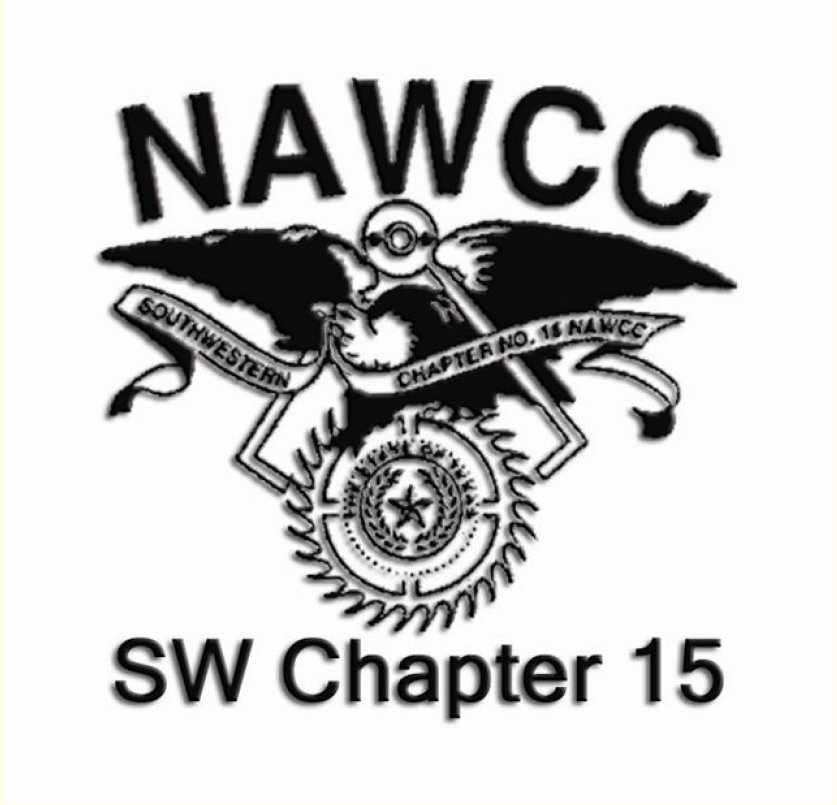
A Tale of Clock Oils



Ken Reindel
NAWCC Chapter 15
March 22, 2014

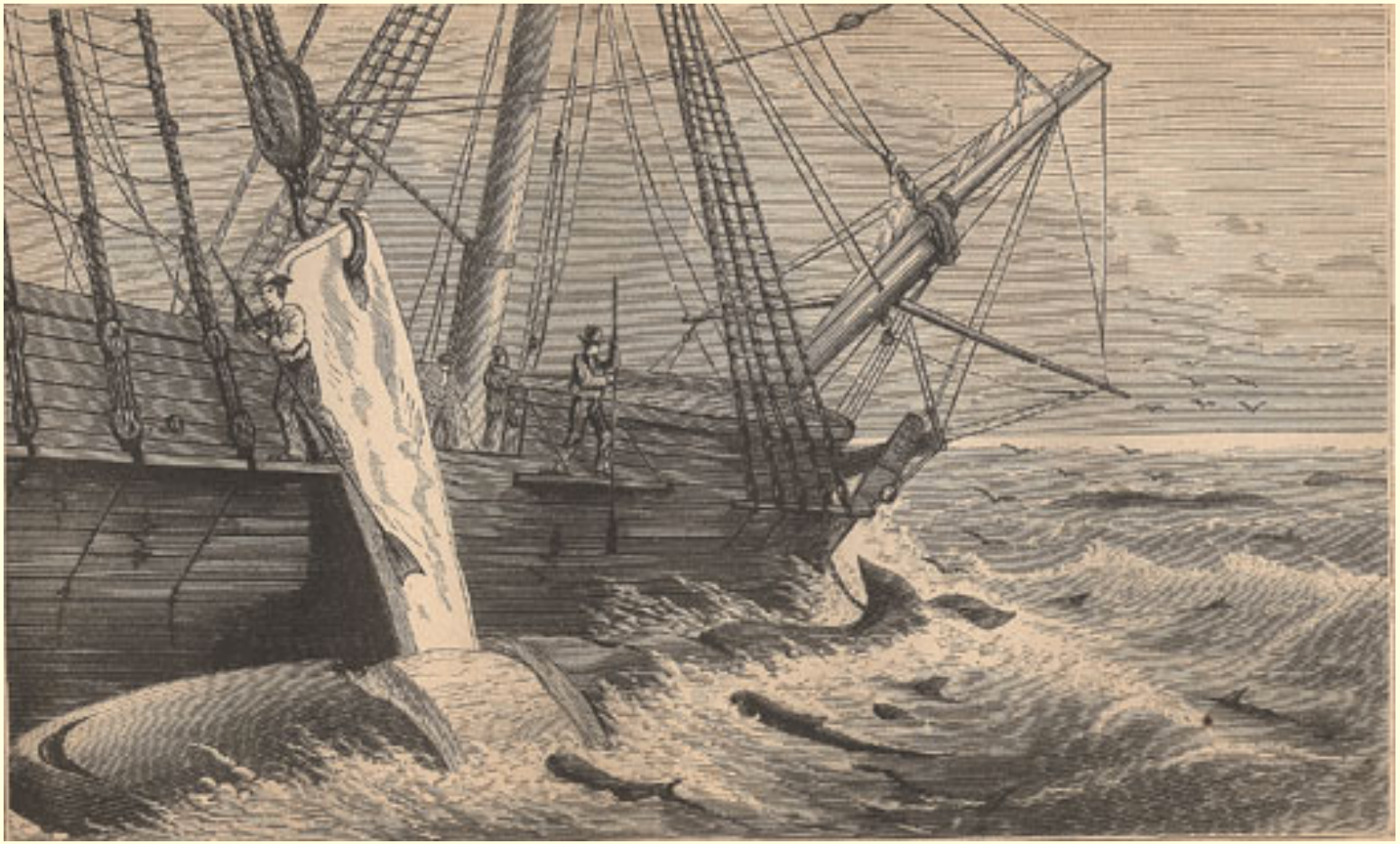
Agenda

- Short History of Oils
- Types of Oils
- 51 Years of Lubricating Clocks
- Summary and Recommendations

