

IBM 91 Series Master Clocks



User Manual and Service Guide

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Overview

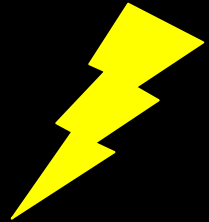
The IBM 91-9 is a master time control system capable of driving slave/secondary clocks, along with 6 auxiliary circuits to run bells and other devices. The unit shown in my photos shipped in December of 1953. This clock is made up of a mix of electrical and mechanical parts, so it has been fun to reverse engineer. I am writing this guide to help other IBM/Simplex 91 series master clock owners revive their clocks and save them the hours of research and reverse engineering I have put into this project. This may not seem like a very interesting piece to most, but I find it important to preserve it as it is a part of history, and a lot can be learned from 1950s engineering.

More of my projects can be found at <http://bognersystems.com>

Disclaimer

This document is written by an inexperienced hobbyist who likes to tinker with old junk. Follow these instructions at your own risk. All of this was learned through trial and error with hours of working with the schematic and a multimeter.

NOTE: Mains voltage is present almost everywhere in this unit, as it is used for driving motors, clutch magnets, and signalling. Use caution when working around mains A.C. voltages.



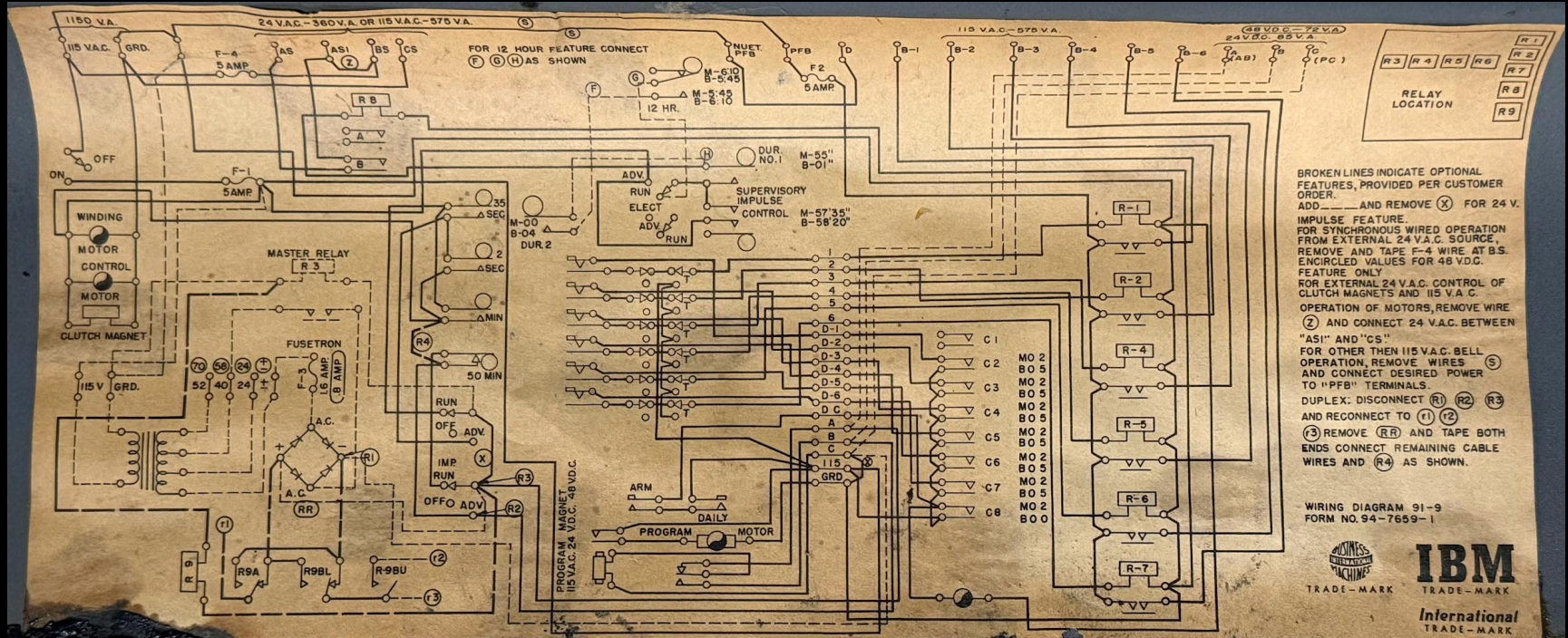
Opening the Clock

The cover is held on by a metal tab at the top, and a key at the bottom. Unlocking the key will allow the cover to lift off the front. Photos of the key, lock, and tab are below. I have also seen units that have keys on the side- note that those will likely open a different way.



