

# DISMANTLING A MILLIONAIRE CALCULATOR

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The following is a description of the partial dismantling of Millionaire No 897. This machine is an 8 x 8 x 16 hand driven machine. The machine was purchased from the USA through an Ebay auction. The seller had purchased it at a flea market! It still has its original special table, which tilts it about 15 degrees towards the operator. As well as a manufacturer's plate, it bears a plate indicating that it was imported into the US by W.A.Morschhauser of 1 Madison Avenue, New York City, as sole agent. It has at some stage been dismantled and undergone repair to the control register clearing gears. I do not know anything else about its history, but it is evident from its condition that it has worked extremely hard during its lifetime. I think it was built at or soon after the turn of the century, but I would be grateful for any information on this.

I would like to thank Daniel Lewin of Darmstadt, Germany, for the information he posted on the Internet. This was a great help.

Inside the lid of the machine is a large sheet of instructions, and printed in red on this sheet is the note:

*If you want to take the calculating machine to pieces, please  
write for special instructions! ( Printed pamphlet.)*

If you write for it, (and I am not sure where you would address your letter), don't hold your breath: it seems likely that no copy of this document survived!

My remarks apply of course to the machine I have. I believe the Millionaire was produced over a period of some 20 years, and it is inconceivable that changes were not made during that time. I'm afraid I simply do not know what changes were made, so the reader of these notes must beware! Also, there were several different models of the Millionaire produced.

## TOOLS

I think the only normal tools I used for dismantling were a number of different screwdrivers. Certainly there is a need for two main sizes, but the screw slots are rather narrower than most modern screws of the same head diameter. In order to avoid damage to screws, some of which may be tight, it is important to have good quality screwdrivers that fit the screw heads really well. This will also avoid unnecessary damage to the screws which may be difficult to replace. If you have a grinder, then it should be easy to craft the screwdrivers, but it can be done quite satisfactorily on an oil-stone.

When it came to dismantling the dial shafts, I had to make up a number of special tools.

For oiling, it is always useful to be able to apply small quantities of oil in precise locations, and a hypodermic syringe is a useful tool for this.

## THE SLIDER UNIT

The old tendency is there – if you see a screw-head, then unscrew it. In the case of the slider unit, this works OK. Undo the four screws at the corners of the slider unit. In order to lift the slider unit out, move all the sliders away from the zero position (positions 1 or 2 will do perfectly well), and lift the unit out, rotating it slightly towards you as you lift. The positioning of the indicator drums prevents the unit being lifted out with a straight vertical movement.

The slider unit can be cleaned and oiled without further dismantling, though it is difficult to be sure that oil is reaching the shaft bearings throughout their length. A hypodermic syringe might allow this to be achieved through the narrow gaps between the wheels.

## **THE CARRIAGE**

### **Cover Plates**

Now we get down to business, but before tackling the carriage, it is necessary to remove some of the outside casing.

The casing is released by unscrewing the corner strips. Each of the corner strips should be held by three screws. If the machine has been dismantled before, there is a probability that some of these screws may be missing. See my notes later on the subject of screws. In addition, there are two small screws at each end of the machine, passing down through the top surface and into the handle castings. With these screws and the corner strips removed it is possible to remove the end cover plates.

In order to remove the front cover plate, undo the single screw pointing downwards from the top plate into the middle of the lock.

I then removed the lid and rear cover plate. I don't think that this is essential if one just needs to remove the carriage, but it does assist with oiling the remainder of the mechanism. I also removed the bottom cover.

The lid comes away with the rear cover plate, but first I removed the lid movement limit arm in the left rear corner of the machine. I am now not sure that this was necessary. Once the arm is detached from the lid, it can be lifted out of the top plate. Then, to release the rear cover plate (plus the lid), undo the two screws near the top of the back cover plate. The lid and cover plate should come away. I did not unscrew the hinges, which appeared to be very tight.

Inside the casing, I found both the original transit locking screws, and one decimal point marker!

### **Top Surface**

Continuing with the theme of 'when you see a screw, unscrew it', the long top surface plate of the machine may be unscrewed. The screws are the four large screws, and the two small screws at one third and two thirds of the way across the machine (or putting it another way, it is all the remaining screws in the top plate, apart from those holding the maker's nameplate!). This may be easy, but it was at this stage that I had more difficulty. I have not found out how to remove the knob that traverses the carriage (the 'Carriage-shifter - W' in the diagram in the lid). My suspicion is that it unscrews, but I do not wish to apply any more force until I have confirmation of this. So with this knob still in position, I was able to lift the top plate a small distance, but not to remove it from the machine. Note: Can anyone tell me how this knob is removed?

