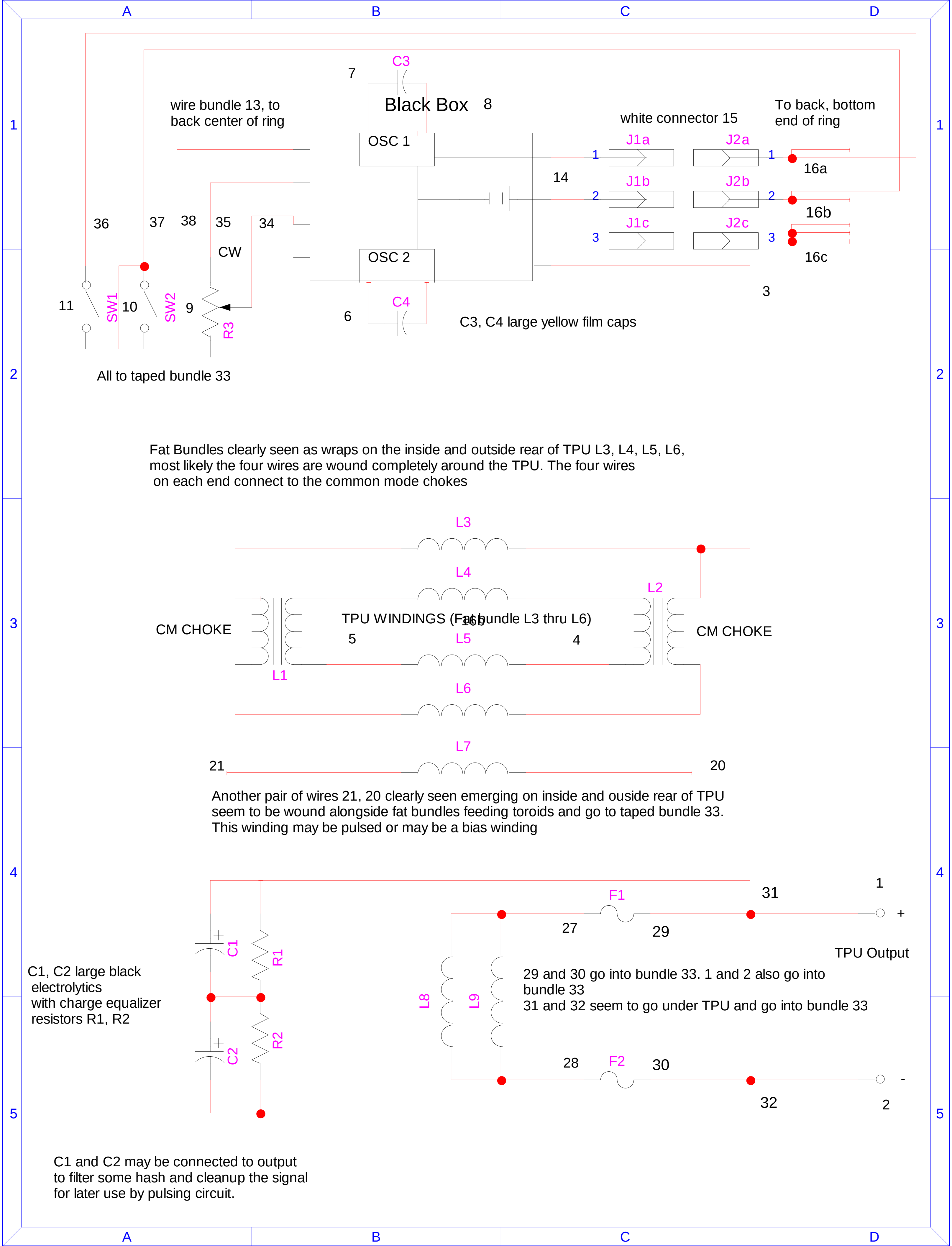
C3
7
Black Box 8
wire bundle 13, to
back center of ring
white connector 15
To back, bottom
end of ring
OSC 1
J1a
J2a
16a
14
J1b
J2b
16b
J1c
J2c
16c
36
37
38
35
34
CW
OSC 2
11
SW1
10
SW2
9
R3
6
C4
C3, C4 large yellow film caps
3
All to taped bundle 33
Fat Bundles clearly seen as wraps on the inside and outside rear of TPU L3, L4, L5, L6,
most likely the four wires are wound completely around the TPU. The four wires
on each end connect to the common mode chokes
L3
L4
L2
CM CHOKE
TPU WINDINGS (Fat bundle L3 thru L6)
16b
5
L5
4
CM CHOKE
L1
L6
L7
21
20
Another pair of wires 21, 20 clearly seen emerging on inside and ouside rear of TPU
seem to be wound alongside fat bundles feeding toroids and go to taped bundle 33.
This winding may be pulsed or may be a bias winding
F1
31
1
+
27
29
TPU Output
C1
R1
C1, C2 large black
electrolytics
with charge equalizer
resistors R1, R2
L8
L9
29 and 30 go into bundle 33. 1 and 2 also go into
bundle 33
31 and 32 seem to go under TPU and go into bundle 33
C2
R2
28
F2
30
-
32
2
C1 and C2 may be connected to output
to filter some hash and cleanup the signal
for later use by pulsing circuit.

