

# **Servicing Dual Motors and Drive Systems**

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## Overview

The information provided in this servicing manual is conforming to the norms used by Dual of Canada/NQI for factory authorized turntable overhaul. The purpose of this document is to describe the recommended maintenance procedures and provide reference pictures. This document supplements the service manual for your turntable, which is available in the Library section of Vinyl Engine: <http://www.vinylengine.com>. Be sure to have read the service manual and to have it handy when working on your turntable.

Before opening your turntable, please take note of the following points often overlooked or misunderstood by advice given in many media including Internet forums, YouTube, etc.:

- *Cleanliness is paramount. It is particularly important to ensure that the bearings are free from dirt of any kind during and at the end of the work. In addition, some parts of the drive must be free of oil, notably the pulley, the idler wheel and the inner rim of the platter: these areas must be handled with latex gloves to avoid finger acid contamination! This point will be elaborated at every relevant step of the procedure. Any contaminants present on these components will reduce the part's service life significantly, and introduce unwanted noise.*
- *Contrary to widespread belief, 10W30 motor oil is **not** a good replacement for the original Shell Clavus 17 or Isoflex PDP 40 used in the Dual motor. Do not use 10W30; it is far too thick! For this reason, use light, non-detergent and non-gumming machine oil such as the oil used in sewing machines. Check out the material data sheet before use! 10W30 or 10W40 may be used in other non-critical places.*
- *Unless the stator of the motor has a defect, it is not necessary to disconnect the motor from the switch box. The cable is long enough to work on the motor without disconnecting, as described further on. This applies to all Dual turntables and motors.*

## **Applicability**

This servicing manual applies to Dual turntables made by Steidinger, with Continuous Pole Motors (enclosed can type motors), two pole and four pole open frame motors as well as the SM100 series.

*Please note: Direct drive motors such as the EDS 1000, EDS900, and EDS 500 are excluded as they should not be re-lubed.*

## **Tools**

Basic tools required for continuous pole motor servicing (Figure 1):

- 2 mm (1/8") flat head screwdriver.
- 5.5 mm (5/16") flat head screwdriver.
- 7 mm (9/32") hex head socket wrench.
- 5 mm (3/16") drill bit.
- Outer Seeger or snap ring pliers of larger calibre.
- Permanent felt-tip marker.
- Mallet.
- Q-tips.
- Isopropyl alcohol (90% alcohol minimum).
- Light sewing machine oil. Note that there are several grades. Only use light oil for the motor.
- 10W30 oil for the drive system.
- Emery paper.
- Latex gloves.

Helpful items:

- Tape
- Cardboard approximately 4mm (1/4") thick, 10 cm (4") wide 70 cm (28")

If using screws at step 13:

- 3 M2.5 (4/40) screws, length 5 or 6 mm.
- 3 M2.5 (4/40) nuts.
- 3 M2.5 (4/40) lock washers.
- 4 mm (5/32) screwdriver.

If using rivets at step 13:

- 3 x 2.4 mm (3/16 ") pop rivets.
- Pop rivet installation tool.



**Figure 1**

## ***Motor Maintenance Procedure***

**Warning:** When turning a turntable upside-down:

- a) Remove cartridge and counterweight.
- b) Put a piece of tape over locked tone arm to prevent accidental release or movement of the tone arm.
- c) Take extreme care to avoid accidental tone arm damage while unit is upside down.

**Warning:** It is very important to avoid touching, hitting, or resting on the tone arm while the turntable is upside down or – even worse – in unstable equilibrium on its side. To this end, a protective ring can be made out of thick cardboard that goes into the chassis. Cut a strip of thick cardboard from a box, about 10 cm (4”) wide and 70 cm (28”) long for small chassis (1009/1019) longer for large chassis (1219 1229). Make a circle just large enough to fit inside the chassis (between chassis wall and idler) and tape the ring as seen in Figure 2. Now the tone arm will be secure from accidents when working under chassis.