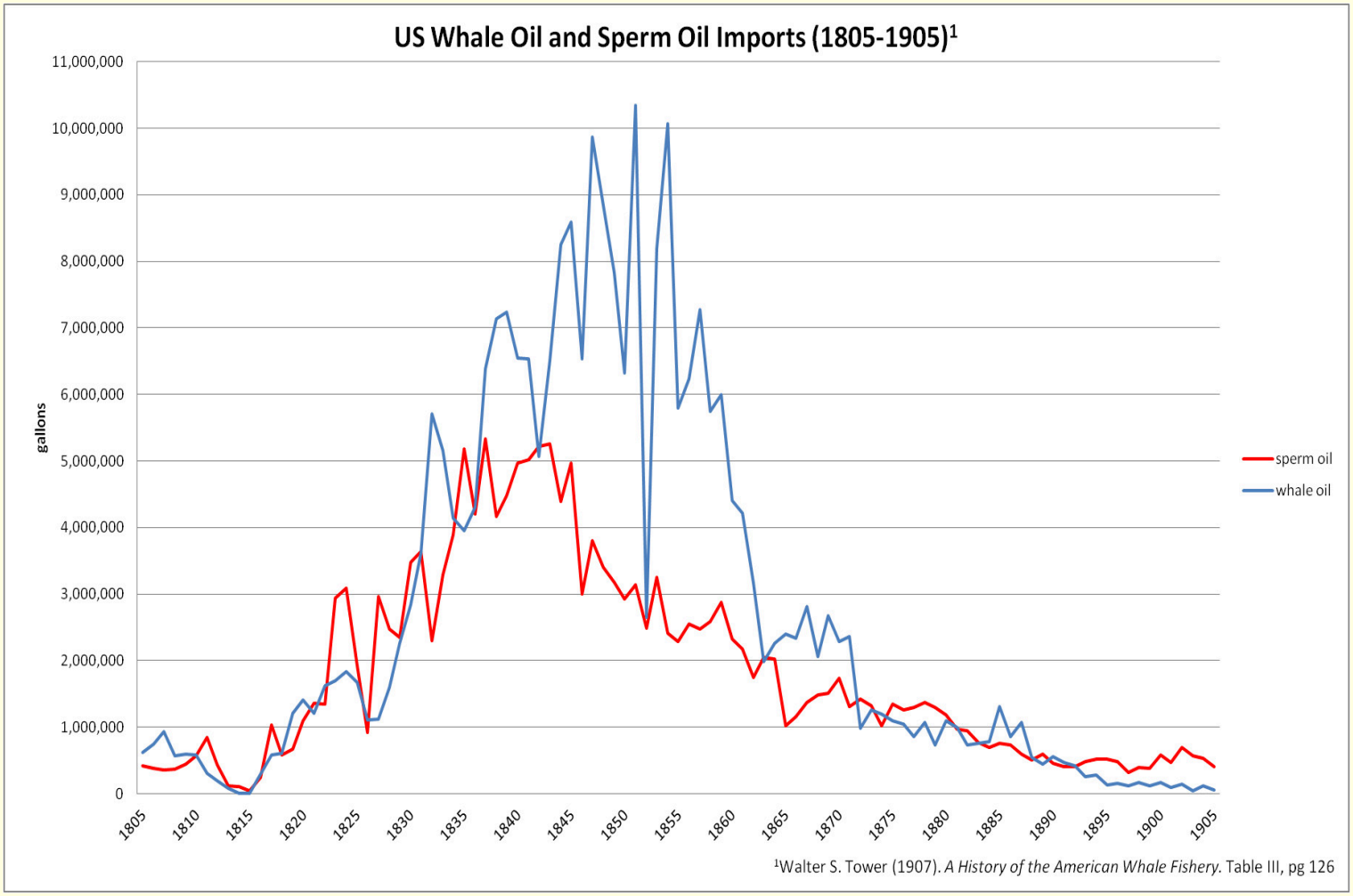
History of Clock Oils

- Boiled from whale blubber (16th Century)
  - Baleen, Sperm, Toothed whales
- Used for lubrication, lighting, soap
- Foul smell without hydrogenation (early 20th century)
- With hydrogenation, used for soaps and margarine
- Extremely stable
- Use declined due to alternatives and environmental concerns (early 1980s)

