The Rowe AMI JAL-200 Jukebox

This JAL-200 was made in Australia by National Instruments around 1963. It is 1.45m tall, 680mm wide, 850mm deep and weighs 150kg. Its audio power output is 25W per channel, and it can play either side of any one of 100 7-inch, 45RPM records, for a total of 200 songs.

By Jim Greig

The first jukebox was made around 1890, and multiple selection devices originated around 1918. So there were over 40 years of development behind this unit. It is interesting to compare it to its competitor another 40 years later – a matchbox-sized MP3 player with thousands of songs, connecting to a powered speaker via Bluetooth.

Like most pre-computer jukeboxes, the JAL 200 is a mechanical marvel. Designed to work almost full-time in dirty, hot bars with minimal problems, it is sturdy and designed to be easily maintained.

It was functional when purchased, but had to be cleaned and all capacitors were replaced. Changes were also made to improve its long-term reliability:

- The metal rectifier (copper oxide or selenium) for the 30V DC control circuits was replaced with silicon diodes.
- Capacitors used as back-EMF suppressors were replaced with silicon diodes (as in later units).
- I added two fuses that were shown in the circuits but not installed.

It has functional units which convert a pushbutton selection to rotary movement, store the selections and play the records. Many of these are visible in Fig.1.

The pushbutton unit is robust (think of the stuff spilt into it!) and divided into two, 10 numbers (1-9 plus 0) and 20 letters (A to V except for I and O), as needed for a 200 record selection. This jukebox supports remote wall boxes, small selection units that can be mounted near selected tables at the bar/restaurant/etc.

Each button is connected to a short copper track segment on the search unit (Fig.2). The number side is shown; letters are on the reverse. When two buttons are pressed, the search motor (top left) rotates the plastic arm until the outer brush touches the energised number segment. A relay picks up to drop power to the search motor, and energise the number sprag relay. The arm stops at the selected number.

It is stopped quickly and in the correct place by the sprag relay, which has a long arm that pulls against a notched wheel and stops the rotation when a

tag on the end of the arm drops into a notch (see Fig.3). The number sprag relay is then released, and the arm is rotated until the energised letter segment is detected. Rotation is again quickly and precisely stopped by the letter sprag relay.

As shown in Fig.4, the letters are split between an inner (EVEN or right) and outer (ODD or left) ring, most likely to provide room for the 200 pins. Holes in the plate provide easy access to the screws underneath. This unit was built to be repaired.

On the same search shaft is an arm with an electromagnetic "pin pusher" on each end. Slip rings on the inner tracks of the number PCB provide a path for a select pulse to the pin pusher solenoids. The pin pusher arm has an inner solenoid on one end and an outer one on the other; the appropriate one is energised to push a pin (see Fig.5). The terms outer/odd/left and inner/even/right are used throughout the manual.

When the pins are pushed, they are loosely held in position and serve as the memory. The positions are 1 (A-V), 2 (A-V) ... 0 (A-V) for the 200 selections. Fig.6 shows the stopper switch assembly above the pins.

Scanning

The pushbuttons are reset, ready for the next selection. The magazine motor is energised, causing the magazine containing the records to rotate. It is geared to the stopping switch assembly. This assembly rotates until a left (or right) stopping switch pawl meets a pin and is pushed slightly back, to activate the left (if a left pin is encountered) and stopping microswitches – see Fig.7.