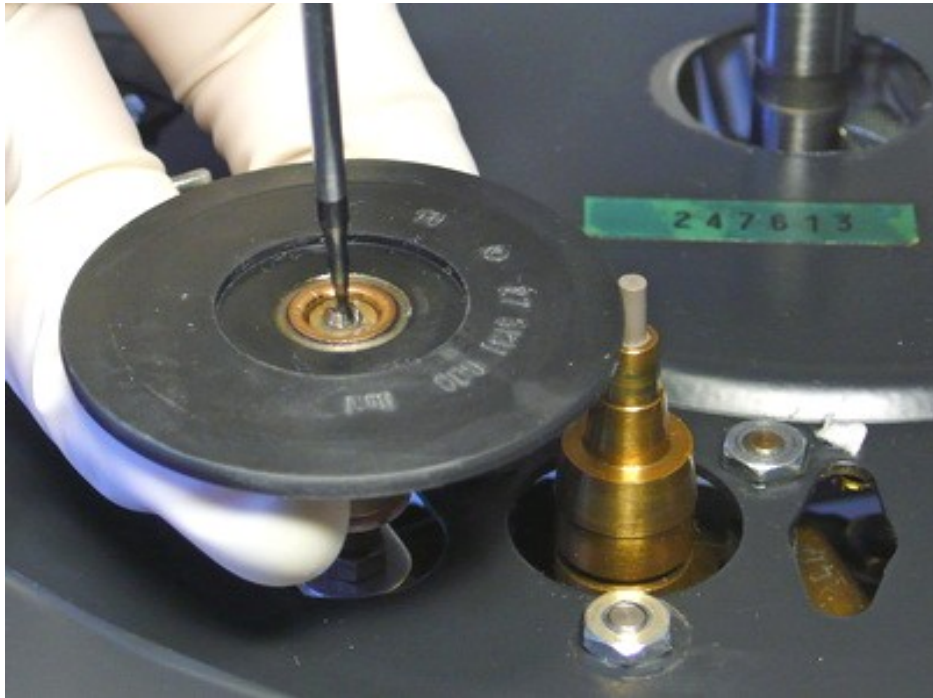
**Figure 2**

- 1.** Remove the platter. Caution: Place a screwdriver into the bearing support diagonally and under the AW2 (or 3) stacker spindle cut-out, to remove the C Clip avoiding damage to the chrome disc, as shown in Figure 3:



**Figure 3**

2. Wearing latex gloves, remove the idler wheel by placing fingers under the idler and using a small screwdriver to push down onto the idler shaft, thus popping off the plastic washer. Lift the idler against the screwdriver tip (smaller than the plastic washer internal diameter, i.e. 2 mm) and pull up: the ring will pop off. This prevents damage to the plastic washer. See Figure 4:



**Figure 4**

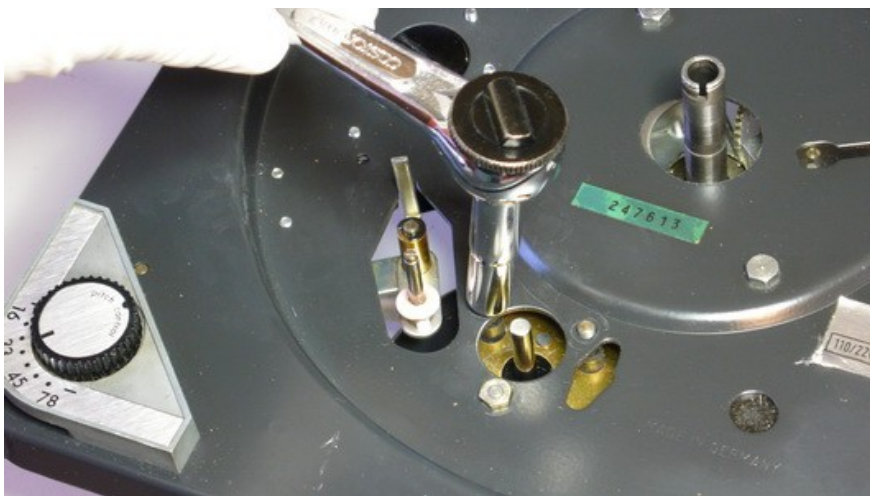
**Warning:** the idler wheel is very sensitive to oil and fingerprint; make sure to wear latex gloves whenever manipulating the idler!

3. After removing the platter and the idler wheel, loosen the set-screw located on the side of the pulley, (Figure 5) not the pulley's top grub screw, if such is present; the grub screw is for speed adjustment.