Harvesting the Blubber



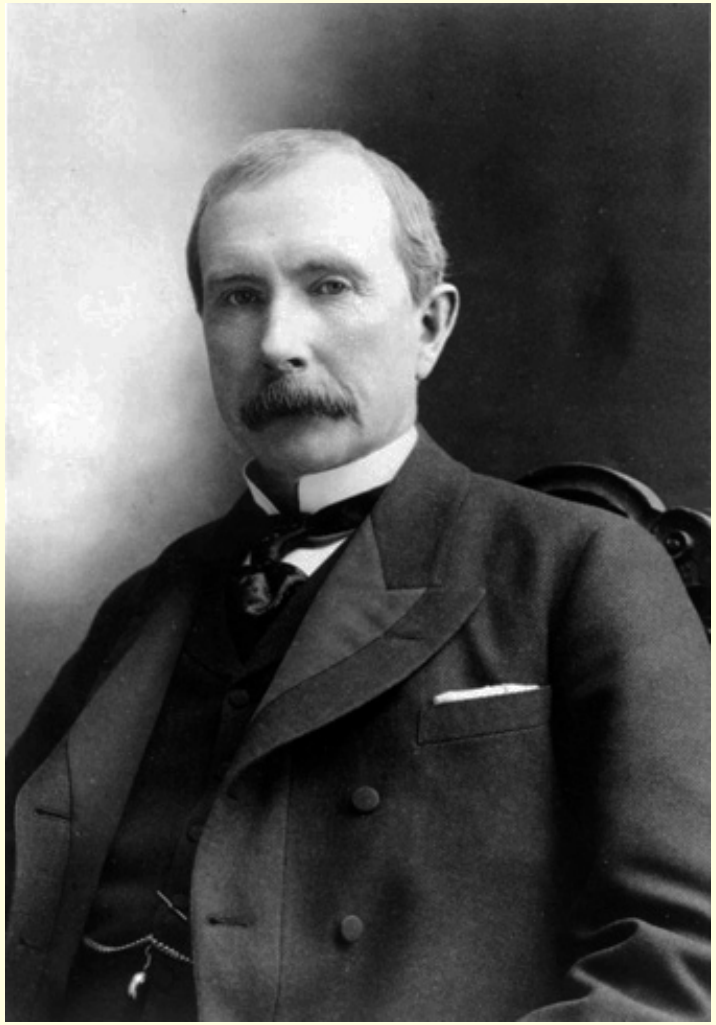
Whale and Sperm Oil



Edwin Drake 1858

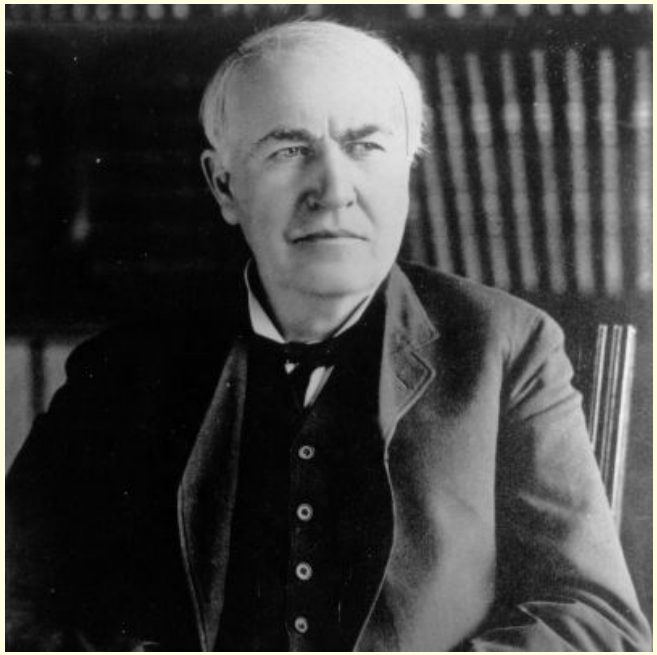
- First oil strike in USA
  - Titusville, PA
- Cast iron pipe driven by steam engine
- 25 barrels per day
- Refined into Kerosene
- Alternative to Whale oil
- Refined into lubricants and fuels later

John D. Rockefeller



