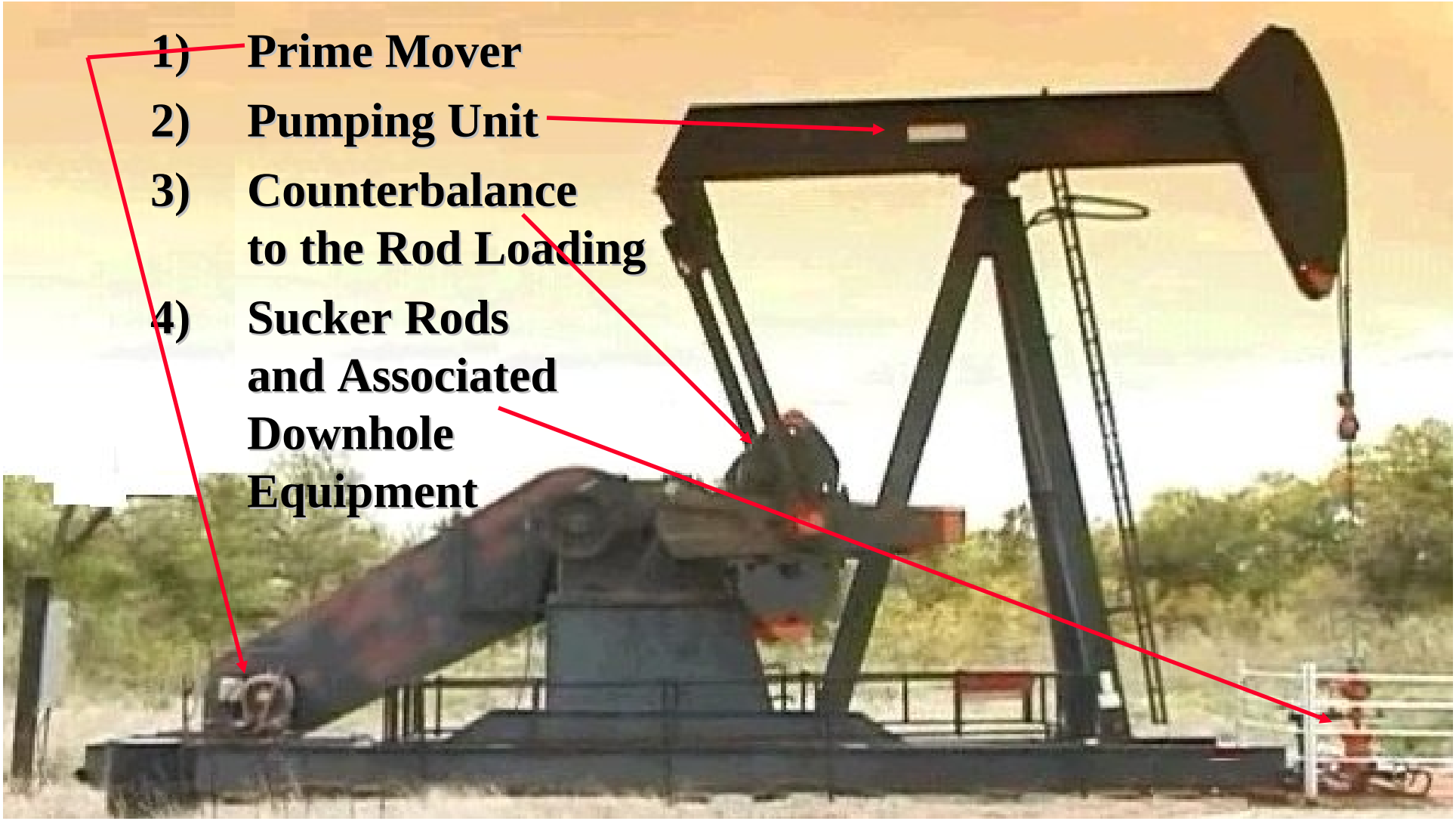
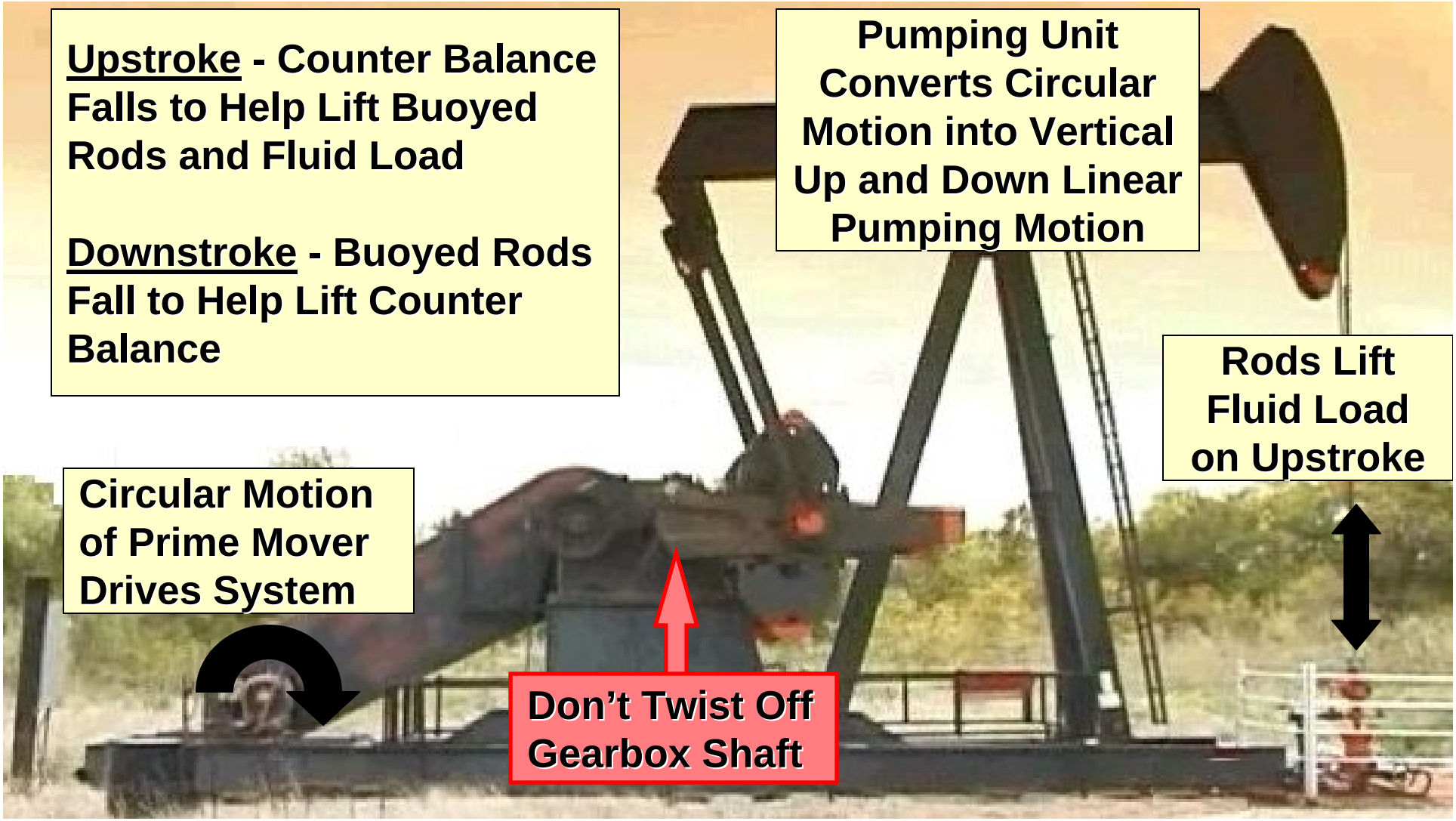
# Sucker Rod Pumping is Oldest and Most Common Method of Artificial Lift