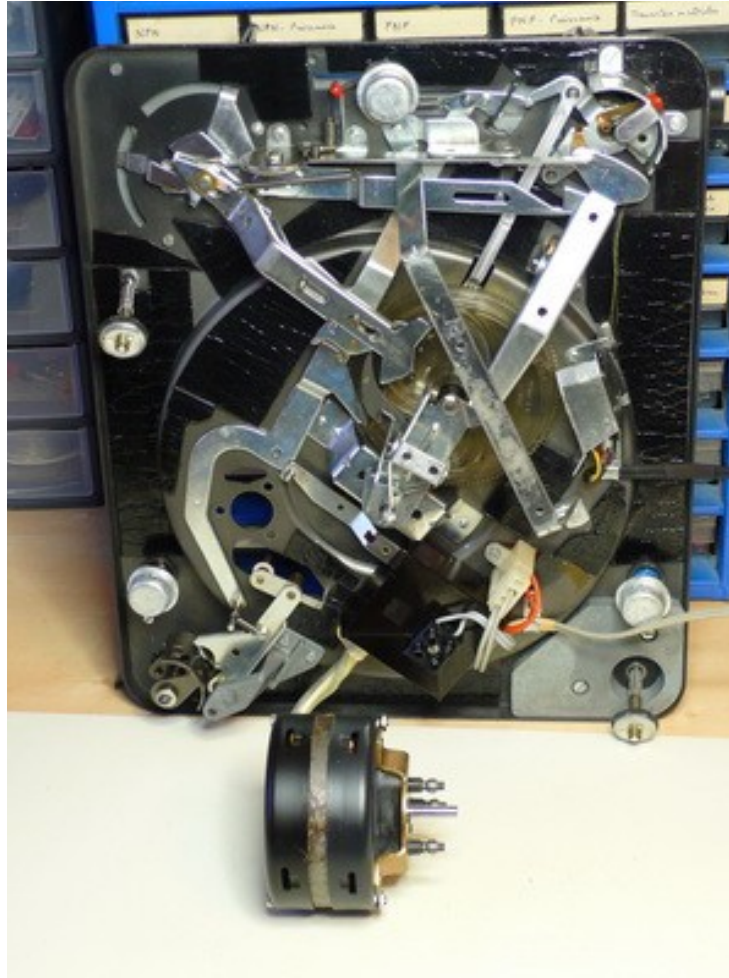
**Figure 5**

**Warning:** The pulley must not be touched with fingers or be in contact with oil. Clean it with isopropyl alcohol. Do not scratch or damage pulley with the screwdriver!

4. Use the 7 mm (9/16") socket or nut driver to remove the three motor nuts. (Figure 6)

**Figure 6**

5. While holding the motor, lift the table off the motor assembly (Figure 7) and place it onto the cardboard ring (Figure 2):



**Figure 7**

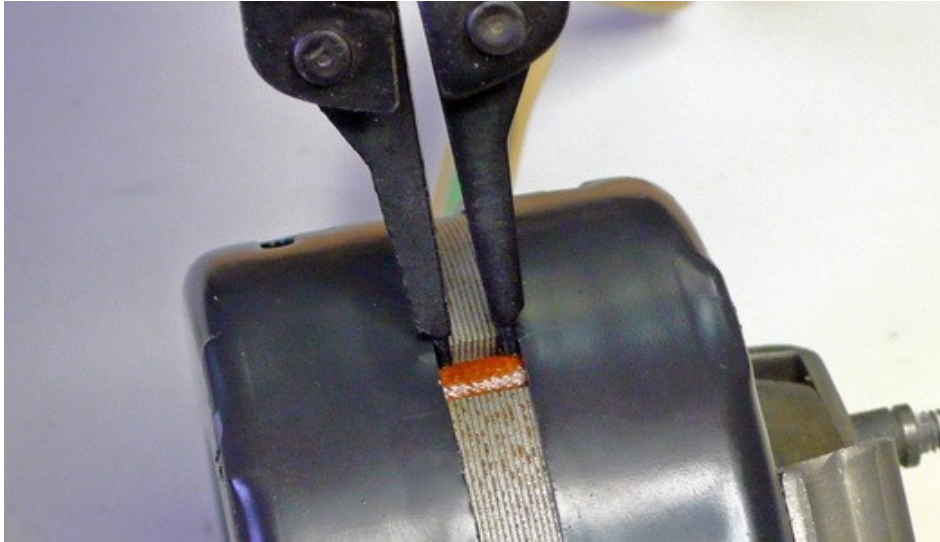
6. Wipe off the exterior of the motor before disassembly.

Use a permanent felt-tip marker to write reference marks on the shells and the armature to remember the original position of the motor halves. These marks will be needed when reassembling the motor (Figure 8):



**Figure 8**

- 7.** Carefully inspect the rotor shaft, especially near the location of the motor pulley locking screw, to make sure there are no burrs. Any burr must be dressed down carefully with fine-grit emery paper. The motor bearing can be scored if the burr is pulled through the bearing. When dressing a burr, make sure to hold the motor horizontally (Figure 8) to prevent filings / emery board particles from falling into the top motor bearing. Carefully clean the shaft before proceeding to the next step.
  
- 8.** With the 7 mm socket and a screwdriver, remove the two frame screws, nuts and lock washers that hold the two halves of the motor. Using an expanding jaw pliers or snap ring pliers inserted next to one frame screw insulator, then the other, carefully force the shells apart a little at a time until they separate. Switch sides several times during the opening procedure in order to pull the shells apart axially thus avoiding damage to the shaft. (Figure 9)



**Figure 9**

**Note:** Motors found on the 1009 and early 1019s have their shells held together by clamps instead of frame screws. Unscrew the clamps, remove them from the shells, and then separate the shells as described above. The socket wrench may not have enough space; a flat 7 mm wrench for this operation is preferable (Figure 10).



**Figure 10**

**9.** Carefully wipe out any debris inside the motor.

**10.** If the armature has rust on its exterior, carefully sand it off with emery paper. Again, **do not get the dust in the bearings!**

**11.** The bottom bell/bearing needs to be opened and cleaned thoroughly. It requires disassembly and maintenance because the metal plate within the bearing cup supports the weight of the rotor. Proceed by removing the three rivets. They are relatively soft and can be removed with a 5 mm (3/16") drill bit.