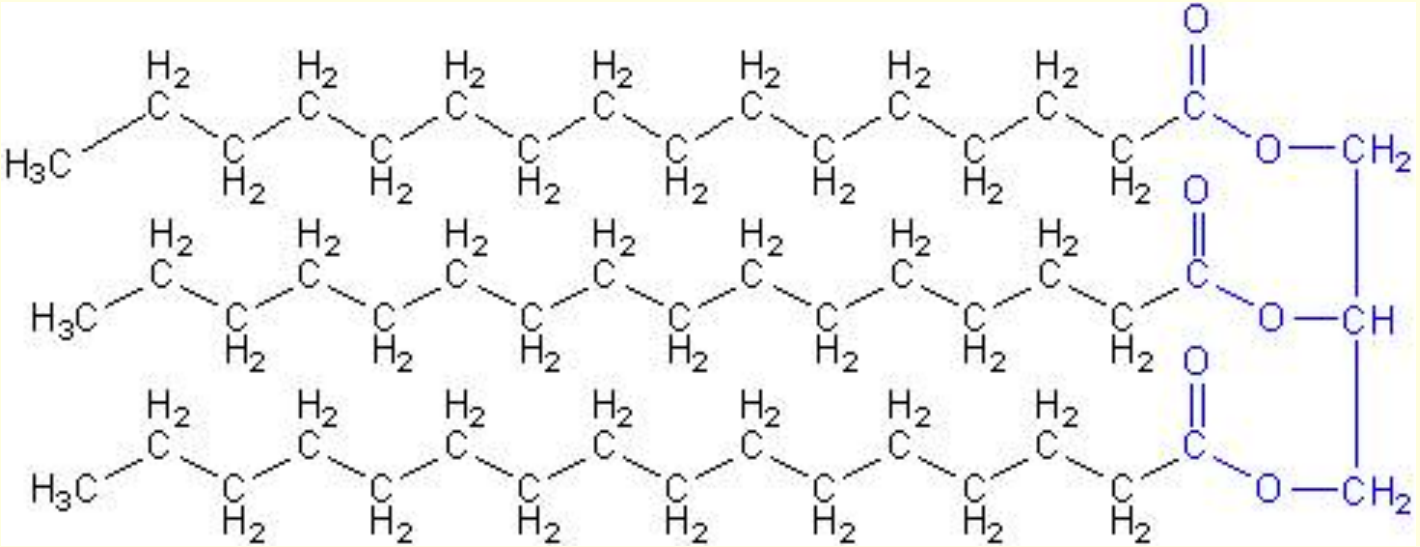
- Standard Oil of Ohio
- Legendary Tycoon 1870-1897
- Created oil industry by integrating:
  - Drilling, Refining, Transporting
- Cleveland, Ohio major refining area
  - Ohio, Indiana, Pennsylvania, Virginia
- 1911: Standard Oil split
  - Anititrust decision by Supreme Court
- Great philanthropher from first paycheck