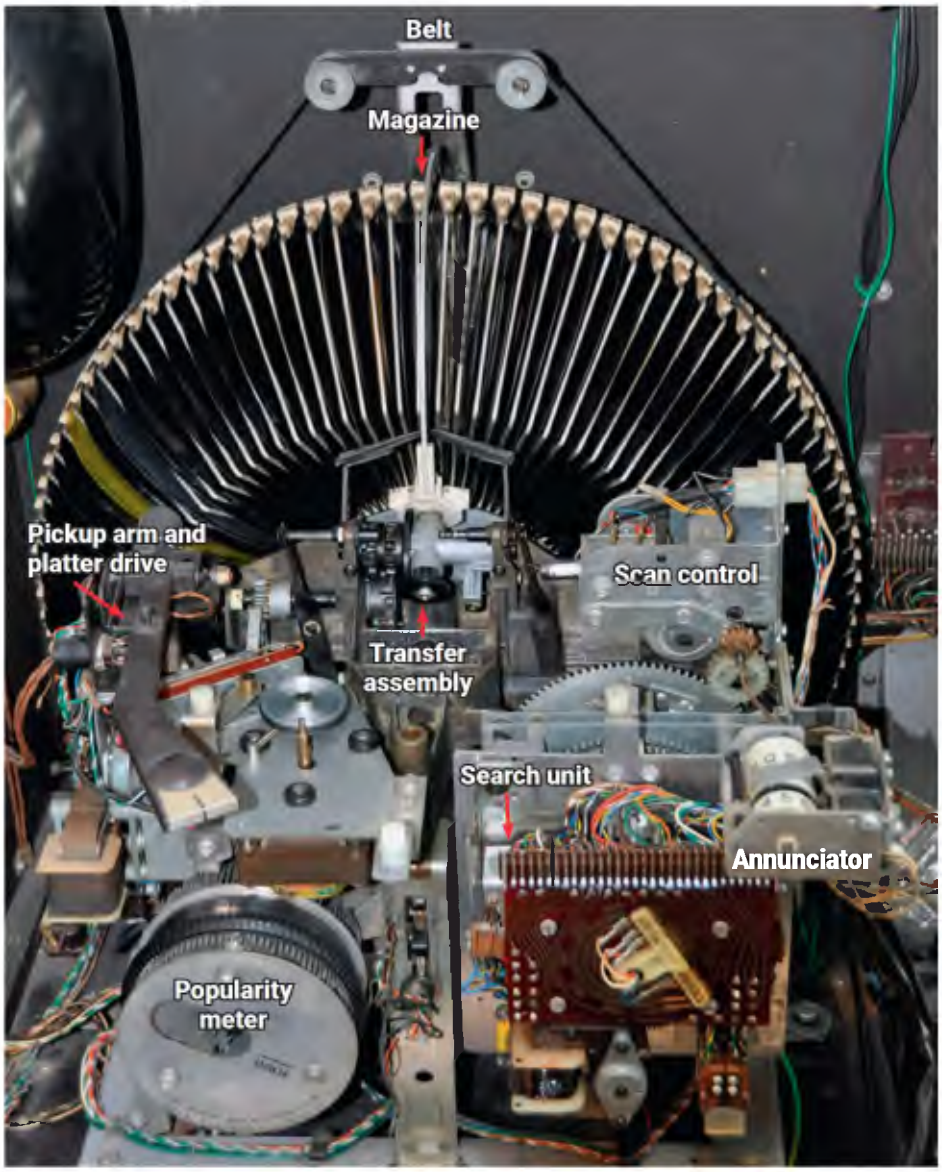


Fig.1: the belt, visible above, holds the records in the bottom half of the magazine in place. The amplifier is housed underneath these components, while the credit unit is at the back. Other visible parts are labelled.