Clean all the parts of the bottom bearing assembly. Submerge the sintered brass bearing, and the felt ring in isopropyl alcohol. The felt ring must be thoroughly cleaned. Replace the alcohol several times, until all of the original oil is removed. Cleanliness is achieved once the alcohol stays clean and felt ring is clean. The original oil must be removed to avoid any chemical breakdown due to the incompatibility of different oils, which can lead to the possible seizing of the motor (Figure 11):



**Figure 11**

**12.** Re-assemble the bottom bearing assembly in the following order (Figure 12):

- copper disc (placing the less worn side up, see note below),
- small felt or foam ring,
- sintered bearing,
- felt ring (which goes around the bearing),
- retaining spring,
- cover cap.

If the foam/felt ring is in poor condition, replace them with fresh home-made felt rings, cut to identical size.



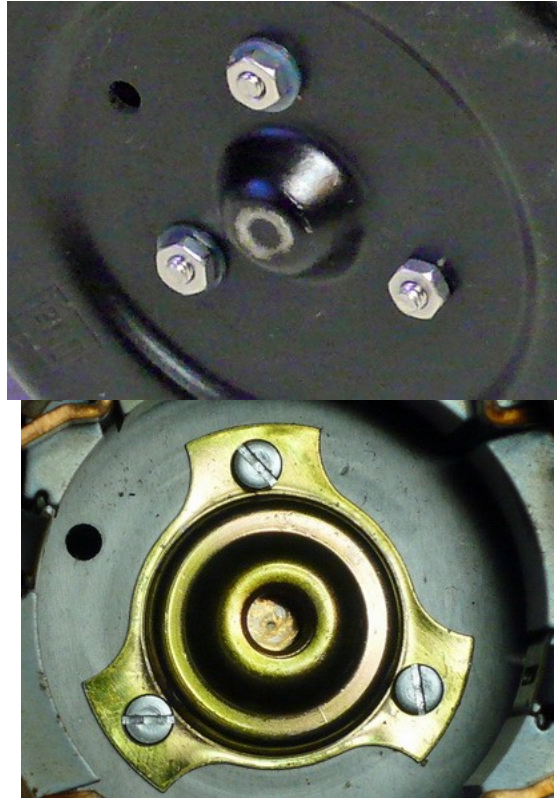
**Figure 12**

**Note:** the small copper disc found under the rotor (far left on the photo) is meant to wear before the chromium plating on the rotor; hence, wear should be noticeable on it. Turn this disc over when reassembling: this will give less friction between the rotor and said copper disc, hence a quieter motor.

**13.** Close the lower bearing assembly by one of the following two options:

- a. Use M2.5 (4/40) screws/nuts with lock washers (Figure 13).
- b. Replace the original rivets: Use 2.4 mm (3/16") pop rivets if available.

Both options work equally well. The choice comes down to personal preference. Pop rivets are easier to use, but screws are easier to find and will be easier to service again at a later date. Figure 13 shows the nut and bolt version.



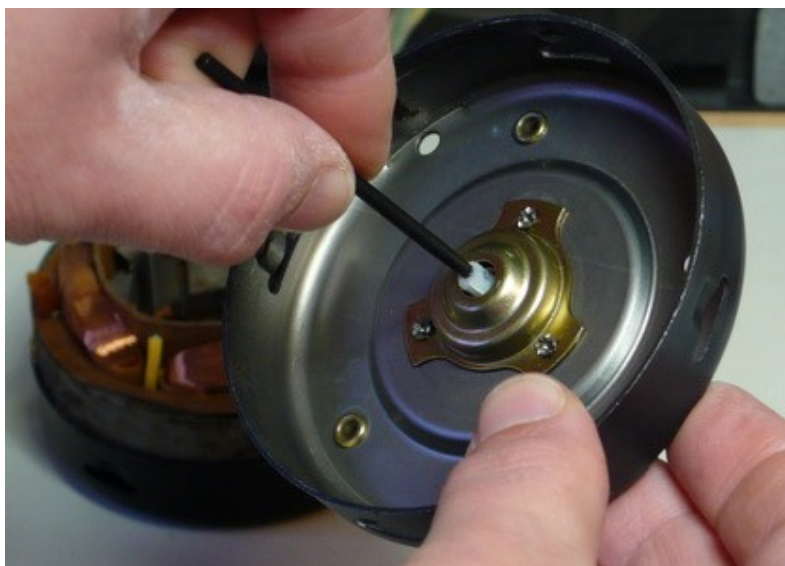
**Figure 13**

- 14.** Put light machine oil into brass bearing bore, to the top of the brass housing. Wait for the oil to absorb into the dry felt rings and oil a second time.

**Warning:** Do not oil the felt rings before reassembling: this prevents the possibility of contamination of the oil/felt rings through the re-mounting procedure.

