assign it to have a temp ID equal to #1. We now move the U36B engine to the ready track and couple up to the waiting FM. After a reset, we select TID #1 and notice that all the engines come on in our #1 consist. It is a simple matter to connect these engines to our passenger cars and move this train to the mainline tracks for it's run.

When this train returns back to the yard, the advantage of TID becomes very clear. After we uncouple the passenger cars, we move the engines to the ready track and do a reset. All engines in this consist, of course, come on when the power is restored. We move to reset option #2 for all engines which is TID clear. Pressing HB clears the TID numbers and returns the previous RID number. Now, each engine in our consist can be selected one at a time using the original ID numbers. We do another reset and select RID #4 which turns on all U.P. engines including our UP U36B. We then select engine #2 from the UP roster, and only our U36B will start up. We move this engine back to its storage track and do another reset to select the SP FM and move it to its storage track.



Both UP and SP engines on layout to demonstrate "Road" and "Engine" selection. Each Locomotive is Labeled and Their Temp, Road and Engine ID Numbers Are Shown As: (TID,RID,EID)

Figure 19

RID and EID along with TID make it possible to avoid blocks completely and allows you to make up complete trains that all have the same ID number. We suggest that you reserve RID numbers 1, 2 and 3 to use for your TID numbers for individual train consists. If you think you will have more that three train consists on your layout at one time, you may want to reserve more RID numbers to use for TID.

Notice that when we were breaking up our consist in the above example, we had to momentarily turn on all UP engines in our yard in order for us to select our U36B on the "Ready Track". Of course, all the engines in the yard went silent when we selected the U36 EID, but it was nevertheless, a nuisance, when all the UP engines started up together just to be shut down again when we made our U36B EID selection.

If all the engines in our consist were from the same road name, we would not have had this problem. For instance, imagine that all engines in our #1 train are UP. We can pull off each engine one at a time without having the whole yard "wake up". Here's how. We first select our train with TID #1 and then select our engine. Since there are no other engines in the yard with a TID #1, only the desired engine in the consist will be selected. When this engine starts up, we move to reset option #2 to clear the TID number and

move into forward to put this engine on its storage track. Once the TID number is cleared, it will have its old RID and return to a normal engine in the UP roster. We return to our consist by again selecting TID #1 and the EID # for the next engine, clear its TID and return to it to its storage track.

You do not have to limit yourself to using RID to label your engines according to road name. For instance, you may only run one road name and would prefer to use RID to classify engine types like large steam, articulated steam, Alco diesels, GE diesels, electrics, etc. Now, when you select an RID number, perhaps all of your FM's would "wake up" and all other classes of engine would be de-selected. You can also classify according to the age of the engines (early steam, late modern diesels, etc.) or perhaps you might classify engines by pulling power or ones that MU together well. Please use these ID numbers in a way that works the best for you.

We propose the following list as a standard for assigning engine RID numbers to the most popular Lionel engines. This is intended for those model railroaders that belong to clubs or run equipment on different layouts. This way, the RID's will, at least, be consistent.

Road Number	**Road ID #** (RID)
Pennsylvania RR	4
New York Central	5
Union Pacific	6
Santa Fe	7
Southern Pacific	8
Chicago and Northwestern	9

A Proposed Standard for Road ID Assignments

Table 3

The first three RID's have been reserved for TID numbers or for your own RID's if your favorite road name is not listed.

The examples here give you an idea of how to use the QSI ID numbers. There are very easy to use as long as you are consist in how they are assigned and do not change the RID and EID number too often. If you are always changing RID and EID names, you will not remember which engine is which. This is the reason for TID numbers - they are made to be temporary. The other two ID's should be considered permanent and only changed with due consideration. We do suggest that you start only with the TID assignments and leave both RID and EID alone until you master some of the basic ideas.

"All select" and All deselect" - using your engines with block control:

All select and all deselect, as we described earlier, provide a way to select and deselect your engine or engines on a powered track without using your ID numbers. An "all select" occurs after a reset by pressing HB and holding for three seconds; you will hear your silent engines all come to life at once. "All select" does not clear any ID numbers; your engines retain their individual identity but will simply be all selected on the same track. In fact, if you press HB again, only the engine with TID or RID #1 will start; twice will select #2, etc. However, "all select" only works after a reset for the first HB. There after, all HB, no matter how long there are "held" will not do an "all select".

There are several uses for "all select":

1) **Using block control to select engines:** If you simply want to use block control to start engines, there is no reason to use th engine ID's to turn on a locomotive. Just power up only that block and press HB for three seconds; your engine will start.

2) **Reassigning ID numbers:** If you have an engine on a powered block and simply want to start it up so you can give it a new se of ID's, simply use "all select" to get it started. This is particularly useful if you have forgotten your engines ID numbers and d not want to do an exhaustive search to turn on your engine; just do an "all select" and give it a new set of ID numbers.

3) **Making up consists of engines with different ID's:** Since "all select" will start all engines on a powered block, you will b able to select all the engines in your consist at once even though all have different ID numbers. For our layout example when we were using only TID's, "all select" provides a third alternative method to make up and break up our trains:

Method #3:

Again, we return to our layout where we have TID's assigned to our three S.P. engines. We are at the point where the GS-4 i pumping away on the ready track and we want to bring up the FM. This time we select the FM directly in reset which de-select the GS-4. We move the FM to couple to the waiting GS-4. We now have the same problem that both engines have a different ID number. To overcome this, we turn off the power to the yard leaving only the ready track powered. When we do a reset, we press HB once and hold it for three seconds to do an "all select"; both engines come on together. We then return power to the rest of the layout and connect up to our passenger cars to pull this train around the layout. When we return to yard and we can use the GS- and FM's individual ID numbers to put these engines away one at a time.