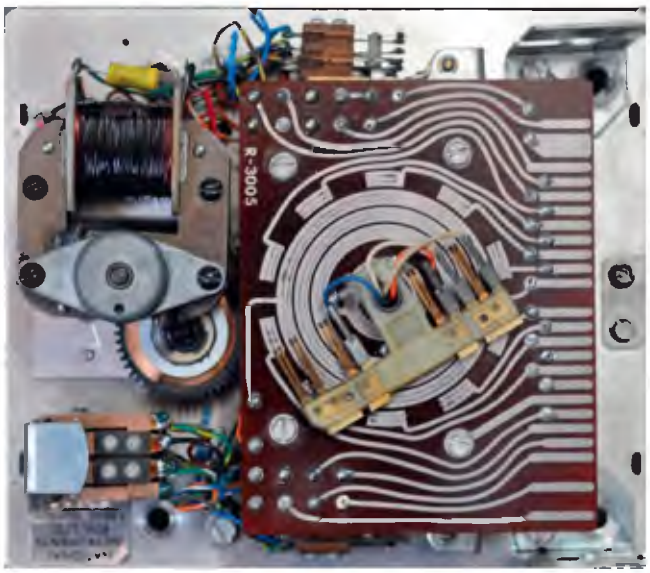
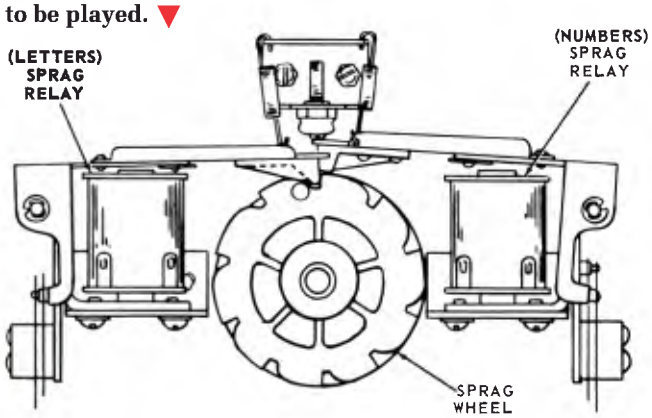


Fig.2: the search unit encodes the numbers and letters as a series of tracks with contacting wipers. It is essentially a mechanical form of digital decoder.

Fig.3: the sprag wheel and sprag relays act to stop the rotation when the search unit has selected the record that is to be played.



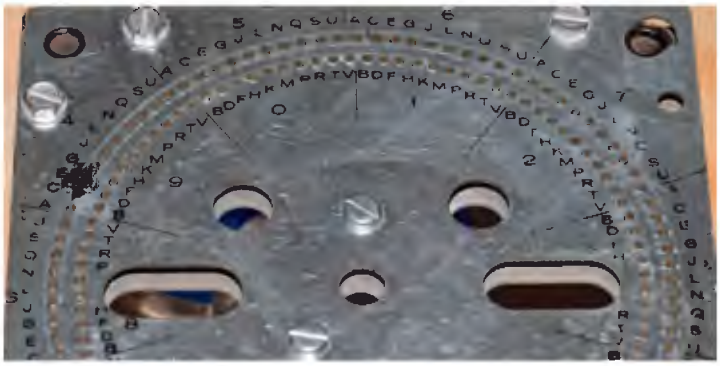


Fig.4: the pins drop into holes arranged in two rows in this wheel, because they would have to be too small if they were in a single row. That complicates the mechanism somewhat.

Fig.5: one of the 'pin pusher' solenoids used to cue a record to be played.

Fig.6: the pin stopper switch assembly.

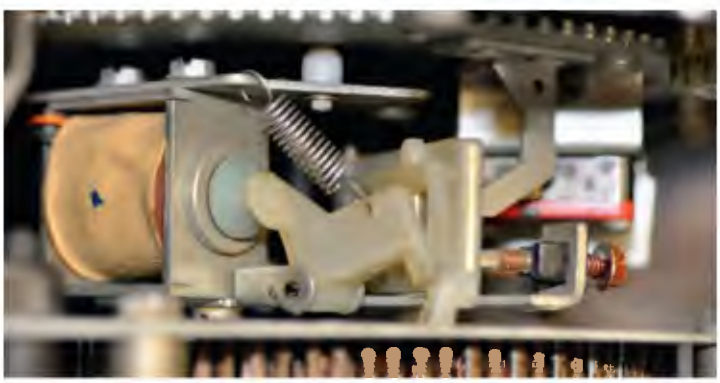


Fig.7: these microswitches are responsible for stopping magazine rotation when the selected record is reached, by detecting the pin sticking out.