A few guesses from an experienced designer of electronic equipment based on common sense

This is not a complete work, but a work in progress. Hopefully all will take this as a starting point towards a finished schematic of the SM17. We cannot know exactly how this thing is wound, but can make a few good guesses. Of course we cannot know exactly what is in the controls circuits, but perhaps the black box will yield some of it's secrets by inductive reasoning and later by experiment. The schematic was created with (free) Design Works Express.

I have used Wattsup's excellent pictorial (SM-17-WD-1.jpg) and and using it as a source have attempted to put together a schematic based on a common sense approach. I have also referenced some of the worthy screen shots made by Wattsup and others, although some of the inserted text on these screen shots does not fully agree with my observations. I will try to limit my theorizing, but this will be injected at points in small doses. Draw your own conclusions.

We see four wires going into one of the common mode chokes. This is the left bundle (5) wound from the outside back of the TPU. We see four wires wound from the inside back (4) of the TPU going into another common mode choke. From the way the wires appear it is reasonable to assume these are the starts and ends of the same four wires. In schematic form this is shown as transmission lines terminated with transformers (the common mode chokes). It is possible that these transformers both terminate the lines and are used to reflect the signals up and down the transmission lines.

We have many bundles of wires ducking under the SM17 rear and emerging in the back. We also have taped bundle 33 with all of the switches and potentiometer and output connections. We can safely assume that all wires entering taped bundle 33 are connected in some way, and can make a few guesses as to how they might be connected.

Wires 27 and 28 emerge from the TPU and connect to the top of the fuses. These wires appear to be wound alongside the fat wire bundles. The wires from the bottom of the fuses 29 and 30 are not labelled in the pictorial, but we can call them 29' and 30' and they go into taped bundle 33. The output wires 1 and 2 also go to taped bundle 33. I feel safe in the assumption that the output is fused, thus have drawn it that way. Two thin wires are seen connecting to the top of the fuses from somewhere down inside the TPU. These have not been labelled. I will go out on a limb and assume that these may be collector wires.

Common electrolytics do not fare well in resonant circuits because of high ESR. Special types are available with low ESR, but in an AC application such as a resonant circuit, you would need to put them in inverse series and possibly add a diode across each of them to prevent reverse charging. I therefore doubt that the large electrolytics were used as part of a resonant circuit. Also there are resistors of about two watt capacity across the electrolytics which would damp resonance.
What am I leading to ?