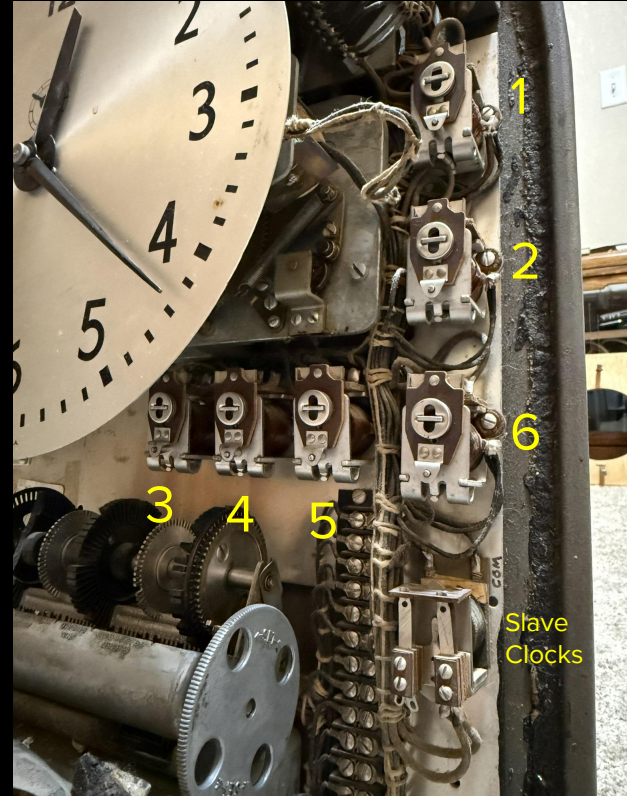
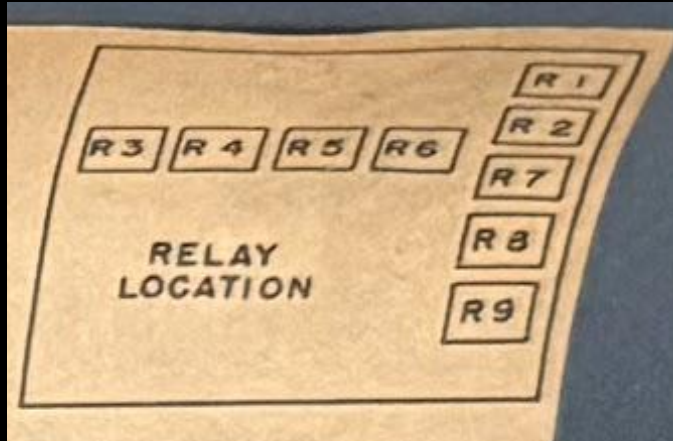
Schematic

This is the schematic from inside of the door. Not every clock will have every option installed.



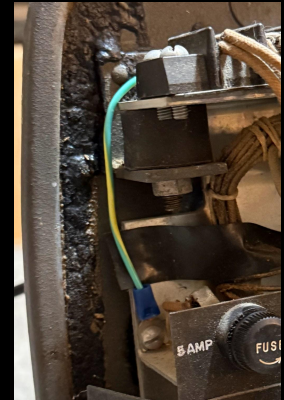
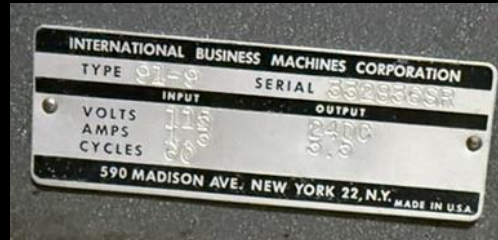
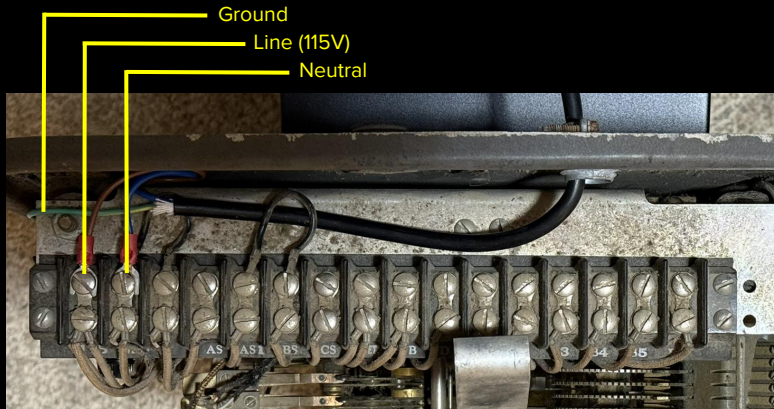
Relay Positions (on this particular unit)

Most clocks will not have all of the relays specified on the schematics actually installed. Most do have mounting holes where they can be installed though.