Power to the magazine motor is then dropped. Rotation is stopped precisely with a magazine detent switch, similar to the sprag relay. The selected record is now at the very top of the magazine, and the transfer motor is energised.

The transfer process is powered from a shaft driven by the transfer motor. There are cams on the shaft, and they activate microswitches to:

- Start the turntable motor
- Reset the pin
- Energise the toggle shifter solenoid if the "A" side is to play
- Stop the transfer motor when the record is in place
- Reverse the process after the record has played

Gears from the shaft cause the transfer arm to grip the selected record and move it to the turntable (shown partway in Fig.8). Another set of gears positions the tonearm over the outer groove and lowers it onto the record (Fig.9). The gripper arm will rotate to play the "B" side if the left side microswitch does not energise the toggle shifter solenoid (at the bottom right).

Record changer

US 45RPM records have a 1.5-inch (~3.8cm) centre hole, first implemented by RCA, possibly to get around existing patents and minimise wear on the small hole as a record is dropped from an automatic changer.

This player has a centre that supports both and detects which size is used. A 33RPM record pushes the assembly down to activate a solenoid which raises the idler wheel, brushing a smaller diameter on the motor shaft to reduce the speed (see Fig.10). This feature is disabled on this jukebox, as all Australian records have the smaller centre.

When the end of the track is reached, all records have a run-out groove that moves the tonearm rapidly towards the centre. When the tonearm reaches a selected distance from the centre, a magnet on it activates a reed relay that initiates the reverse transfer, shown in Fig.11.

If no more records (pins) are selected, and the last record is played, it would be possible for the magazine to rotate continuously until the next selection is made. To prevent this, the scan control limits it to one revolution. The scan control is linked with a Bowden cable to the annunciator, which displays the current selection – see Fig.12.

Sound system

The JAL-200 has stereo midrange speakers on either side, with common low and high-frequency units at the front. The midrange speakers are 15 x 23cm oval types, which reproduce signals in the range of 250~12000Hz.

The tweeter measures 10 x 15cm and handles 400~15000Hz, while the horn-loaded woofer, mounted in the back with the horn exiting at the lower front, is 30cm in diameter and rolls off at around 250Hz.

The power amplifier is a stereo unit with push-pull 7868 valves giving around 25W music power per channel, at 1.5% distortion – see Fig.13. Octal 7591 equivalents are installed here. The output valves operate at a conservative 370V HT for a long service life, and it uses global negative feedback. It also includes a mute

Fig.8: a record being lifted out of the magazine by the transfer arm, ready to drop onto the turntable.

Fig.9: this set of gears is responsible for driving the transfer arm and positioning the tonearm over the starting track of the record on the turntable.

Fig.10: this mechanism detects whether the record is a 33RPM or 45RPM type, and adjusts the turntable speed accordingly.

Fig.11: this reed relay is triggered by the tonearm when it approaches the record centre, indicating that playback is finished.

Fig.12: the annunciator wheels show the location of the currently playing record.

Fig.13: the stereo 25W audio amplifier is based on 7868 valves in a push-pull configuration, with global feedback only (not ultralinear).

This jukebox was manufactured with serial number 12412, and interestingly enough, badged by National Instruments.

The JAL-200 was the first jukebox sold by AMI that incorporated their "Stereo Round" system, which was four loudspeakers arranged in a 3-way configuration.