- 15.** The top bearing keeps the rotor concentric and only requires cleaning prior to lubrication. Do not disassemble it! Clean it with a Q-tip impregnated with isopropyl alcohol (Figure 14).

**Warning:** Make sure no Q-tip fibres are left behind in the brass bearing, otherwise it will inhibit free rotation once reassembled.



**Figure 14:**

Fill the felt pocket of the upper bearing with the same light sewing machine oil.

Put a drop on the top shaft and bottom shaft of the rotor, and reassemble the motor.

Place the upper bell bearing on the armature, being careful not to invert the armature (check the mark!)

**Note:** Some rotors were equipped with a red washer on the rotor shaft (inside motor). Reposition this washer onto rotor shaft prior to next step.

Put the rotor's upper shaft through the upper bell bearing.

Place the lower bell bearing onto the rotor and align with the mark.

Do not forget the screw insulation sleeves, if they were used.

Press the halves together by hand until the screws pass through the bottom bell, the stator, and the upper bell. Check alignment with the mark and/or make sure the screws are sitting perpendicular and central in the holes of the bells and stator. Tap each screw to gain the necessary freedom on the screws for the lock washer and nut. Tighten the nuts, lock washers and frame screws alternatively, until the motor is tight. The bell halves have indents to prevent over-tightening.

For motors using clamps instead of frame screws, the procedure is much the same: reinstall the two clamps at their original location and tighten them alternatively by tightening their screws.

**16.** Make sure the motor shaft turns easily and smoothly. This is accomplished by "seating the bearings" (Figure 15) with a little nudge from

the mallet! Tap the motor side to shake the rotor and thus re-align the two bearings, achieving proper alignment. Turn the rotor tip by hand prior to tapping the motor and after. There will be a noticeable difference in free-spin. If not, then there are either some Q-tip fibres or other contaminants left in the bearings and the operation must be repeated, or the bearings were not seated properly with the mallet.



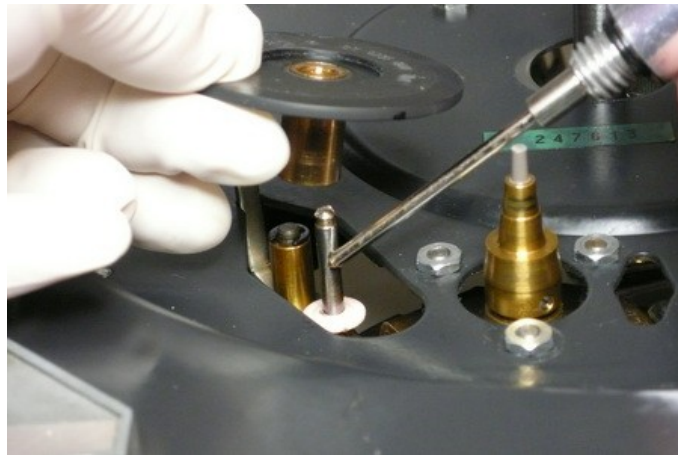
**Figure 15**

- 17.** Reinstall the motor in the chassis with the three nuts, using the 7 mm (9/32") socket or nut driver.
- 18.** Reinstall the motor pulley on the motor shaft and tighten the set-screw on the side of the pulley. Manipulate this part with clean latex gloves! If the part was touched directly with the fingers, clean it with isopropyl alcohol.

### ***Idler Preparation and installation:***

- 19.** Dress the outer edge of the idler by rotating it against a piece of emery paper, with grit grade depending on condition (hardness) of idler. This is best accomplished on a drill press and not on the turntable. The drill press has the advantage that rubber dirt will not fall into the motor and that the idler is not moving out of centre, causing eccentricity. Note that the idler wheel is a critical part that is no longer made and is difficult to replace when worn out, so dress it only as much as needed to get a clean, regular surface with a good grip and without flat spots. There are some idler rejuvenators listed on the Internet, for idlers which are no longer be usable.

Once the motor is fixed on the chassis, install the idler (Figure16), handling it with clean latex gloves, lubricating the shaft and the idler bore with 10w30 and locking it with the nylon washer.