All deselect:

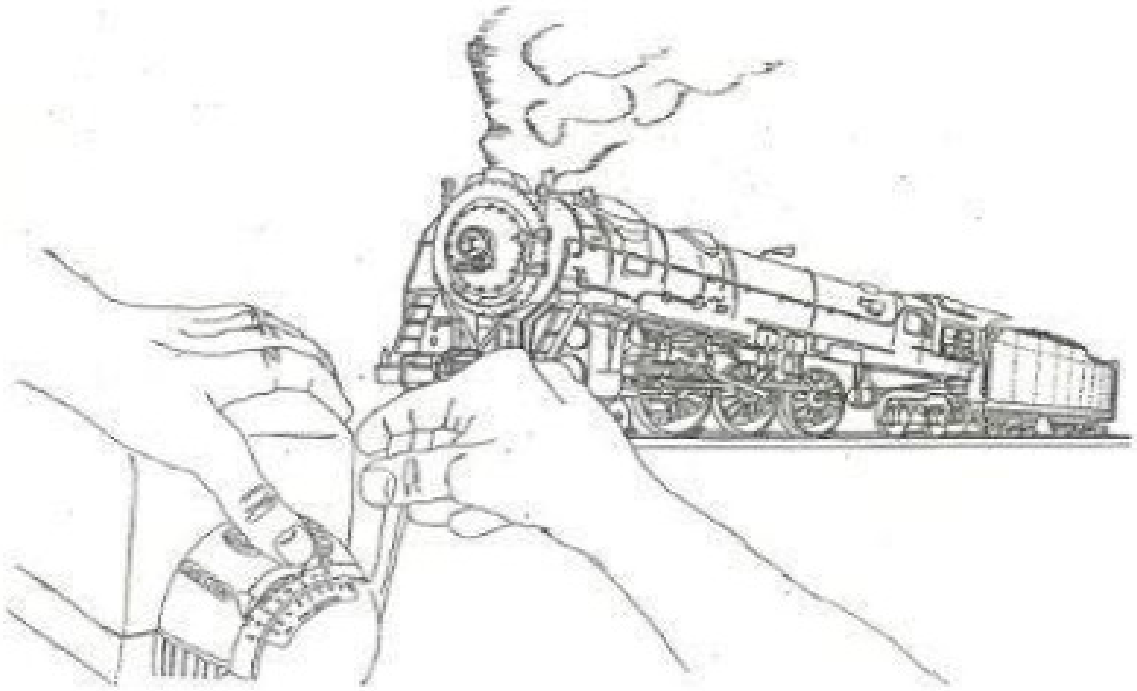
All deselect will turn off all engines on a powered block. An "all deselect" occurs only in reset when you press the Lionel bell button. You will hear no feedback "ding" but will notice that all engines fall silent. All deselect does not clear any of your engine ID's and any engine can be selected after another reset.

There are a number of places where an "all deselect can be useful:

1) **Moving trains onto occupied tracks:** Imagine that you are pulling into a yard that is un-powered. As you turn on the powe you notice that many of your engines come to life. Since you want to stop your train and switch some cars, you realize that this will also make your yard engines move as well. You can avoid this problem by pressing the Lionel bell button as you pull int the yard. This will turn on the bell in your moving engine but since all the other engines in yard are in reset, this same bel signal will "deselect" all of the other engines. This technique also works well when you want to pull onto a siding to pick up a car where there is already a selected but un-powered engine on this track.

2) **Turning off engines with different ID's in consist:** Suppose you are pulling into a station with a consist of six engines wit different ID numbers and you would like to shut them all off but you want to leave the power on the track for the passenger cars. The easiest way to do this is to use "all deselect". This also works well when you want to stop to operate some accessory that requires track power but would like to shut the engines sounds down temporarily.

Using Lock-Out



Lockout is achieved by pressing the horn button and turning the power off briefly

Figure 20

QS-1 has the ability to lock-out the directional state of the QSI reverse unit by remote control. No levers or switches on the engine are needed. Lock-out is easily done using the horn button. You first place the engine into the directional state that you want to lock and then press the horn button. While the horn or whistle is blowing, interrupt the power with the throttle lever until you hear a short whistle or horn blast and then quickly turn the power back on (see figure 20). The engine is now locked in that directional state and will remain there through all power interruptions including resets, total power downs or storage in a box for 99 years.

To get your engine out of lock-out, do the same procedure again except leave the power off for a complete reset (listen for the single "ding"). Your engine will now return to normal operation. Note that if you attempt to lock out your engine and continue to leave the power off until the reset "ding" occurs, you engine will not be "locked". The procedure of holding HB and turning off the power for three seconds, always unlocks your engine, regardless of it previous "lock" status.

Note that once an engine is locked out, it will always be selected until you take it out of lock-out and de-select by selecting another engine. This means that a reset has no effect on a locked-out engine and engine features in the lock-out state will always be accessible. Unless you are aware of this you may be surprised that an engine locked-out in neutral on a siding will respond to HB by arming the uncoupler or turning the bell on and off.

There are a number of uses for lock-out:

1) **Running trains with many engines:** Since lock-out is easy to do and undo, it is good practice to lock your consist as you leave the yard with your train. This way, none of your engines will "drop-out" into neutral because of faulty switches or dirty track. With a large number of engines, it can happen that one engine might "drop-out" and you would not notice.

2) **Running your locomotives with block signal control:** If your layout has block signals that shut the power down to your block track sections when a red "stop" light is encountered, you will need to lock your engine in forward. Since it is so easy to lock and unlock you engine, you can still have all the advantages of directional control when ever you want it and still lock it out for the block signals.

3) **Locking your engine in neutral:** Occasionally it is desirable to have your engine idling away on a siding and not have it respond to directional control. This can be done by locking the engine in neutral by using the same procedure described above. However, since it is locked in a directional state, it will respond to HB by turning on and off the bell or arming and firing the uncoupler. You can suppress these features by first putting your engine into slave mode before it is locked out. This way, only the pump and hiss on your steam engine or the motor on your diesels will have sound.

4) **Making up consists:** You can use lock out to make up consists on your ready track using only TID's without needing blocks. We will use our layout example again to show how this works:

Method #4:

Again we return to the point where the GS-4 is selected and pumping away on the ready track. We do a reset and select the FM and place it in slave mode before we move it to the ready track. Since the GS-4 is de-selected, we can move right up behind the waiting steamer. We put the FM into neutral and use the reverse unit-out to lock this engine in this non-moving directional state. Now we can select the GS-4 after a reset and move back to couple to the FM. Note that the FM is still selected but will not respond to the transformer because it is locked in neutral. We then leave "lock-out" by pressing the horn button and turning the transformer to off. After we hear the bell, all engines will be out of "lock-out" and can be moved as a single consist. When we return from our trip, the engines can be individually selected to return to their storage tracks.

> **Note:** If you have a number of locked engines on sidings on your layout and you wish to unlock a specific engine, remember to turn off all power to all other locked engines or they will all unlock together.

Using Reversal and Slave

The reversal mode allows engines to start in the opposite direction after a reset has occurred. For instance, you may want to have two powered F3 units connected back to back. After you have selected the second engine, you would move to reset option # 5 and press HB. The next time power is interrupted, your engine would start backwards and will thereafter reset to "neutral before reverse".