Like SM, I designed tube power supplies back in the day and it was very common practice that if your final voltage exceeded 500 volts or more, you would stack electrolytics and use charge equalizing resistors to insure the peak voltage was equally shared between the stacked devices. Electrolytics having a continuous rating of 450 volts are common, but not much higher than that. Since the SM17 output exceeded 800 volts I feel it is a reasonable assumption that the large electrolytics are stacked and connected to the output, thus I have drawn it that way. I believe wires 31 and 32 are extensions of the capacitor (12) wires that duck under the TPU and emerge again on the outside rear of the TPU and go to the taped bundle 33. These connect directy to 1 and 2 along with the lower fuse connections 29' and 30'

Why do we not get a big bang from the charge of those electrolytic capacitors when SM demonstrates the flame-like discharge between the probe tips?

To quote SM directly: ***By the way, the fire discharge everyone sees in the video is after the output of the device is switched through a large high value resister! I hope that will wake up a few of you to the danger potentials.***

Yes the output without a current limiting resistor would have created quite a bang instead of a flame-like discharge.

From Dr. Schinzinger's observations:
"He provided a quick blow fuse rated at 50 amperes.With two large electrical clamps and wiring, he shorted the fuse across the output terminals of the toroid and destroyed the fuse, (ObS). There was only a slight flickering of the ten incandescent bulbs as observed although there was a tremendous discharge of sparks from the output terminals of the toroid unit.
The inventor then gave me the fuse for examination. It was warm to the touch and smelled acrid, (ObS). It was a large 240 volt AC air conditioner disconnect fuse and designed for severe service duty, (OsS)."

One puzzling question. We see a white connector on the inside of the TPU going to the black box. This cannot be for removal service as there are other wires going to the black box with no connector, so the box cannot be easily removed without cutting other wires. Can this be for pre-charging a ni-cad pack used for startup? Or, in the event the TPU hadn't been demo'd in a while and the pack went flat it could be given a quick charge.

This would make some sense, and three would be a good number of connections, power out (from ni-cad), power in (to control circuit) and common ground. One of the switches could then be connected to "power out" and "power in" to activate the circuit. This connector would allow SM to insert a meter to measure current drain on the controls when starting.

The way the switches are wired would be: output from ni-cad pack to wire #37, which is common to both switches. Switch #11 turns on main circuit or first frequency, Switch #10 activates second circuit or frequency. Potentiometer #9 may adjust frequency or DC bias (for flux nulling) applied to another winding.

My guess is that when a slight DC bias is applied to a toroidal overwinding, electrons in the collector are pre-aligned in a direction parallel to the toroidal overwinding and are thus freed from influence of the earths magnetic field. This is the flux nulling SM talks about. Because of the alignment, oscillations in the other toroidal windings (the transmission lines terminated by the chokes) once started will sustain for much longer as they race from end to end.

A note on load regulation: The devices tested by Schinzinger and others seemed to exhibit excellent load regulation, with no reported change in voltage output with a two times load increase (amps). This would point to one of two things, either an inherent extremely low output impedance of the generator or some form of negative feedback regulation to cause an effective low output impedance. In a standard DC machine or generator, this can be accomplished by using the output current drain to directly modulate field current. In some DC machines an extra high current field winding is in series with the output of the DC machine. In this type of self excitation, load regulation can be excellent without any type of "active component regulation control circuit", providing the winding is properly sized (number of turns). With this in mind, we can hypothesize that a bias winding could be in series with the output such that as more current is attempted to be drawn, a stronger biasing field is produced, thus greater alignment of flux and increased power output as in a DC machine. This makes sense from the standpoint that the speed of the rotating field winds up slowly and cannot quickly slew to new values as loads change. In the videos, SM makes intermittent contact with the lamps, going from no load to full load a few times. Also in the arcing probe tips as the flame discharge is demonstrated, no load to high load is shown without having to wait for the speed of rotation to catch up. As in a DC machine, speed is not varied, field intensity is. These ideas do not rule out active circuitry for output power control, they just point to alternative methods. Anyone familiar with DC rotating generators can appreciate this.

Signals may be induced into the transmission lines by other overwindings. We see at least one winding in the video captures. This is L7 with labelled leads 20, 21 in the schematic and Wattsup's pictorial.

17" SM-TPU - Wiring Diagram

by wattsup - Sept 23, 2007