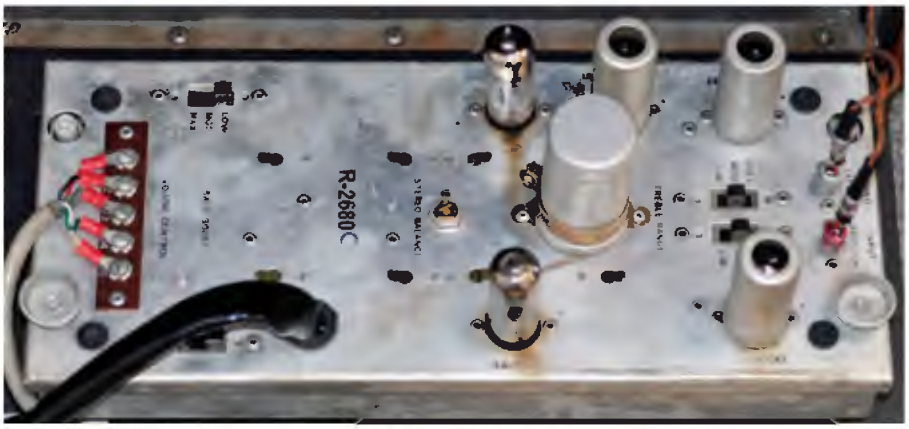


Fig.14: the preamp includes a magnetic cartridge amplifier and treble/bass presets for the installer to adjust.

Fig.15: use of amplifier tone controls for acoustical compensation (from manufacturer)

Sound level in room	Room Acoustics					
	Dead or soft, highly absorbent		Average – moderately absorbent		Live or hard non-absorbent	
	Bass boost	Treble range	Bass boost	Treble range	Bass boost	Treble range
High	Low	Mod/Max	Low	Mod/Max	Mod	Lim
Moderate	Low	Max	Mod	Mod/Max	Max	Lim
Low	Mod	Max	Max	Max	Max	Mod

Note: reduce treble range setting as required by record noise (scratch) conditions F-9660

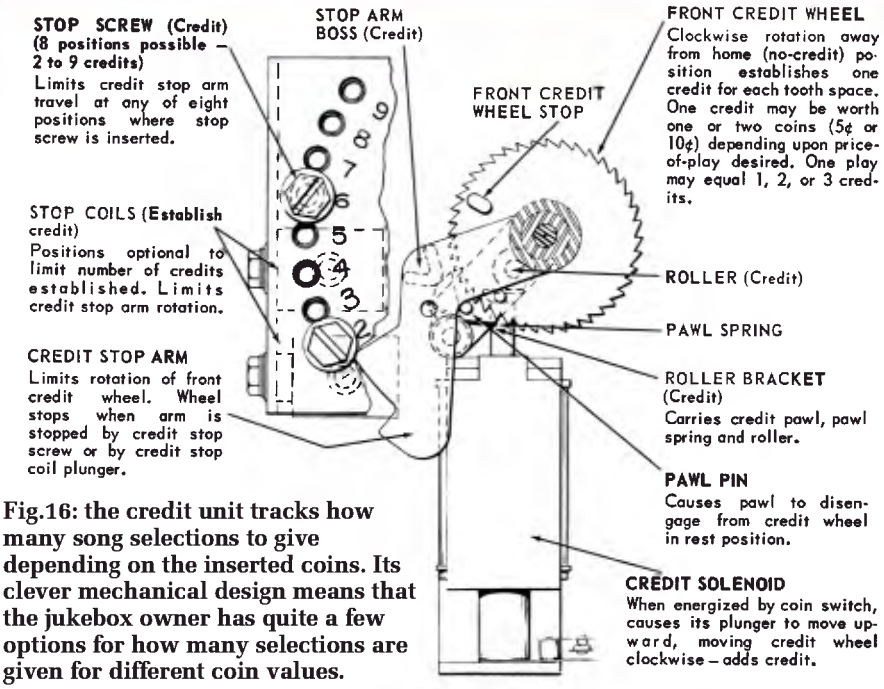


Fig.16: the credit unit tracks how many song selections to give depending on the inserted coins. Its clever mechanical design means that the jukebox owner has quite a few options for how many selections are given for different coin values.

function that shorts the input unless a record is playing.

Note the massive power transformer, designed for continuous use. The amplifier uses a fixed-bias pentode output stage with no ultra-linear connections. The goal is maximum power delivery; ultimate fidelity is not required.