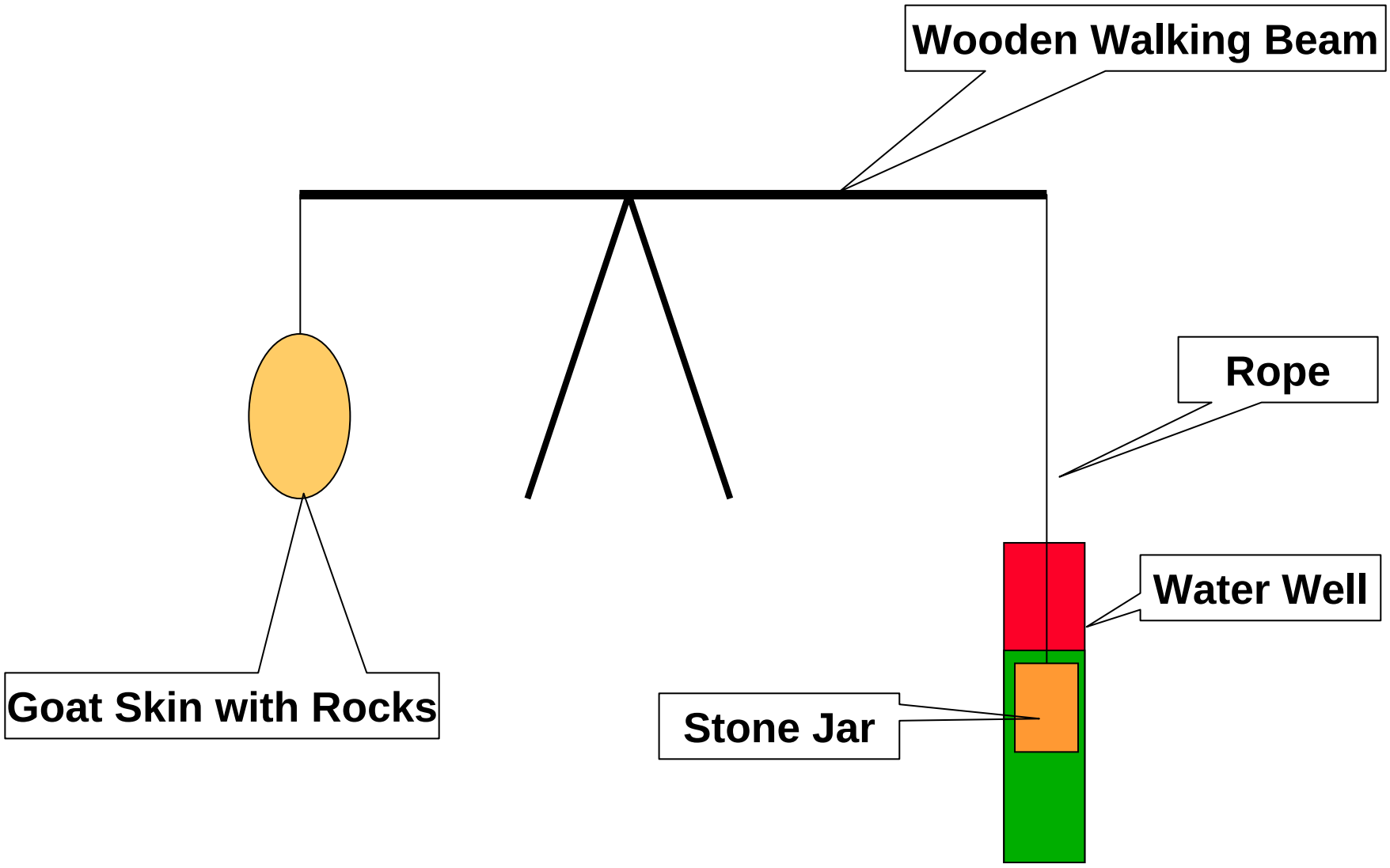
# API Documents

- Spec 11E Specification for Pumping Units
- RP 11G  Installation and Lubrication of Pumping Units
- API STD 11E  Pumping Units
- API BUL 11L4 Curves for Selecting Beam Pumping Units