**Figure 16**

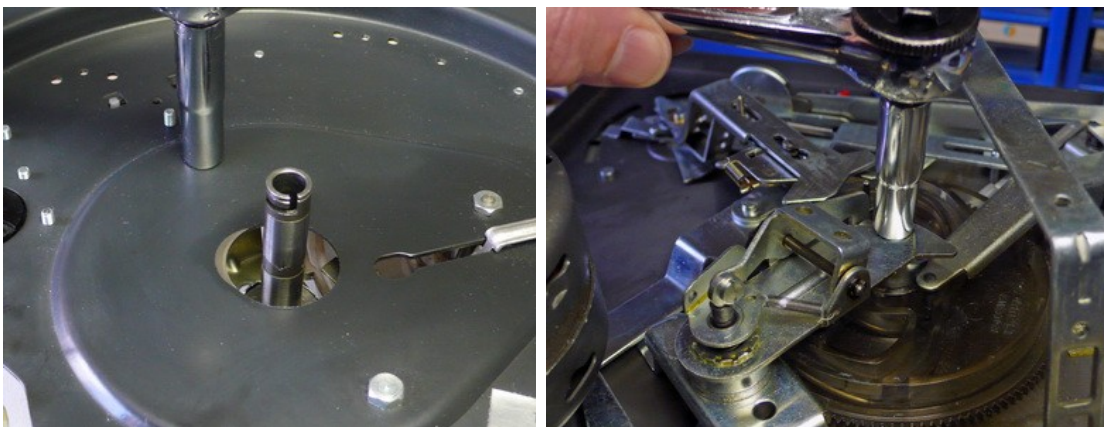
### ***Platter Preparation and Installation***

**20.** Before putting the platter back, check its inner rim for debris and dirt. Clean with isopropyl alcohol while taking care not to let alcohol get onto the strobe paper (for the models that have it). Remember to wear latex gloves when touching the platter rim!

**Note:** Dual reference numbers used are taken from the isometric parts list of the 1019 service manual. Other models will have other numbers for the same item!

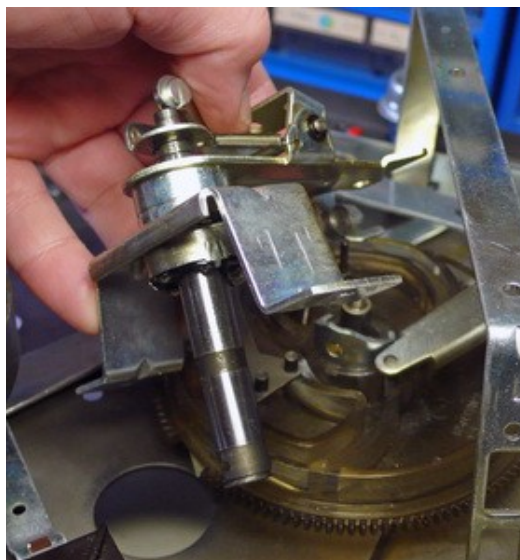
Next, clean the platter support bearing. Follow this procedure to remove the bearing:

a) Remove the 2 screws (22) and nut (143) (Figure 17):



**Figure 17**

b) Remove the main bearing support block (142) (Figure 18) by pulling it straight down, and leave the cam in place.



**Figure 18**

- c) Now that the platter support bearing is free, pry up the three tabs and open it up, clean it, and re-lubricate with Renotac or similar heavy adhesive oil to keep the shaft well lubricated and prevent oil from creeping down/out of the bearing. Lubricant 10W30 can be used, but it is not ideal. For reassembly, make sure to place the washer with the smaller inner diameter on the bottom and the larger one on top. The larger hole is required to give the proper space needed by the platter's brass bushing (Figure 19):

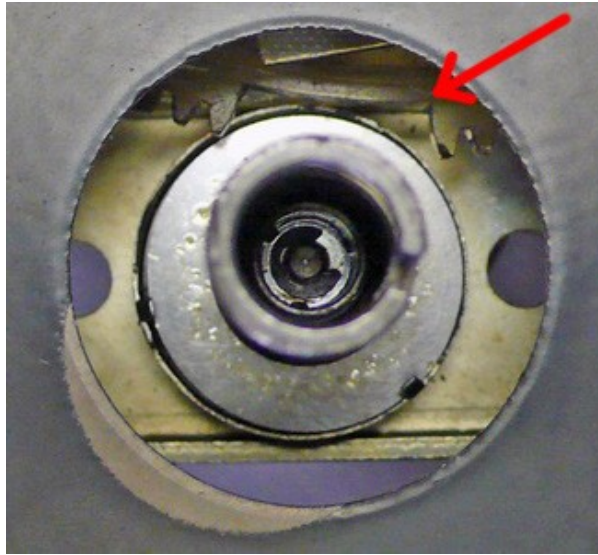


**Figure 19**

- 21.** Adjust the speed before securing the platter: This adjustment is model-dependent. Once the motor is fixed on the chassis, align the speed fine adjustment knob (if applicable) in the centre position between + and - speed indicator. Now adjust the speed via the pulley height on the rotor (12xx models) or the idler shaft height (10xx models) for proper speed as seen on the stroboscope.