Wiring to Mains

In order to power the clock, you will need to connect the voltage specified on your unit- in my case, it needed 115V at 60Hz (typical line voltage in North America). Photos of the terminals are shown below. The schematic does not appear to specify a separate ground, so I connected it to the chassis in the location shown. Prior to connecting your clock to power, also do a visual check to make sure none of the old insulation is flaking off and that the clock has no internal shorts between line and ground.

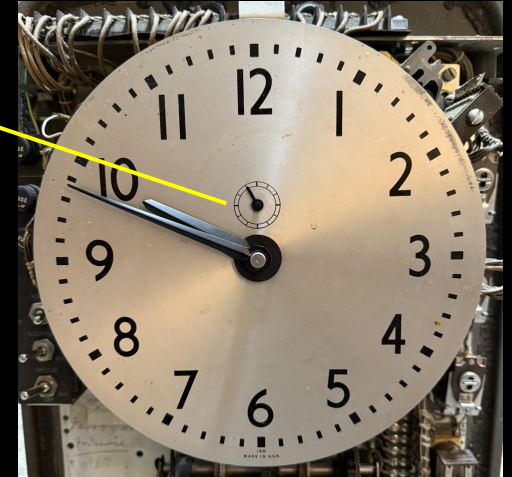


Initial Power On

For the first power up test, have the ELECTRONIC (secondary clock control) switch set to RUN and the IMPULSE (wired to the program assembly in my case) switch set to off. When the power is turned on, you should hear the motors start to run and the second hand should move (labeled in the photo below). If this goes well, that means your clock is running (at least partially)! If nothing happens, check fuses and check the motor at the bottom left under the clock face- that is the one that drives the clock mechanism. It is an 1 RPM Synchron motor, pictured below.



Second
Hand



Setting the Time on the Master Dial

In order to set the time on the master clock's dial, you will need to remove the thumb screw from on top of the minute hand (power down the clock before doing this). Once removed, you can rotate the minute hand **CLOCKWISE** until the desired minute and hour are reached. Do not turn the hands counterclockwise as the switch mechanisms are not designed to run backwards. You cannot adjust the second hand- do not force it. Once the time is set, reinstall the thumbscrew and tighten until snug. Do not overtighten the thumbscrew. The minute hand should now appear secure, and if you gently nudge it, it should not turn like it did without the thumbscrew.

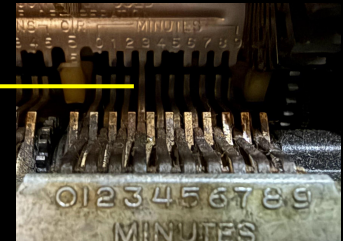


Setting the Time on the Program Assembly

The program (auxiliary circuit control) assembly and master are set separately, but the master clock advances the program assembly once each minute with an electronic pulse, which should keep it synchronized to the master. The program assembly is set using the wheel on the right side. The fingers indicate what day, AM or PM, hour, and minute (10s and 1s) it is set to. Each minute, the assembly will turn and the fingers will shift to the right (or roll over), similar to how a car odometer would.

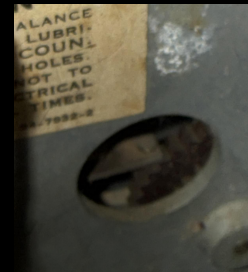


The ones digit for minutes is set to 3 in this photo



Advancing the Program Assembly

The program assembly can be advanced manually using the knob, electronically using the advance feature on the toggle switch (once every couple seconds), and would be set to advance during normal operation (once per minute) when set to RUN. The contacts that time each advance are shown in the photos below for reference- you may need to clean or adjust them to get them to work properly. Also note the clock must sit upright for these to work properly (like it is mounted on a wall).

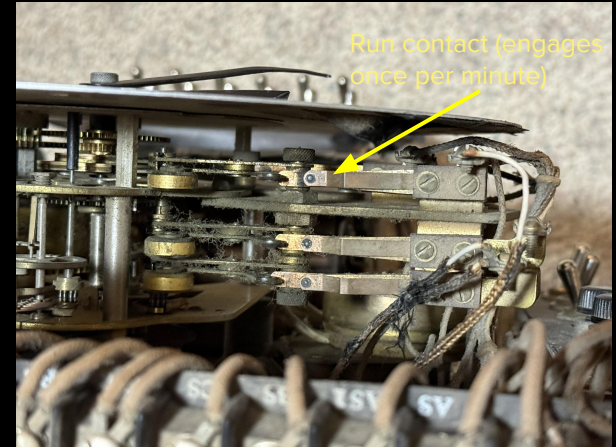


Advance
Contact
(under dial)