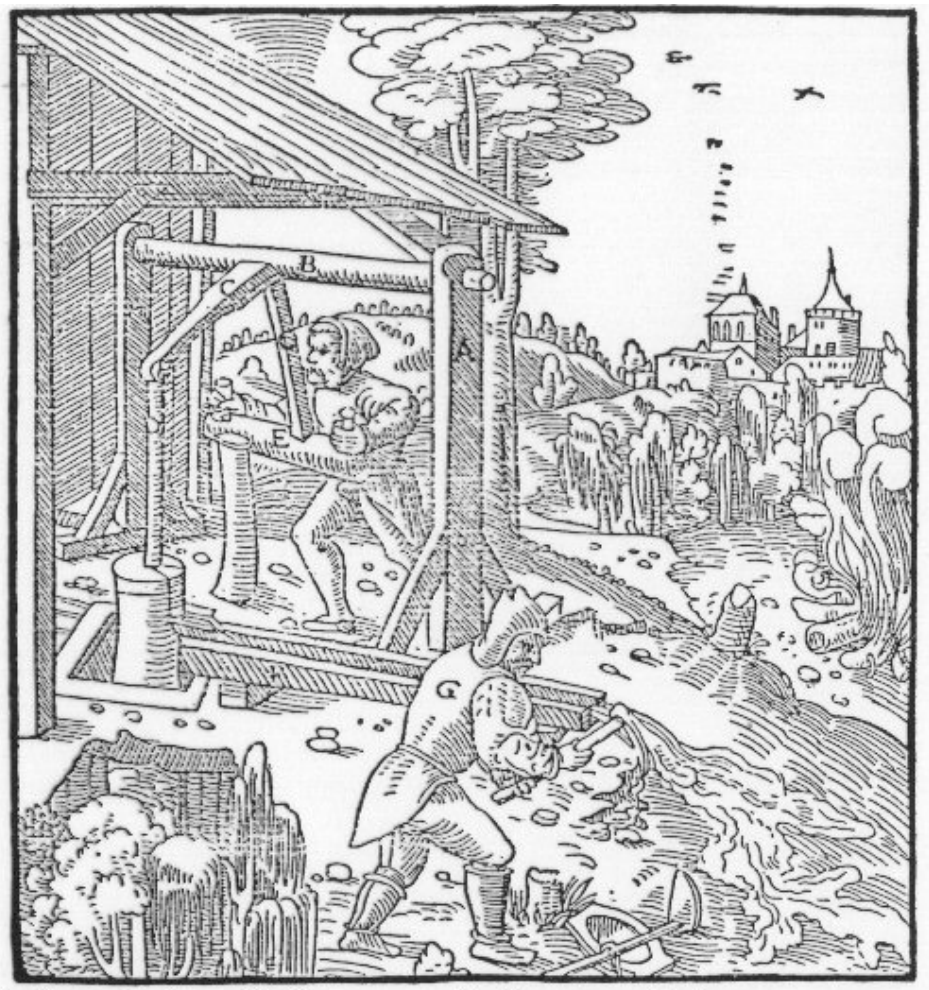
# Counter Balance System
# Effect at Polished Rod is *Approximately* Equal to Buoyant Weight of Rods + 1/2 Fluid Load Weight



# Egyptian Sucker Rod Pump
# 476 AD



A—Erect timber. B—Axle. C—Sweep which turns about the axle. D—Piston rod. E—Cross-bar. F—Ring with which two pipes are generally joined.