**Note:** The platter must be removed and put back every time an adjustment is made. Make sure to put the cam in neutral position. This is accomplished by rotating the cam manually counter clockwise until the mechanism clicks off and a toothless section of the cam is visible op-

posite the platter bridge support stem when viewed from top down onto the chassis, as shown on Figure 20:



**Figure 20**

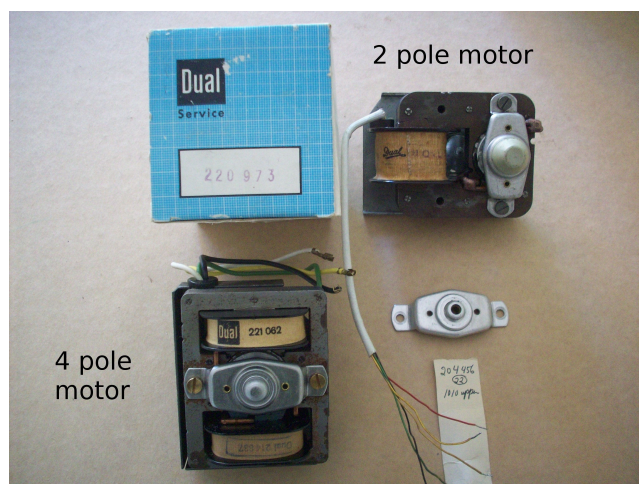
Once the speed is set, tighten the pulley (12xx models) or the idler shaft (10xx models). Check the free rotation of the platter (it should spin for at least 90 seconds after stopping the turntable at 33 rpm), then secure it with the locking ring.

**IMPORTANT:** Remember to wear latex gloves!

## **Two and Four Pole open-frame Motors.**

### *Older versions:*

When servicing these motors, the same cleaning and re-lubrication procedures for the bearing as described above are to be followed. These motors are subdivided into two categories. The early versions had stamped aluminium rotor bearing bridges as shown in Figure 21:



**Figure 21**

These motors are easily opened via the two bolts, visible on either side of the bearing bridge. While the four pole motor as shown, has the same bearing parts within the bearing bridge as seen in Figure 12, the two pole version as shown with the plastic cap on the bottom, will have a steel ball under the rotor as a support rather than the copper disc. Both type of bearing bridges are used on these motors.

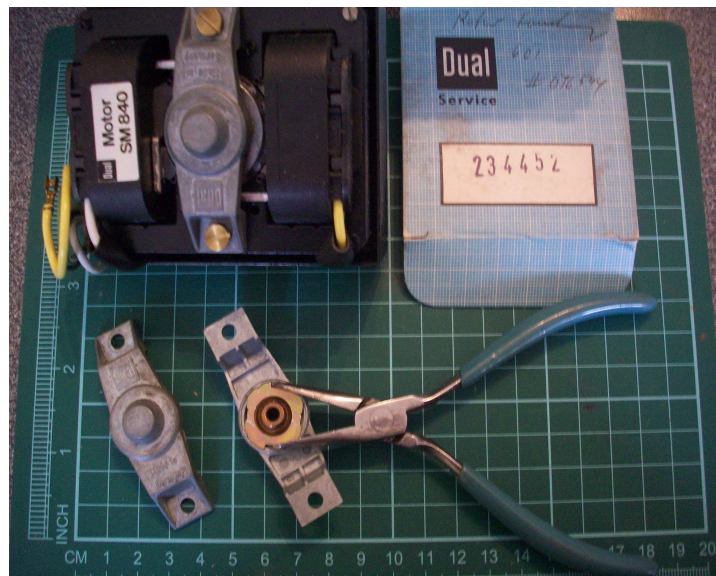
To open the bridges, drill out the rivets as was done on the round motor and proceed with the cleaning in the same manner.

Once cleaned, these bridges can be re-riveted or closed with fine nuts and bolts. If using nuts and bolts, secure these with loctite or another sealing agent to keep the nuts from loosening.

## ***Two and Four Pole open-frame Motors.***

### *Newer versions:*

The AM and SM two and four pole motors utilizes cast bearing bridges. These can be removed via the two bolts as was seen no the previous motors. Once removed they can be opened with small angled pliers. The pliers are inserted into the two slots opposed to the crimped edges on the bearing bridge as shown with a four pole motor in Figure 22.

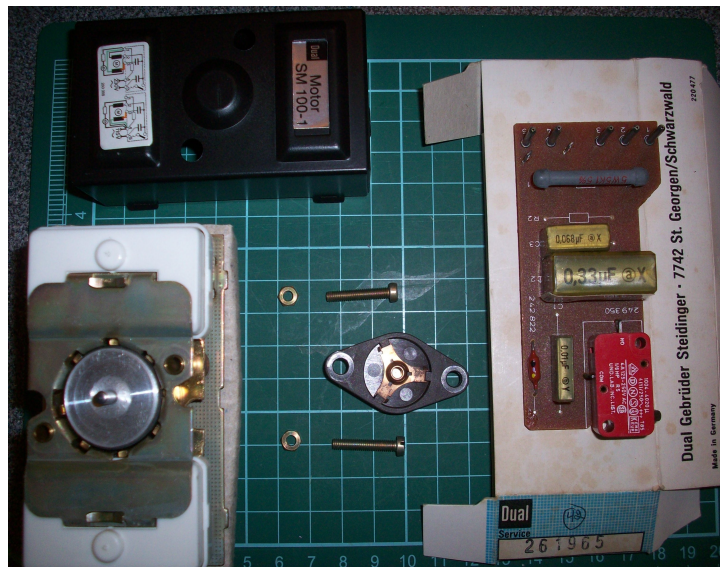


**Figure 22**

Rotate the inner plate until it clears the crimped edge. Clean and re-lubricate as shown in Fig.11 and 12. Re-fit the bearings parts in reverse order.