In our layout example, suppose we wanted to have the FM in slave mode and be connected facing back from the steam engine. After we selected the FM, we would move to reset option #4 and press HB and then to reset option #5 and press HB again. You will hear a single "ding" in either option indicating that you have done this correctly.

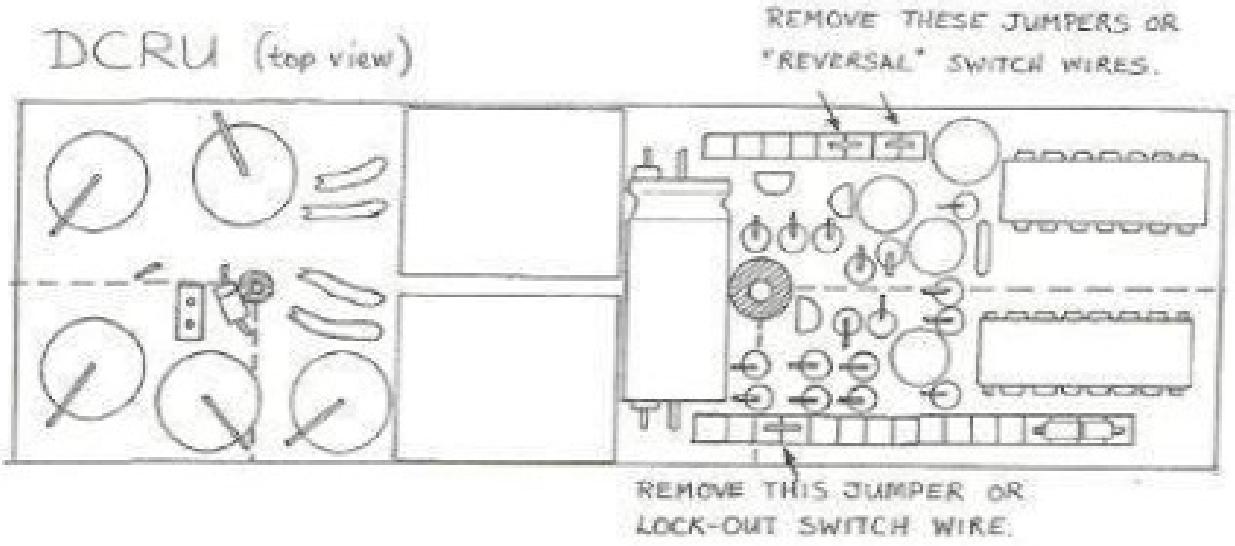
To change back to normal forward direction, you will need to reset and move to reset option #5 and press the horn button. You will hear a short whistle blast to indicate that you are returning to the factory setting (neutral before forward). Generally, on all toggled reset options we use a whistle blast to indicate one state and a bell ding to indicate the other. This is important enough to commit to memory:

Whenever we return to the original factory setting on any option that can toggle between two states (i.e. on-off, slave-non-slave, forward-reverse, feedback on- feedback off, etc.), you will always hear a short whistle or horn blast. A single ding occurs when the changing from the factory state.

Installation

QS-1 was designed to work with all O'Gauge engines that operate on three-rail track. The two boards that make up our train control and sound system simple plug into any of the QSI reverse units except the ACRU-E. QS-1 can also work with this smaller unit but special wiring is required to cable over to reverse unit. Many engines already have the QSI reverse unit installed at the factory. These include all 1991 and 1992 Weaver engines, 1990,91 and 92 Williams engines, and certain Lionel collector edition engines. All of these Weaver and Lionel engines already have allocated space for the QS-1 unit and most already have speaker holes included. QS-1 and its companion board is shown in stalled in a Williams Niagara tender in figure 22 .

Note: If you decide to separated the speaker wire from the QS-1 board for easier installation, be sure to note the proper place to re-attach this speaker cable to the QS-1 board.



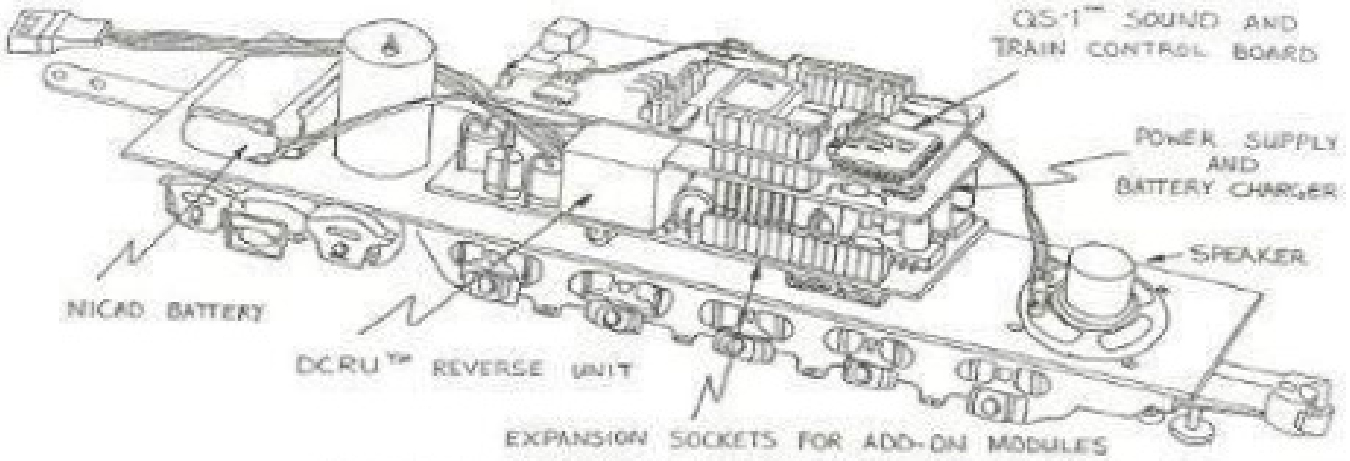
Top View of QSI DCRU Reverse Unit

Figure 21

Installation is straight forward:

1) Remove the engine cab or tender shell.

2) Remove the three jumper straps from the socket strips that run along the sides of the reverse unit as shown in figure 21 . If your reverse unit does not have these straps, you will need to take your reverse unit to an authorized service station for alteration. If your engine has wires that go to the lock-out switch, either tape the wire ends or remove the wires and switch completely since a separate lock-out is not needed with QS-1.