The Oil Industry Prevails
(and expands)



What is oil, chemically?

- Organic, complex chains of hydrocarbons
- Oil molecule is non-polar ➔ slippery, non miscible with water
- Generally, double bonds ➔ reactive (more electrons!)
- Oxygen included ➔ esters ➔ alcohol condensed with organic acid
- Esters ➔ Frequently synthetic



Grades of Oils

- Group I and II: Derived from crude oil
- Group III – Ultra-refined mineral oil made through hydrocracking
  - Sometimes called “synthetic” in North America (marketing)
- Group IV: True synthetic oils; Polyalphaolefin (PAO)
- Group V: Synthetic stocks other than PAO’s; include esters and other compounds

Types of Oils

- Organic
  - Plants
  - Lipids
  - Whale Oil
  - Animal Fat based oils
- Mineral
  - Name is somewhat misnomer
  - Crude oil and its refined components
  - Fossilized organic materials
- Synthetics
- Blends
  - Mixtures of the above

Clock oils can be any of the above

Synthetic Oils

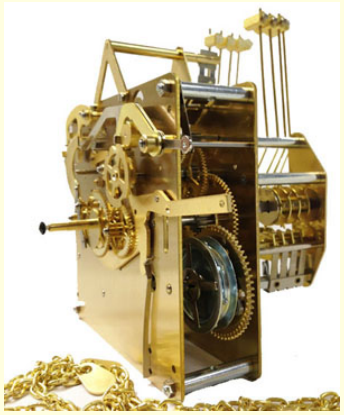
- "Man Made" building blocks or Esters:
  - Group IV Polyalphaolefins
  - Group V Esters
- Fischer-Topsch process
  - Starts with CO, CO_2, Methane, etc.
- Can be molecular modifications of petroleum
  - Can also be blends of true synthetics and mineral oils
- Originally developed in Germany, WWII
  - Cut off from crude oil