The separate preamp (Fig.14) has a magnetic cartridge preamp, volume compression bass and treble filters that are pre-set for room conditions and a cathode-follower output feeding the volume control potentiometer, which connects to the power amplifier.

The recommended settings are clearly laid out for the installer, as shown in Fig.15. There are more charts showing connections for external speakers and radiation patterns to assist in siting the unit.

Credit unit

The credit unit accepts valid coins and stores the value. The stored value is decremented for each play. The credit unit in this machine has mostly been removed, and it is set up so that no money is needed.

Credit information is stored in the front credit wheel; a ratchet wheel moved by the credit solenoid. It rotates one tooth clockwise for each credit.

Coins are mechanically sorted, and there is a coin switch for each value. The coin switches are connected to the credit circuit board. This is wired to advance the front credit wheel depending on the coin inserted.

As with other rotational functions, the credit solenoid only advances the wheel; it is stopped at the correct value by the credit stop arm reaching a set position. The stop arm is engaged by a pawl as the wheel moves and drops back when it stops.

For the largest value coin (20¢), a screw sets the number of teeth to advance (positions 2-9 in Fig.16). For the smallest value (5¢), the lower stop coil is activated to limit rotation to one tooth. In between (10¢), the second stop coil limits the rotation according to the position it has been fixed in (three possible options: 2-4).

By adjusting the positions, combinations like one play for 10¢ and three for 20¢ can be set. The wheel is held in place with a spring-loaded detent ball, acting on a linked rear credit wheel.

The rear credit wheel (with teeth in the reverse direction) is activated with the cancel solenoid and decrements credits when a selection is played. A cancel stop solenoid (one or two credits) and cancel stop screw (one, two or three credits) control the deduction with the cancel stop arm acting like the credit stop arm.

On the same shaft are a series of wipers, making contact with circular traces on a PCB. The position of the wipers reflects the credit status, and the contacts present it to the rest of the machine. This powers the credit lights (five, 10, 20 or more), ensures there is sufficient credit for a selection and allows a selection to be played.

Links (screws) on the credit circuit board set combinations like one standard play for 10¢, and one EP for 15¢. EP records are not confined to 33RPM, but are set with a premium pricing unit attached to the number bank of the selection switches. One to five groups

Fig.17: this 'popularity meter' pushes in the pin corresponding to a given record a little bit each time it is played. Thus, the pins sticking out further correspond to records that have been played more times.

of 20 consecutive records in the magazine can be set as premium.

Popularity meter

The popularity meter has 200 long pins, each corresponding to one side of a record. They are stored on a small drum and pushed a small distance each time a selection is made (see Fig.17).

Cabinet construction

The cabinet is solid 19mm ply all-around, with plenty of screws. The mechanism is spring-mounted to reduce feedback and improve stability when the cabinet is bumped. The glass top lifts to provide access to the records and labels. The front panel can tilt forward some 20°, and for better access, it can be removed entirely after disconnecting a few plugs.

Selections are printed onto small paper or cardboard rectangles and inserted into marked spaces (eg, A1) corresponding to the slots in the magazine.

Serviceability & adjustment

The whole machine is designed for service. There is a detailed 250-page manual with circuit diagrams, troubleshooting procedures, stepping though a cycle, parts lists and adjustment details. The pushbutton assembly is removable, and all parts are easily disassembled with basic tools.

Most parts are still available, mostly from stripped machines. A few, such as the idler wheel for the turntable, are still made.

With the top up, and front door removed, there is good access to most areas. Adjustments will drift with usage, causing operational problems. The magazine must stop in the right position (top record precisely inline with the transfer arm) so the screws locating it can be backed off while it is moved to the correct position.