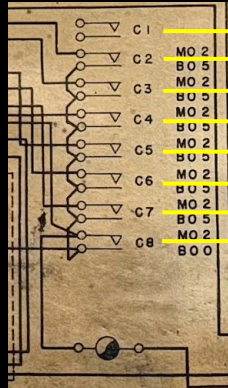
Solenoid

Advance
Motor

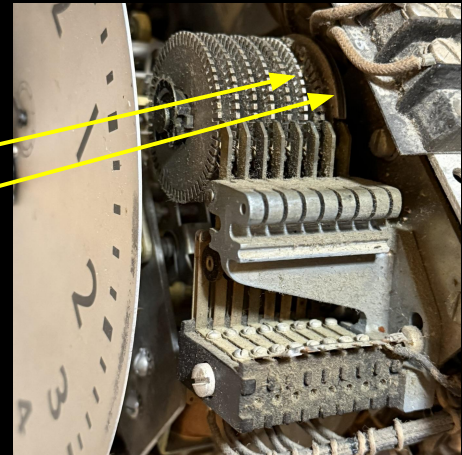


Setting ON Duration of Auxiliary Circuits

The ON duration is set by little metal tabs on toothed gears near the top right of the clock. This assembly only turns when the program tells it a circuit will be turning on, and it will make one full rotation in one minute (meaning the maximum ON duration is 1 minute). Each circuit can be set independently, hence the multiple gears. More metal tabs installed means a longer ON duration.



- Not Used
- Circuit 1
- Circuit 2
- Circuit 3
- Circuit 4
- Circuit 5
- Circuit 6
- Timing Motor On/Off



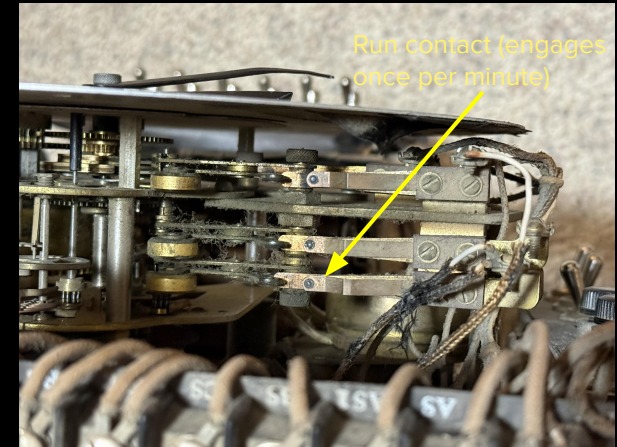
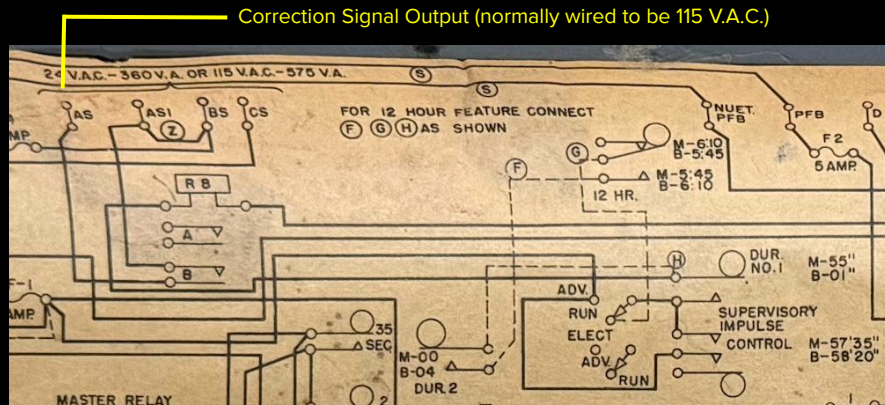
Programming Auxiliary Circuits

This is one of the trigger sticks (for lack of a better term) that would be installed in the program wheel. Tabs are broken off to show circuits that don't get used and the time the circuits not broken off are turned on. (Instructions are stamped on the part) On this particular stick, not a single circuit is enabled... most of my other ones make sense though. Perhaps this one was just used as some kind of delay. Normally the tabs for the circuits you want to turn on are left attached, so they can trigger the plastic lever that pushes the contacts together to turn on the corresponding relay.



Controlling Secondary Clocks

The master clock can control secondaries that run on an hourly correction signal. The signal this clock was set up to do was a pulse once every hour for 6 seconds. This pulse went from xx:57:55 to xx:58:01 (this can also be seen on the schematic, with the two contacts wired in series) when set to RUN. When set to ADV, the secondaries will receive a pulse every minute from xx:xx:55 to xx:xx:01 (a 6 second pulse), advancing them an hour each pulse. Recall that the master must be set manually, and will not be affected by these correction signals. The minute run contact is shown for reference.



Power Loss Feature

When power is shut off to the unit, there is actually a small mechanism that keeps the clock running for a few seconds- this would be used to keep the clock running in short power outages. That mechanism is shown here. The clutch magnet engages when the unit is turned on, which holds the wheel. When power is lost, it releases the wheel, triggering a mechanism that drives the second hand for a few seconds.