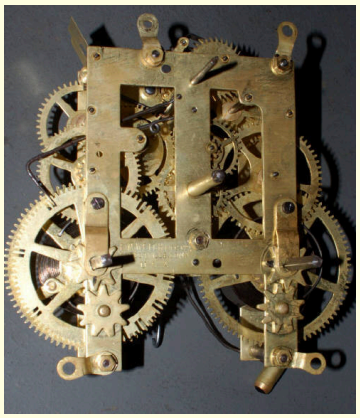
Synthetic Oils

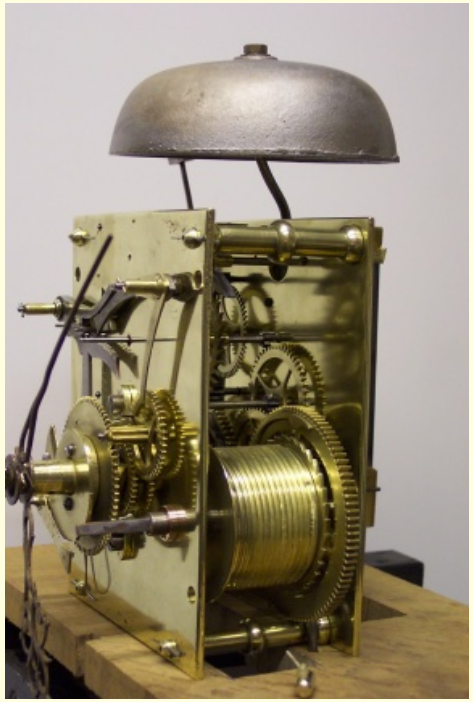
- Most commercial synthetics are blends of different building blocks, including mineral oil
- **Advantages:**
  - Better stability over time and temperature
    - e.g., resistant to sludging
  - Free of hydrocarbons, sulfur, etc contaminants found in mineral oils
  - More slippery

What do clock oils need to do?

- Provide separating film (eg, don't break down)
- Stay put, not run off (proper viscosity)
- 5-10 years without sludging, thickening or varnishing
- Don't discolor brass (green, brown)
- No evaporation
- Safe with lacquers

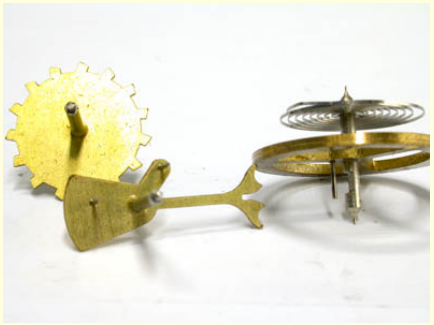


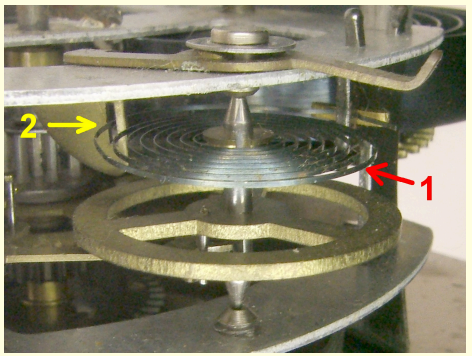




Clock Oil Challenges

- Graham Dead beat Escapements
- Lever Escapements—especially balance cups
- Main Wheel (and second wheel) Pivots
- Escape Wheel Pivots
- Mainsprings





51 Years of Clock Oils

- 3-in-1 Machine Oil
- Horolube 9-C
- Moebius 8030, 8031, and 8040
- Etsyntha 859
- Keystone Clock Pivot Oil
- Nye Traditional and Synthetic
- Molybdenum Disulphide based oils
- “Nanolube” Diamond ball bearing oils
- “Other”

3-in-1 Household Oil

- Used in my early days for small clocks
- Spindle (mineral) oil
- Citronella oil (perfumes, insect repellant)
- Corrosion inhibitor
- Low Viscosity (runs out)
  - Foul smelling
  - Sludging—Unknown
    - Thickens over time

NO LONGER USED

Horolube 9-C

- 1970s Vintage

+Whale-oil based

  - May have been blend

+Very stable

+Stays put

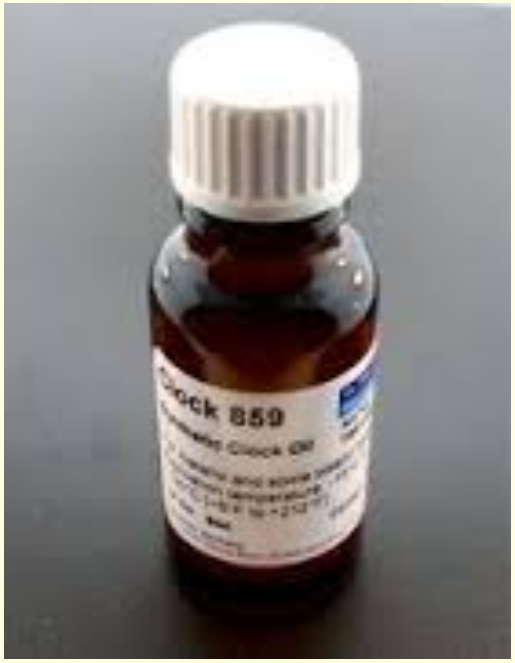
+Very good results

- Non-synthetic

NO LONGER AVAILABLE

Etsyntha 859

- Most expensive oil out there
  - 3.5ml is $14.00
  - Compare to 20ml for $17.50 for Moebius
- Claimed to be “compatible” with ‘most’ plastics--Don’t believe it!
  - Melts lacquer on plates into sludge
- Vanishes in a few years from plates