QS-1, PS1 and DCRU Reverse Unit Installed in Williams Niagara Tender:

Figure 22

3) Verify that you have enough space (minimum recommended head room is 1.8") for the two boards by using a ruler; you may have to move the position of the reverse unit and in some cases you may have to machine some of the extrusions in the tenders in order for the board to fit. In particular, the bottom extrusions on the bottom the tender cab may need to be cut back in order to clear the electronic boards when the cab is replaced. After you have convinced yourself that there is room, plug in the smaller power supply board, PS-1, into the socket holes on the reverse unit. Be sure that the pins line up in the holes before you press the boards together. When the board is in place it will fit snugly down right on top of the reverse unit and some of the components will almost touch the two reverse unit IC's (flat gray/black parts with many legs); see figure 23 (next page). Also, it is a good idea to cover the inside of the roof on brass tender cabs with electrical or suitable insulator to insure that electronics on QS-1 do not touch this metal surface.

> **Note**: If you have to relocate the reverse unit, you may need to extend the wire length to the marker lights and bulbs. If length permits, tape the extra wire to the roof of the tender to keep the wires from laying on top of the speaker and vibrating.

4) Now slowly and carefully press the larger board, QS-1, into the socket pins on PS-1. This should also be a snug fit.

5) Find a suitable place for the battery clip and attach with the double sticky foam tape provided. In some tenders you may have to remove or relocate the weight for additional space. The battery used by QS-1 is a 7-cell, 8.4 volt NiCad. If you need to replace the battery, be sure that you do not use the far more prevalent 6-cell, 7.2 volt NiCad that is typically found at Radio Shack, drug stores and super markets. If you have difficulty locating an 8.4 volt NiCad, try a commercial electronics supply store located in the "yellow pages" under Electronics - Parts, or contact QSI for a replacement.

6) The speaker mounts directly over holes that are located over the rear truck in many engines. Some early engines have the holes in the wrong place and you will have to drill a new set of speaker holes. Remove the rear truck to drill the new holes. If you have the room, use the speaker resonator included with QS-1. Use Walthers "Goo" to attach the speaker to the resonator. Be sure that you do not get any of this glue on the speaker diaphragm since this will seriously degrade the sound quality. Also, the magnet should be mounted inside the resonator. Use additional Goo to attach the speaker and resonator to the metal chassis. Always verify that you have room before you attach the speaker.

7) Attach the speaker wire to QS-1 and re-assemble the cab; make sure that no wires are caught between the cab and the chassis. If it does not fit down all the way, do not force. Re-open and recheck clearances.

QS-1 will accept other circuit boards through a number of output connectors. In addition to the coil coupler circuit board, you will be able to add special circuits to give different lighting effects such as simulated fire box flame, overhead blinking lights, etc. and perhaps some controllers to move the reversing levers or throttle linkage. In the future, we can even have a waving engineer or a swinging bell. The point is, that QS-1 allows you to expand you basic system indefinitely with new effects and features inexpensively and in a way that is integrated into the entire system.

Troubleshooting

The following list of questions and answers should serve to get you out of most common troubles that could occur when operating your QS-1. In addition to being helpful in recovering from some difficulty, this section should prove interesting reading as well as educational. Often a difficulty arises from simply misunderstanding the normal way QS-1 operates.

1. When I interrupt the power, my engine goes backwards! *By this, I presume you mean: After the power is turned off for 3 (or more) seconds to do a reset, the engine's direction after a power interruption is reversed from what you expected. This means the engine is in REVERSAL.To return the engine to it's "forward orientation", go to rest position #5 and press the Horn Button (HB) once. Exit reset with a power interruption. Your train will now run in "forward".*

2. I try to select engines or make settings in reset, but nothing happens - the bell ringing toggles on in response to HB pressings, but, otherwise nothing happens. *The wires between your transformer and the track need to be reversed.*

3. When running my engine, I press the HB expecting the horn to blow, but the bell comes on instead. *the The wires between your transformer and the track need to be reversed.*

4. I'm in neutral and WHISTLE/BELL EXCHANGE is ON, and I'm in Low Throttle, I push the HB and the bell comes on. *The wires between your transformer and the track need to be reversed.*

5. I operate the uncoupler, but my coupler does not open. *The problem is most likely that you have not purchased the uncoupler option which is sold separately. If you have purchased this option, make sure that the various uncoupler options in reset are all enabled. Second, make sure the plug from the uncoupler option is connected to QS-1 correctly.*

6. I operate my whistle and two unusual things happen: first, it seems to turn on very slowly or sometimes not at all. Second, the sound of the whistle is distorted or seems to have a "dead spot" in it when I release the HB. *The battery is disconnected, damaged or "worn out". NiCad batteries normally last about 5 years. In some very unusual operating circumstances, it may be possible to discharge the battery. Before you replace the battery, try allowing your engine to sit with the power on about half way for about 6 hours. Or, remove the battery and recharge on a commercial charger.*

7. When I turn off the power, the sounds cut off immediately rather than lasting through brief power interruptions or the 3-second reset time. *The battery is disconnected, damaged or "worn out". NiCad batteries normally last about 5 years.*

8. When I turn off the power, the sounds from the locomotive keep going, and going, and going for 8 seconds or so. Do I need to turn the power off somewhere? *This is exactly what QS-1 is supposed to do. QS-1 has a battery back up that allows the sounds to continue for up to 8 seconds after the power has been turned off. This allows the sounds to continue naturally even during power interruptions during normal operation. The battery is recharged during normal operation - there is no switch to turn the battery off.*

9. The sounds are distorted and/or scratchy. *The most likely cause is the speaker installation. Check that no metal slivers are stuck to the paper speaker cone and that no wires or other objects are touching the speaker cone. Check that there is no glue, double-sticky tape or other adhesive touching any part of the speaker cone. Examine the speaker for any evidence of a torn speaker cone. If the speaker is damaged, replace with a 2" round , 0.2W, 8 Ohm, speaker - or contact QSI for a replacement.*

10. My cab (or Overhead Blinking) light does not work or is very dim, or it blows the lamp out in a flash. *First of all, the Cab/OH light only comes on if the engine is selected; if deselected this light will be off. The Overhead blinking light must be plugged into the correct QS-1 socket with the correct polarity. Try reversing the polarity. If an LED is used for the cab light, being plugged in backward could be the cause of it not working. The Cab/Overhead light output delivers about 15-20 mA of DC current at a 5V bulb. The lamp must be connected to both pins on the Cab, Overhead light plug - I.E., "do not" return the lamp to chassis ground. This will blow the lamp out.*