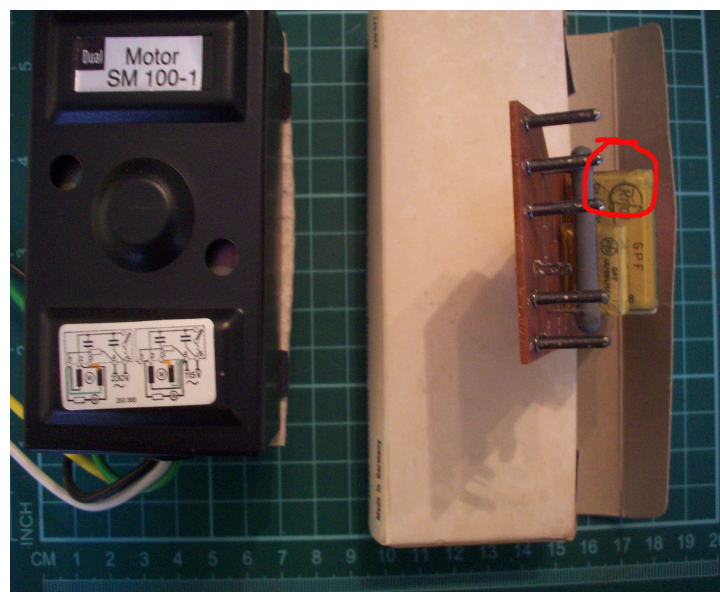
### SM 100 motors

The SM100 motors are encapsulated with a shield as shown in Figure 23. These shields are clipped onto the upper motor support plate. The motor is wired to a power board. These motors are also issued bearing bridges which can be opened in a simpler manner as described on the previous motors.



**Figure 23**

The power board used with these motors, invariably need a replacement of the condensers due to aging. It is very important to check these condensers for cracks in their shell as shown in Figure 24:



**Figure 24**

These cracks indicate that the condenser is about to fail. These cracks let humidity into the dielectric and will cause the condenser to short out in time. Once shorted the condenser will blow apart, but will not flame-out. The mess, noise and odour created, are however best avoided, by replacing them.

Since they are safety items, they must be replaced with X2 safety factor parts.

Here is a small excursion into the X2 condensers:

EMI/ RFI suppression condensers are used to filter out noise or high voltage spikes that can cause damage to an electronic device.

There are two classes of interference suppression capacitors, Class X and Y. Class X capacitors are connected from line to line while Y capacitors are connected from line to ground.

Another important distinction between these two classes, occurs when an X condenser fails, there is no risk to anyone for electrical shock as apposed to a Y condenser which upon failure, will have that risk of exposure. Of the two types of noise suppression condensers, the Class X is more common with the Class X2 being the most widely used.

Dual used X2 RFI/EMI and AF (radio and audio frequency) noise suppressor condensers which are also snubber circuits. Within the casing of these condensers, there is a 100 ohm resistor. This snubber, also known as Boucherot cell, protects the condenser from high in-rush voltage and also minimizes pitting on the power switching contacts.

Different values that Dual used were 68nf, 47nf and 10nf.

For the 47nf (0.047uf) X2 RIFA, the part number is:

PMR209MB5470M100. This is a snubber 47nf/100ohm X2 combo.

The RIFA condensers can be obtained in local supply stores and are manufactured by Kemet. Some suppliers of these condensers, amongst others, are: Conrad electronics in Europe and Mouser or Digi-Key in the U.S.

Ideally, these Rifa R/C snubbers should be installed, however if these are not locally available, then as a substitute, a simple X2 condenser can be employed, such as :

Wima MP3 X2 68n,

Wima MP3 X2 47n

Wima MP3 Y2 10n

These condensers should be used with a 100 ohm flame proof resistor in series, space permitting.

**Warning :** Utmost care must be taken when installing these separate resistors and can only be used if they are to be enclosed inside the covered switch boxes. Do not attempt to work on any ac power equipment, if you are unfamiliar with live electrical circuits and the safety aspect thereof.

Utilizing the X2 condenser without the resistor is possible, but there will be more stress on the switching points as explained previously.

As a reminder, these aging condensers may be found in the following Dual turntables and changers:

500 series : 508, 521, 522, 528

600 series : 601, 604, 606, 621, 622, 626

700 series : 701, 704, 714, 721, 731Q, 741Q

122x series (starting with the 1220)

123x series

124x series

They are also found in other Dual products.

This list is not necessarily complete.

... And this concludes the motor chapter.