But under this top plate is the top surface of the carriage itself, and on this is the famous inscription 'This plate never to be taken off!'. That is a pretty dire instruction, but there is reason for it. The procedure is to remove the complete carriage, and then to dismantle it from the other side.

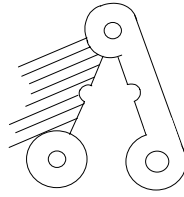
### **Top Front Carriage Guide Rail**

The top front carriage guide rail must now be removed. This runs the full length of the machine, and is held in place by two screws at each end. The screws point towards you as you stand in front of the machine (i.e. the heads of the screws are away from you). A bell striker is attached to the left hand end of this rail.

### **The Traverse Release Bar**

This is the critical one. Underneath the carriage, a cast iron bar runs the length of the carriage, and this rotates through about 40 degrees when the traverse knob is depressed. This bar has to be released from its bearings before the carriage can be removed from the machine. Don't even think about lifting the carriage out until you have released this bar - you will see why once you have got it out! The bearings at each end of this bar are split, and each is locked closed by a single screw located below the bearing. These two screws must be removed, and the bearings opened. The traverse release bar can then drop

about an inch onto the floor of the machine. See the photographs for identification of the bearing locking screws.



The Split Bearings of the Traverse Release Bar

### **The Carriage**

When the carriage is eventually lifted out, it will disengage the pair of gears at the left hand end of the machine. These will have been marked during manufacture to show the correct tooth engagement of this pair of gears, but it is worth checking to see that the information needed for reassembly is indeed there. In the event that there are no such marks (usually a centre pop on each to be aligned during assembly) then make a clear marking (scratch or marker pen) before removing the carriage. I have no doubt that the precise engagement of these gears is critical.

The shaft nearest you, which passes through the enormous brass cylinder and with the gear wheel at the left hand end, must be released from its bearings. The bearings are conventional split bearings, and the removable part is secured by two screws. Note that when you replace these, they must be in the same positions and the same way round.

The carriage can now be lifted out, rotating it slightly away from you as you lift.

### **DISMANTLING THE CARRIAGE**

In the case of my machine, three of the carriage dials were not free to turn, and thus could not be placed in the zero position. This made life more difficult, since the removal of the clearing bars is designed to be done with the dials in the zero position. I will not describe that particular problem, but will assume that the dials can be placed in the zero position.

There are eight screws holding the three brass strips which provide the bottom bearings (bottom when installed in the machine), and these three strips are now removed as a single unit. One of the screws (the one screwing into the cylindrical support column) was missing on my machine. One of these strips also houses the guide slots for the control register clearing bar.

To remove the control register clearing bar, one end of the clearing bar return spring should first be detached (this does not have to be unscrewed – it is a close fit, but it simply lifts off). The clearing knob (the ‘Effacer of the control numbers – C’ in the lid diagram) should be unscrewed from the clearing bar. It is also necessary to unscrew the single screw in the carriage front plate holding the cylindrical pillar. The bar may then be slid out, first one way and then the other, to come clear of the carriage.

The results register clearing bar also has to be removed before the register dials can be lifted out. This is removed by first unscrewing the clearing knob (the ‘Effacer of the result numbers – R’ in the lid diagram), removing one end of the return spring, and removing the two guide screws set into the ends of the bar. The bar may then be slid out to the right.

The individual dials of the control register may now be lifted out. A spring-loaded arm presses into the detents in the number wheel of each dial shaft, but these are not difficult to position as one reassembles the register. The dials are placed alternately high and low, to allow the register windows to be sensibly close to each other. The high and low dials are not interchangeable.

Before removing the dials of the results register, it is necessary to unscrew the sixteen manual setting knobs on the projections of the shafts through the carriage top plate. These are normal right hand

thread, and on my machine were not locked in any way. The dials are again placed alternately high and low, but note that the extreme left hand dial is different to the others. The arm that normally triggers the carry to the next digit is in this case not required (as there is no next digit), but the arm, which is set at a different angle, triggers the bell instead.