11. The engine seems to be selected, in fact I can even turn on the bell and operate the uncoupler sound, but the engine won't move. *The engine is "locked-in" neutral. If you want it unlocked, press the HB and while holding the HB, turn the power off. You can let go of the HB as soon as the power is off. Turn the power back on as soon as you hear the "ding". Your engine is now unlocked and in reset, and should function normally.*

12. The engine just goes in one direction. I can't seem to make it stop. *The engine is "locked-in" forward (or reverse.) If you want it unlocked, press the HB and while holding the HB, turn the power off. You can let go of the HB as soon as the power is off. Turn the power back on as soon as you hear the "ding". Your engine is now unlocked and in reset, and should function normally.*

13. I thought QS-1 has engine selectability. But no matter which engine I choose, my QS-1 engine is always selected. *See Operator's Instructions on engine selection - your Road ID and Temp ID and your Engine ID are all set to zero. This is an "always select" setting. Your engine was shipped to you with this setting. Read the Operator's Instructions to learn how to set the Road, Temp, and Engine ID's.*

14. No matter what I try, I just don't seem to be able to select my engine. *There is a very slim chance that some sort of noise spike modified your engine's address. Much more likely is that someone in your family (perhaps as a joke) set your Temp/Road ID to some high value thinking you would never figure out how to get your engine going. To get your engine selected (so you can then change the Temp/Road ID to what you want) all you need to do is: do a reset and press HB once and hold it pressed for 3 seconds. This will select any and every engine that is on that powered block. This is called a "Select All". Once you have gotten this engine selected you will want to clear the Temp ID and the Road ID. Cycle back through reset and re-establish the ID codes that you want. Check the Engine ID and set it to what you want. Scold your children if they did it - obviously it is not really funny.*

15. I pressed the HB to sound the whistle on my selected engine(s), but instead I got one bell "ding" and the engine(s) I was running went silent. *You were probably running your selected engine(s) so slowly that you did not notice when you actually turned the power "off". The "ding" that you may or may not have noticed was the reset indicator. Your selected engines deselected because you were in reset position #0, pressed the HB once and selected Temp/Road ID = 1. If the train you were running was not #1, then it would become deselected. This problem is especially possible if you are using a Right-Of-Way transformer. This transformer runs down to extraordinarily low values. Any voltage below 1.9V AC will be regarded as "off" by QS-1. Just be mindful of what you are doing when the throttle is nearly off.*

16. My engine runs fine, but there is no chuff. *The chuff volume is set to zero. Go to reset option #10 and set the volume as you wish.*

17. My engine runs fine, but the chuff starts only when the engine is moving fairly fast. There is no chuff at lower speeds. *The chuff threshold is set too high. Go to reset position #27 and adjust the chuff threshold to a lower setting.*

18. My engine runs fine, but neither the whistle nor the bell will sound. *The engine is set with slave=on. Go to reset position #4 and press HB once, returning the engine to slave=off. Slave=off is the default (normal) way the engine is set when you received it from QSI.*

19. Sometimes when I run my engine, it just resets for no apparent reason. *You have run your engine over a dead spot in your layout and lingered there long enough (3 seconds) to cause a reset. Sometimes it is hard to tell that you hit a dead spot on your layout since the sounds keep on going. Investigate why your layout is dead in this particular spot. Also, check your locomotive to be sure that both of the rollers are actually hooked up.*

20. Sometimes when I am running several engines in an MU consist, one of the engines will get out of synch for no apparent reason. *You have run your engine over a dead spot in your layout and lingered there long enough (0.3 seconds) to cause a direction change. Sometimes it is hard to tell that you hit a dead spot on your layout since the sounds keep on going. Investigate why your layout is dead in this particular spot. Also, check your locomotive to be sure that both of the rollers are actually hooked up.*

21. I cannot get any of the reset positions except #0. Also, I can only get the bell to operate in neutral - i.e. I cannot get the uncoupler armed or operational. *The transformer you are using is not powerful enough to get a "high throttle" reading. You need to get at least 12 V. delivered to the engine. With some small transformers (e.g. a Lionel 1033) you may have a problem getting*

26. I go to reset and the pump on my selected engine can be heard pounding away. But, when I get to option #3, the pump stops. In fact it is stopped for all reset positions higher than #2. *Is my engine now deselected, or is my unit maybe defective? No problem here. This is exactly how your QS-1 is supposed to behave. We turned the pump off in reset positions higher than #2 so you can clearly hear what is occurring in these higher reset positions. If your engine was selected in the lower reset positions, it remains selected in the higher reset positions - even though the pump stopped.*

27. Most of the time I don't have much trouble with selecting engines (addressing) and features (bell, whistle, uncoupler, etc.), but occasionally my QS-1 will miss one or more of my HB commands. *The electrical load on your transformer is too low for the HB signal to be detected. Refer to " The Lionel Transformer Explained in the Appendix".*

28. I am often surprised that something happens that is different than what I expected. For example, I reverse an engine to be part of a consist, but when I go to run the consist, parts of the consist are "dead" while the engine I just reversed is "alive". What's going on? *The Train Control and Features must be enabled and used in a proper sequence. Review the material in the Operator's Manual relating to reset options. In the case given here, the problem is that when the specific engine was selected (so that it's direction could be reversed), the other portions of the consist were deselected. To get the entire consist operating together, you must give all the engines a common identity. Perhaps they already had a common identity (such as TID=2). If this is the case, you probably called up the engine to be reversed by calling out it's identity as (TID + EID, for example TID=2 + EID=3). When you did this, the rest of the consist (TID=2) deselected. You reverse the one engine. Now, you must explicitly select TID=2 (with no further EID extension). This will re-select the entire TID=2 consist. If the reversed engine has a TID different than the rest of the consist, then you need to set this engine's TID to 2, and then explicitly select TID=2 to select your entire train consist (reset position #0, HB pressed twice - 2 "dings").*

29. I can't figure out how to simply use QS-1 as part of a straight "block-control" layout. That is, I want to turn on a block and have any and all of the engines on that block come "alive". *Do a SELECT ALL (3-second long holding of the first pressing of HB right after you enter reset). If you want these engines to stay in an "all selected" mode in a more permanent way, you can return all of the IDs to zero (i.e. TID=RID=EID=0). Once you have cleared all the ID codes, they will stay that way until you explicitly set them.*