USED A FEW TIMES AND ABANDONED

Moebius 8030, 8031, 8040

- Used for about 20 years

+ At first, this was a very nice oil!
  - Probably whale oil based initially

- Then, deteriorated over time
- Now, pivots sludge and turn green in 3-5 years
- Stains plates brown and green over time

WE NO LONGER USE THIS PRODUCT

Keystone Clock Pivot Oil

- Used 12 years for re-oiling
  - Somewhat thinner than ideal
- Included in our OK-1 Kit for a few years
- Seems to be mineral-oil based

+ Holds up over time

- Never *observed* any sludging, varnishing
- Never *observed* any staining

– Tendency to run, smear if over-oiled

NO LONGER USE IN OUR KIT

Keystone Mainspring Grease

- Used 15 years for large springs in barrels
  - Comes in 3 grades; prefer “Medium”
- Not sure what’s in it
- No indication that it’s synthetic

+ Works ok but tends to run out and drip

– Don’t like dark color

– Sludging--Unknown

NO LONGER USE

Nye Synthetic 140B

+ Used for 10 years now
+ Claimed to be synthetic
+ For lightweight applications
  + Alarm escapements
  + Carriage clock escapements
  + Small movements
+ Still use for Telechron rotor lubrication
+ Never any sign of sludging or varnishing
– Will run out if over oiled (too thin for large clocks)

GREAT PRODUCT STILL IN OUR SHOP!

Molybdenum Disulfide Oils, Greases

- Light lubricants with additives
- Theory is “Micro particles” add slip
  - No data available
- True advantage uncertain for clocks
- Dirty product
- Oil needs to be mixed before use
- Will contaminate cleaning solution downstream

NEVER REALIZED ANY ADVANTAGE

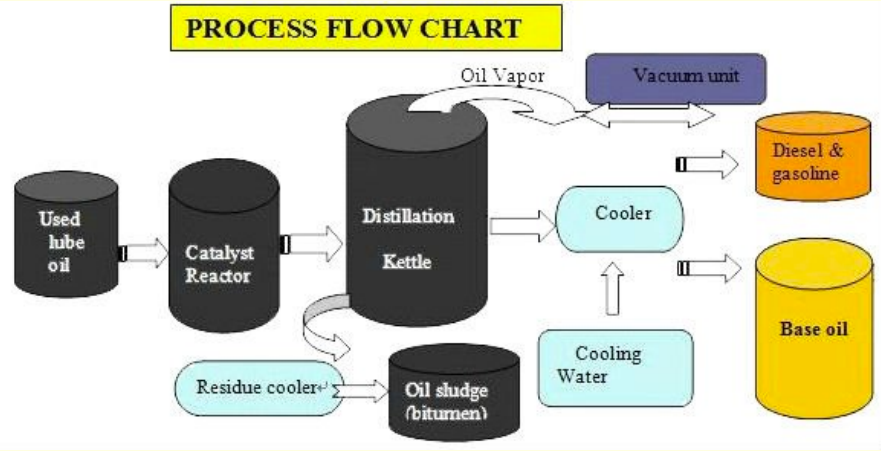
Butterworth's Nanolube Clock Oil

- Another light lubricant with additives
- Genealogy of this oil unclear
  - Who did the research, and for what?
- Much smaller particles, teflon slip
- Claim is PTFE particles are polarized
  - Isn't this anti-lubricating?
- Need to consider base lube + additive individually, then as a system
  - Base lube is runny
  - How do you qualify the system?

NO CLEAR ADVANTAGE, SOME RISK

Who is researching oils?