This is as far as I disassembled the main mechanism of No 897. I had no need to disassemble further, except in the case of the register dials described below. So far as I could see, further disassembly would not have been difficult.

### **Control Register Dials**

I think this is the point at which the dismantling must stop, unless one has something of a workshop in support. I used a lathe and a range of handtools to make up the necessary punches and supports to dismantle the dials. I also used silver soldering to repair the clearing gears.

On my machine, the two end teeth of the clearing gears on the control register were worn to the point where the machine was not clearing reliably. Four of the gears had been repaired before, but I had to repair the remainder. In addition, the silver plating on the discs had partially or totally disappeared.

The dial and clearing gear assembly is held on the shaft by a steel pin. At first I thought this was a taper pin, but I now believe it is simply a 1.5 mm soft steel pin that has been expanded by hammer or by a press. The pins appear to have a length of parallel, but some of them show a considerable expansion towards one end. The pins were very solidly inserted, and I had to make up several special tools in order to remove them. The direction in which they remove is not easy to see, and seemed to vary randomly. This makes them difficult to remove. Even once the pin is out, I needed to make up special tools to press the disk off the shaft.

The original drilling was pretty accurate, but not perfect. Some of the pin holes are not perfectly through the centre line of the shaft. It is therefore worth marking each shaft and its gear so that they can be reassembled in the same combinations and the same way round.

Writing now after also assembling the dials to the shafts, I would say that the original pins were probably expanded in a press tool. Even once the pins were out, the shafts were found to be expanded by about 0.001" around the point which was pinned.

### **Results Register Dials**

On the left hand dial, the pin came out in the direction between the nine and the zero. On the other dials, four pins came out in the direction between the seven and the eight, and eleven between the two and the three. There appears to be no consistency in this. Otherwise, the comments regarding the control register dials apply equally.

### **OILING**

I had no need to disassemble further, and I found I was able to apply oil to all moving parts without going any further.

### **REASSEMBLY**

I did not find the reassembly difficult. Naturally it is the reverse of the procedure outlined above, and I would only add a few additional comments:

I reassembled the register dial shafts using 5/64 inch taper pins and the appropriate taper pin reamer. The pins on the control register dials have to be trimmed flush in order not to foul the results register clearing bar. There is hardly any clearance between the gear hub and the clearing bar. The length of the pins on the results register is not so critical.

The traverse release bar should be placed in the bottom of the machine before installing the carriage. The split bearings should be close to the closed position as it is lowered, even though the bearings are empty.

As the carriage is lowered in, it may help if an assistant is standing on the left to ensure the alignment of the gears.

It is a bit of an awkward job getting the traverse release bar back into its bearings. It may help if one person can work each end of the machine. As the traverse release bar bearings are closed, it is necessary to see that the crank on the left hand end of the bar fits into the fork on the traverse knob extension.

When it comes to inserting the slider unit, it seems to be easiest if the sliding gears are moved to between the 2<sup>nd</sup> and 3<sup>rd</sup> racks (the “1” rack and the “2” rack), and the sliders all set to the digit “2”. With good lighting, it should be possible to see that the forks all position correctly over the sliding gears.

## **SCREWS**

Apart from several specially machined screws, there are two main sizes used, which I will refer to as small and large.

### **The Small Screws**

The small screws have a thread diameter of 2.28 mm and a pitch of 0.4 mm.

This could well be a screw with a nominal diameter of 2.3 mm. A screw of this diameter and pitch is still available on the continent of Europe, though not normally in use in the UK.

The screws are countersunk, and most of the heads are slightly domed – I think known as semi-countersunk. A few of the screws are countersunk with flat heads, but I suspect that on my machine these were not in their original positions. The overall length is about 7.4 mm. The screws are steel, with a black finish.

I have now obtained some of these screws, but they are flat-headed and not the ‘semi-countersunk’ variety.

### **The Large Screws**

The large screws are 4 mm diameter with a pitch of 0.6 mm. This is a little used fine thread, the standards for this diameter being pitches of 0.5 mm, 0.7 mm or 0.75 mm. The screws are again semi-countersunk. I have located a die for this thread, and now have this available. If anyone is stuck for one of these, something might be done! The overall length is about 8.7 mm. The screws are steel, with a black finish.

### **Finally!**

No blame accepted for Millionaires in pieces, but I hope the above information may be of some help to someone!

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