30. My engine seems to be "lost in space". It just doesn't respond correctly. *QS-1 is a sophisticated computer system that is installed in an electrically hostile environment (a model railroad engine). Perhaps some minor noise or massive arc from a derailment has confused the electronics. You should be able to recover normal behavior by turning the power off. Try the power off for 3 seconds. If this does not fix things, try power off for 30 seconds. If this does not fix things try power off for 2 minutes. In any case, you need to make sure that the trouble you are having is not arising from reversed transformer leads, engine addressing, engine lock-out or other operational settings.*

31. My engine is set to "all go" - that is TID=RID=EID=0 but the engine seems to be deselected! How can this possibly have happened? *This is possible by pressing the bell button in reset. This operation is called "all deselect" and it will even deselect engines set to "all go". You can get these engines selected again by pressing HB in reset position # 0 one or more times. You can also get them going with an "all select". Once you have pressed the bell button in reset (all deselect) you will have to cycle back to reset (power off for 3 seconds)to re-select your engines.*

32. Sometimes when I first turn the power on - especially if the power has off for quite a long time - the engine does not do a double ding indicating reset. In fact, it seems to have missed reset since it appears to operate the bell, whistle, etc. *This can happen since QS-1 will depend on the reverse unit reset signal if the power has been off for a long time. This signal from the reverse unit is occasionally missed. The solution is to turn the power back off for 3 seconds (till you hear the ding) and then back on again. This time the QS-1 will depend on its own reset signal. We will attempt to improve the reverse unit reset detection in the future.*

33. I was operating my QS-1 with the battery removed (or with a discharged battery) and when I shut off the power, some of the reset options I set seem not to have been saved. *That is true; this is because the selections you make are saved to memory only after you cycle to the next reset position. When you immediately turn the power off (even to operate your engine) you will lose the reset information you just set. Remember, this is only if operating with no battery.*

34. I was operating with a battery. I turned the power off and removed the battery. I tried running the engine with the battery now removed, but all it does is reset every time I interrupt the power. *This is because QS-1 thinks you still have a battery installed. (It was there last time you turned the power off). If you want to run your QS-1 without a battery, It will function correctly only if you remove it while the engine is powered. Then interrupt the power (doing a direction change). Now, QS-1 knows the battery is missing and will function correctly without it.*

If you have been unable to solve your problem using the suggestions in this section, then contact your local QSI dealer to see if they have any additional ideas or perhaps more current documentation form QSI. If you are still unable to get your QS-1 functioning properly, call QSI Customer Service at (503)-640-5785. Hopefully, you sent in your warranty registration card. If you did, we will be able to help you right away, including, if necessary repairing or replacing your QS-1. If you have not done this, we will need to verify your ownership and purchase date, hardware version number, and software version number. This may take some time. In either case, we will need a description of your problem, type of engine you are installed in, transformer type, type and value of ballast resistor (if used), bell button type (if used) and a brief description of your layout. We are committed to your satisfaction.

Warranty

QS Industries Hardware Warranty for QS-1

Limited warranty: The QS-1 hardware, except the NiCad battery, will be free from defects in materials and workmanship for a period of one year from the date of receipt. Any implied warranties on hardware and software are limited to one (1) year and 90 days, respectively. The NiCad battery has a 90 day warranty from the day of receipt. This limited warranty gives you specific legal rights. You may have others which vary from state to state.

The limited warranty does not apply: a) to any QS-1 that is damaged by accident, misuse, or improper installation, b) if QS-1 is altered or repaired by anyone other than QSI or one of its authorized service centers, c) if used with altered or copied software.

QS Industries Software License Agreement

1. Grant of License: QSI grants you, the owner, the right to use the Version 1.00 software, that is included with your QS-1 system, only with the QS-1 hardware that you purchased.

2. Copyright: The software is owned by QS Industries and is protected by United States copyright laws and international treaty provisions. Therefore, you or anyone else may not copy the software.

3. Limited Warranty: QS Industries warrants that: a) the software will perform substantially in accordance with the accompanying written materials for a period of ninety (90) days from the day of receipt.

How To Get Service

1. Contact QSI or an authorized QSI service center to determine if there is a problem. To identify your nearest QSI service center, call (503)-640-5785

2. Ship insured or deliver to QSI or an authorized QSI service center.

3. If in warranty, please have proof of purchase date available.

How to obtain upgrades to the software and new product information.

Your prompt return of your warranty registration card to QSI confirms your right to the protection available under terms and conditions of our warranty. You will be informed of any upgrades as well as new product information. Also, your local authorized QS-1 dealer will help keep you informed about upgrades and other product offerings.

Appendix

Principles worth memorizing:

- *Each time HB is pressed, you will hear a bell "ding" as a feedback signal to indicate that the engine acknowledges that the horn button has been pressed.*
- *A locked-out engine is forever selected*
- *Whenever we return to the original factory setting on any option that can toggle between two states (i.e. on-off, slave-non-slave, forward-reverse, feedback on- feedback off, etc.), you will always hear a short whistle or horn blast. A single ding occurs when the changing from the factory state.*
- *When you have many engines with different ID's on the same powered track section, and you use HB in reset to select an engine, only one engine ID will be selected at a time*
- *If two engines have the same ID, both will be selected or both will be de-selected at the same time.*
- *Once an engine is selected it will remain selected until de-selected and a selected engine will operate like a normal engine until it is de-selected.*
- *A "clear" applied to any ID type will assign a number "0" for that ID which is equivalent to always being selected for that particular ID type. If all three ID types are cleared, the engine will operate under all select conditions.*

The Lionel Transformer Explained:

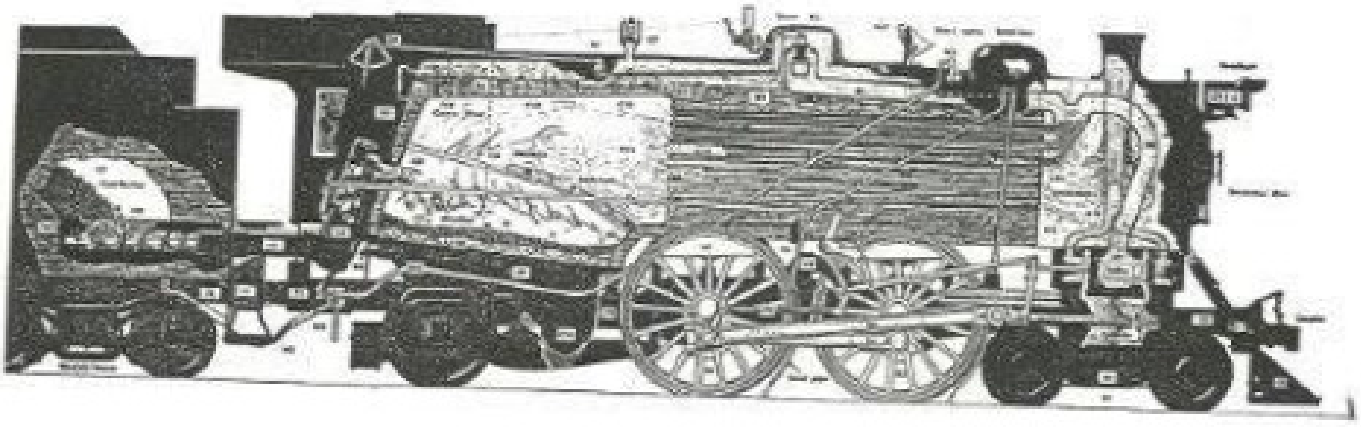
Something that many train operators are not aware of is that the Lionel transformer actually has not one, but two different whistle control settings. I will call them position one (P1) and position two (P2). P1 is activated when the whistle control is pressed only part way. Electrically, the transformer is putting half-wave rectified power to the track. The purpose of P1 is to make sure there is sufficient DC on the track to operate the shaded-pole relays that are in early Lionel train whistles. P2 is activated by pressing the whistle control all the way. In this position the transformer puts out only a tiny amount of DC and adds about 5 volts of power to the track. The purpose here is twofold: first the selenium rectifiers used in the transformer will burn up if you hold the whistle control in P1 for a long time. Second, when the whistle motor locks in, there is so much power drain that the train will typically slow way down. So, in P2 Lionel added "whistle boost" - an extra 5 volts - to keep the train's speed constant. The size of the DC whistle signal in P2 depends on the amount of load current drawn out of the transformer. Since Lionel only envisioned using P2 when the train was running, there was always a good size whistle control signal, since the motor would draw a dependable amount of load current. Thus, using P2 for signaling purposes when the train is in neutral requires a minimum load so the Lionel transformer puts out a detectable whistle signal. If you are using your QS-1 on a very simple test track, you will need to attach a **ballast resistor** across the track (or transformer) to ensure that the transformer puts out a useable 2nd position whistle signal. We recommend 15 W, 25 Watts. On layouts with extra accessories and lighted cars and the like on it, the ballast resistor is often not necessary.

Modeling Steam Engine Sounds

The QSI sound system uses recordings from real engines. These sounds are digitally encoded and stored on the QS-1 memory chip. We have tried to have our sounds represent how the sound would occur on the actually prototype engines. In some cases, we have made some compromises in order to provide good audio feedback to the operator, or to keep within the limits of the technology or to make some concession to the fact that these are models. For instance, whistles on real steam engines are blazingly loud, much louder than the chuff or the bell. If we kept the proportions of the whistle volume to the bell volume like the prototype, you would only be able to hear the bell when the engine was very close.

How a Steam Engine Works

In order to understand what the different sounds represent in a steam engine, you will need a little information of how a steam engine works. The diagram below shows the cross section of a small steam engine. The main areas of interest are the boiler, firebox, smoke box, steam cylinders and valves. In principle, steam engines are very simple machines even though they look complex.



Steam Engine Cross Section

Figure 25

The firebox is surrounded by the boiler. When fuel (coal or oil) is burned in the firebox it heats the surrounding water to create steam. When steam is formed it rises to the top of the boiler where it can be drawn off to do useful work in the cylinders. When the engineer pulls back on the throttle, steam under high pressure is applied to the steam valve directly over the main steam cylinder. The valves are mechanically coupled to the piston and emit steam directly into the cylinder at the right time to apply force to the main drive rods. When the piston moves back into the cylinder, another port opens on the steam valve to exhaust the spent steam directly into the smoke box to the smoke stack. The steam is vented directly through the smoke stack and not directly out from the main cylinders for a very good reason - it provides draft for the fire. Notice that the firebox is connected to the firebox with a number of hollow pipes called flues that run directly through the boiler. When steam is vented through the smoke stack, it creates a vacuum that draws the hot gases from the firebox through the flues to help heat the water in the boiler. Hence, the exhaust from a steam engine smoke stack is a combination of both smoke and steam.

Steam Engine Sounds Modeled in QS-1 Version 1.00

The following sounds are used in the QS-1 system to represent the operation of a real steam locomotive:

1) **Steam Exhaust**: The familiar chuff sound from steam engines is the sound of the spent steam venting through the smoke box and out the smoke stack. Each side of the steam engine has a single duel stroke steam cylinder that applies force to the drive rods on both the forward and reverse motion of the cylinder. Steam is vented for both strokes of the position and since there are two cylinders on a locomotive, there are four separate steam exhausts per wheel revolution. We have recorded four separate chuffs to produce the familiar four beat cadence that is so distinctive in steam engines.

2) **Steam Hiss**: The sound of steam hiss is a ubiquitous sound on steam engines. It can come from different steam appliances that naturally vent steam like the steam generator or it can simply come from a number of leaky fittings.

The most common source of steam hiss from an engine at rest is the blower. In order to keep the proper draft for the fire on non-moving prototype engines, the fireman will turn on the "blower" which vents steam directly through the smoke box. This produces a very loud steam hiss sound.

The QS-1 steam hiss is "on" in all directional states but is much more discernable in neutral. The steam hiss is not heard in the reset state. The steam hiss is the only sound that is not digitally recorded; it was much easier to synthesized this sound and it sounded much better than digital recordings that we had tested.

3) **Coupler Sound**: The sound of the coupler "lift bar" being pick up is heard when the coupler is armed. When the coupler is fired, there is the sound of the coupler knuckle opening and the air release from the air lines coming apart. The lift bar sound was included for audio feedback to indicate when the coupler was armed. You might imagine that the brakeman riding the engine, grabs the life bar in preparation to open the coupler; it first makes a sound as the metal bar is lifted and a second sound when the slack in the chain is drawn out.

The coupler sounds are included on QS-1 so you will not need a new addition of software if you buy the QSI coil couplers for your engine. Even if you do not have the QSI coil couplers, the coupler sounds adds realism to your engine. If you are well coordinated, you can fire the coupler sounds to be coincident with an uncouple from a magnetic uncoupling track. After installing the QSI coil coupler, you can uncouple in neutral, forward or reverse anywhere on the layout without the use of a magnetic uncoupling track.