- WW Oil and Gas industry approaches $10 Trillion (and growing)
- WW Automotive industry north of $5 Trillion (and growing)
- Difficult for any other industry to compete



Automotive Lubricants

- Gearbox Lubricants
- Transmission Oils
- Engine Oils

Gearbox and Transmission Oils

- Sulfur additives—Bad!
  - Will react with brass
- Viscosity too heavy
  - Difficult to match to light loads in clocks

Engine Oils

- Available in broad range of viscosities
- Fully Synthetics well refined, long lasting
- No harmful additives vs. Brass, Bronze, Steel

Of Oil, Oilers and Oil Sinks

by Steve Nelson (NAWCC) pp 76-80
January-February 2014

- This article recommends using 5W40
  - We recommend 0W40 for most pivots
- His research was independent of ours
- Results and recommendations virtually identical
- We've added recommendation of 10W60 for:
  - Main wheels and Mainsprings (large clocks)
  - Graham Dead Beat escapements (larger clocks)

Viscosities

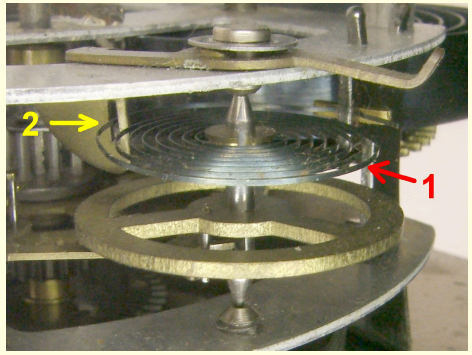
Material	Viscosity in Centipoise @ 70F
Water	1
Milk	3
Nye Clock Oil 140B	20
Sperm Oil	52
Coconut Oil	55
Soap Solution	82
Mobil 1 0W-40	215
Mobil 1 5W-40	250
Mobil 1 10W-60	500
Honey	2000

Modified from Steve Nelson's article NAWCC Watch & Clock Jan-Feb 2014

Recommended Oiling Methodology

- Mobil 1 Synthetic 0W-40 for most pivots

- Mobil 1 Synthetic 10W-60 for:
  - Main Wheels
  - Mainsprings
  - Second Wheels
  - Graham Dead Beat Pallets

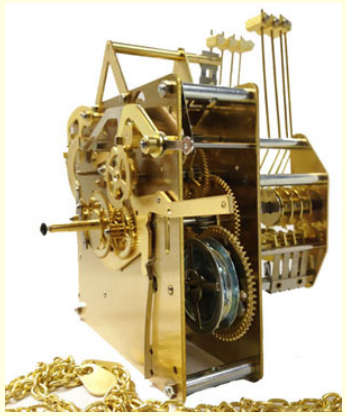


- Nye Synthetic 140B for:
  - Small pivots (<.015”)
  - Balance Cups and Pivots
  - Lever Escape Wheels

Conclusions

- Many clock oils evaporate and leave no residue
- Some can attack lacquer
- Other clock oils thicken greatly and leave green sludge or stains
- Properly selected synthetic motor oil outperforms clock oils

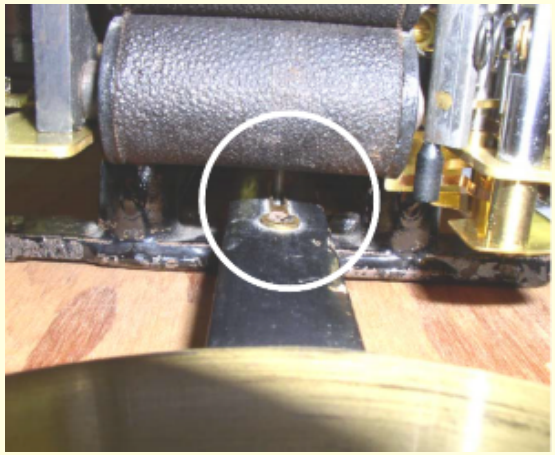
+



=

Time for A Few More Tricks?

- Pendulum Crutch Pins
  - Super Lube Synthetic Grease
- Protecting Mainsprings
  - Boeshield T-9
    - 1 part with 2 parts mineral spirits
    - Also useful for quenching



Viscosity Experiment