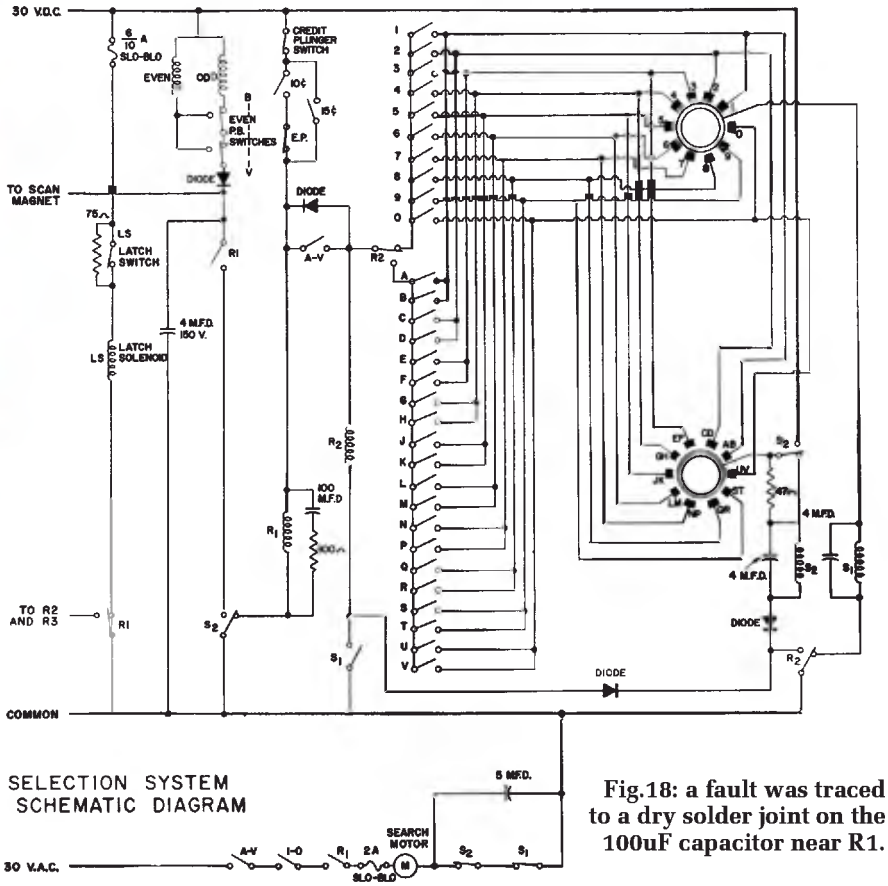


Fig.18: a fault was traced to a dry solder joint on the 100uF capacitor near R1.

Repairs

This jukebox had developed a fault where it would not play a record. When a record was selected, the pin pusher arm would rotate to the correct place but not push a pin. The pushbuttons were not cleared, so a second selection could not be made.

Testing with a multimeter showed a pulse to the pin pusher coil, but it was not energising the solenoid. Cleaning the various relay contacts in the path did not fix it.

Machines of this era can have problems with poor spade lug connections, but they all checked out OK.

The next step was to check the circuit (Fig.18) to follow the sequence of operations to energise a pin pusher solenoid (EVEN, ODD). The A-V and 1-0 switches are closed when the pushbuttons are pressed. The letter sprag relay S2 is not active, and R1 closes when the coin mechanism is happy the selection is paid for.

The search motor rotates until the number and letter segments are found. S2 then closes and drops the power to R1. The selected pin pusher is energised through S2 (ON) and R1 (ON), but R1 is now off.

A 100µF capacitor across the coil of R1 keeps it closed for long enough for the pin pusher solenoid to push a pin, then it drops out. The power to the search motor is then dropped, and the latch solenoid activates to clear the push button selection.

On closer inspection, the 100µF capacitor had one dry joint, left there years ago when I replaced the capacitors. Resoldering it fixed the problem.

The search unit motor, visible in Fig.2, shows signs of overheating. That happens when a fault causes the search motor to run continuously. Later models include a thermal switch in contact with the windings to prevent this. This motor has now been rewound, and a thermal switch included.

The diagrams have been taken from the Rowe AMI Service manual. More details on this jukebox can be found at Radiomuseum (siliconchip.com.au/link/ab80). SC