4) **Bell**: There are two types of steam engine bells used in QS-1: hand pulled and pneumatic. The hand pulled bells have a "ding-dong" sound while the pneumatic has a single "ding". Most large modern steam used the pneumatic type of bell and the smaller engines often had a hand pulled bell.

5) **Whistle**: The whistle in a steam engine is usually located on the top of the boiler. The whistle makes its sound by having steam exhaust through hollow closed-ended pipes. The closed pipe has a woeful wail that is so characteristic of steam locomotive. In general, the larger the steam engine boiler capacity, the larger the "steam whistle" sound. Big engine usually had bigger pipes with larger steam capacity and produced a deeper, louder and richer sound with a stronger "steamy" sound.

6) **Neutral Air Release**: When the engine stops in neutral, you will hear air release sound after about a two second delay. This represents the movement of the air-operated power-reverse needed to move the cylinder valves to the reverse position. The two second delay is intentional; it is there to allow the operator to cycle through neutral to another directional state without the sound of the air release; the air release is only appropriate if the operator actually intends to stay in neutral.

7) **Compressor pumps**: All engines need a supply of air to operate the air brake system and other appliances that operate on air pressure. The QS-1 air compressor sound operates in all directional states and will respond to the amount of air that is used. In particular, when the engine stops in neutral, the pump will automatically speed up to compensate for the drop in pressure. It will continue to pump fast for about fifteen seconds and then will gradually slow down to a slow "steady state" pump rate of about once every 8 seconds.

A number of users have pointed out that the pump should speed up when an uncouple occurs since air is lost in the break system when the air hoses part. This is not true; when the brakeman uncouples the engine, he closes an air cock on the air line directly

above the hose on the engine. The air sound is only the residual pressure left in the short section of air line between the cars or it is the air in the train break-line, not the engine. However, it would be appropriate to have the pump speed up when the engine couples to a train but we have no way of knowing when this is done and hence, do not supply that sound effect.

APPENDIX II

CONNECTING THE LIONEL TRANSFORMER TO YOUR TRACK:

The chart below gives you the correct way to attach the wires from your transformer to the track. Some transformers send a negative DC signal when the Horn Button is pressed instead of the positive DC signal QS-1 requires. For these transformers the wires to the inside and outside tracks are switched compared to the ZW wires.

Some transformers, like the Z, are not listed because they do not have Horn Buttons. The Lionel MW can be used but is not recommended for use with QS-1 because it violates the Three-Rail Electrical Operating Standard. With an MW the engine's Chuff rate can be thrown out of kilter.

QS-1 needs over 14 volts of power to operate some options properly. When you are signaling QS-1 by working the throttle lever you may find there is not enough high voltage to trigger the QS-1 commands. Your transformer may be overloaded, it may be worn out or an accessory controller (such as an OTT box) between the transformer and track is taking voltage. You can remove some of the accessories or use a larger transformer (see table below) if you have this problem.

Transformer Type	**Outside Rail**	**Center Rail**	**Min-Max Voltage**	**Power Rating**
1032 1033 1032M	A	U	5-16v	90 watt
1043 1043M				
1044				
1053	a	u	8-17v	60 watt 1063
LW	U	A	8-18v	75 watt
KW	U	A or B	6-20v	190 watt
MW	inside track terminal	outside track terminal	5-16v	60 watt
RW	A B	U U	9-19v 6-15v	110 watt
SW	a	u	unknown	130 watt
TW	A	U	8-18v	175 watt
ZW	U	A or D	8-20v	275 watt

Glossary of Terms

ACRU Reverse Unit — This stands for a series of reverse units that are designed to operate with ac or "universal" motor that are used commonly in Lionel engines

Clear — This refers to clearing the ID numbers stored in memory on the QS-1 system.

Clinks and Clanks — These are sound made by the QS-1 sound processor to provide feedback about what reset option is selected.

DCRU Reverse Unit — This stands for a series of reverse units that are designed to power DC "Can" motors used in some three-rail locomotives.

EID — EID is an acronym for Engine ID.

Hard Reset — This occurs when you leave the power off for forty seconds or more. When this happens, power is lost to the computer and it starts fresh when power is reapplied. This is useful if the computer finds it self in a state that is different than expect where the normal commands have no effect.

Hardware — This refers to the actual electronic boards that make up the QS-1 system including the power supply and reverse unit.

HB — HB is an abbreviation for "Horn Button".

HV — This is an abbreviation for High Voltage. High Voltage or high throttle settings are used with the horn button to control certain features available in the QS-1 system.

ID Numbers — These are numbers that are assigned to QS-1 equipped engines that uniquely identify the locomotives for independent train selection.

Lock-Out — Lock-out is a condition of the reverse unit where it will not change state from power interrupts on the track.

Neutral before Forward — This is a neutral directional state of the reverse unit where the next power interruption will cause the reverse unit to go to forward.

Neutral before Reverse — This is a neutral directional state of the reverse unit where the next power interruption will cause the reverse unit to go to reverse.

NiCad Battery — This a special rechargeable battery used with QS-1 to provide extra power for the sound system and the computer when the applied power is unusually low or when the track power is turned off.

PS-1 Board	The power supply board used with QS-1. This board supplies the power needs for QS-1, the battery charger, the battery shut down circuitry, the overhead blinking light.
QS-1 Board	The computer, memory and audio amplifier board for the QS-1 system.
	QSI Coil Coupler - This is a special coupler similar in design to the early Lionel Teledyne coupler It is used with QS-1 to provide automatic uncoupling anywhere on the layout without the need for a special uncoupling track.
Reset	This is a state of QSI reverse units that occurs when power has been reapplied after being off for three seconds or more. This state is generally selected to be in the "neutral before forward" directional state.
Reset options	These are features that are available from QS-1 when the reverse unit has been reset.
Reversal	is a condition of the reverse unit where it will reset to "neutral before reverse".
RID	RID is an acronym for Road ID.
Slave	This is a condition of QS-1 where the horn or whistle, bell and QSI coupler will not operate. This condition is ideal for operating with other locomotives in multiple engine consists.
Software	This refers to the actual program that creates the train control, sound and features of the QS-1 system. This program is resident in the memory chip on the QS-1 circuit board.
T.F.S.	An acronym for Train Control, Features and Sound used to describe the QSI QS-1 system.
TID	TID is an acronym for Temporary ID or Train ID.

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