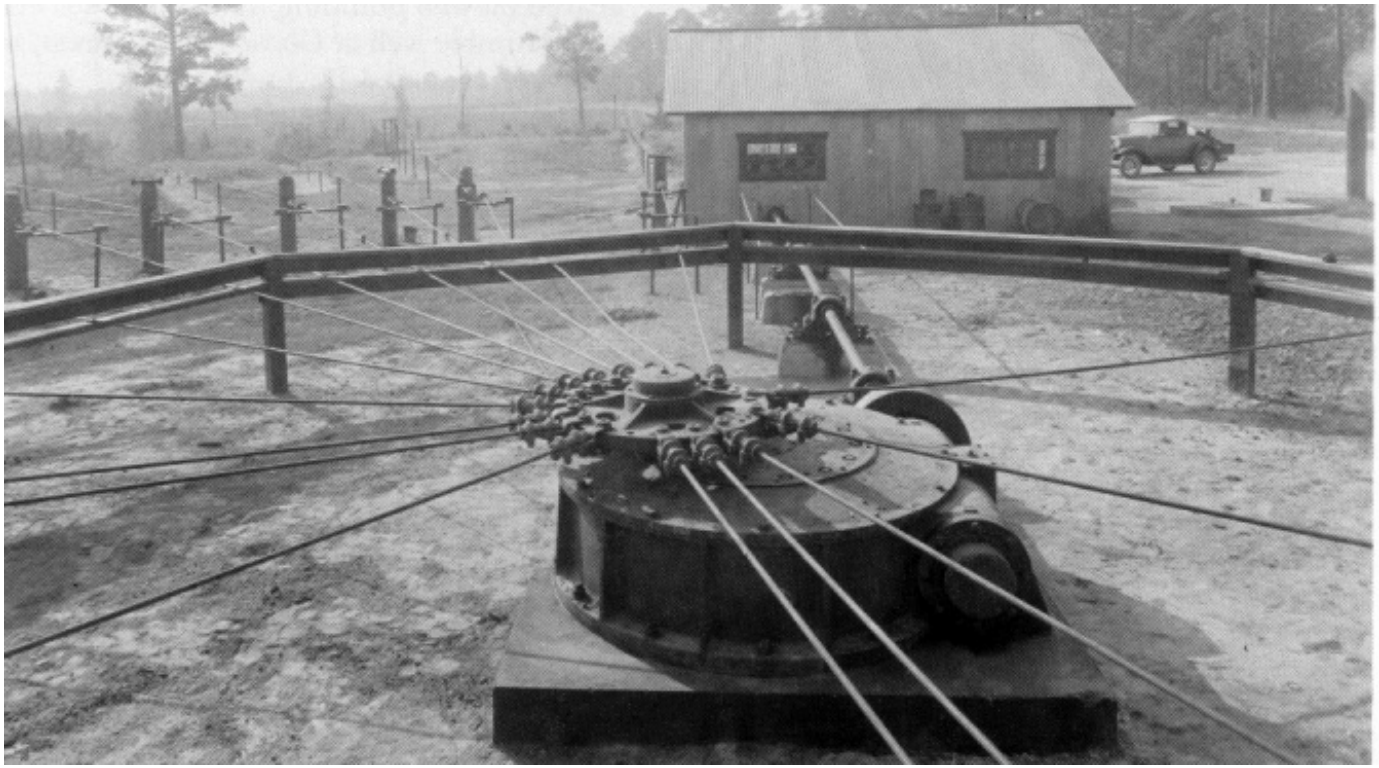


A—Posts. B—Axle. C—Wooden bars. D—Piston rod. E—Short piece of wood. F—Drain. G—This man is diverting the water which is flowing out of the drain, to prevent it from flowing into the trenches which are being dug.

# 16th Century Pumping Unit


# Standard Rig - Pre 1923

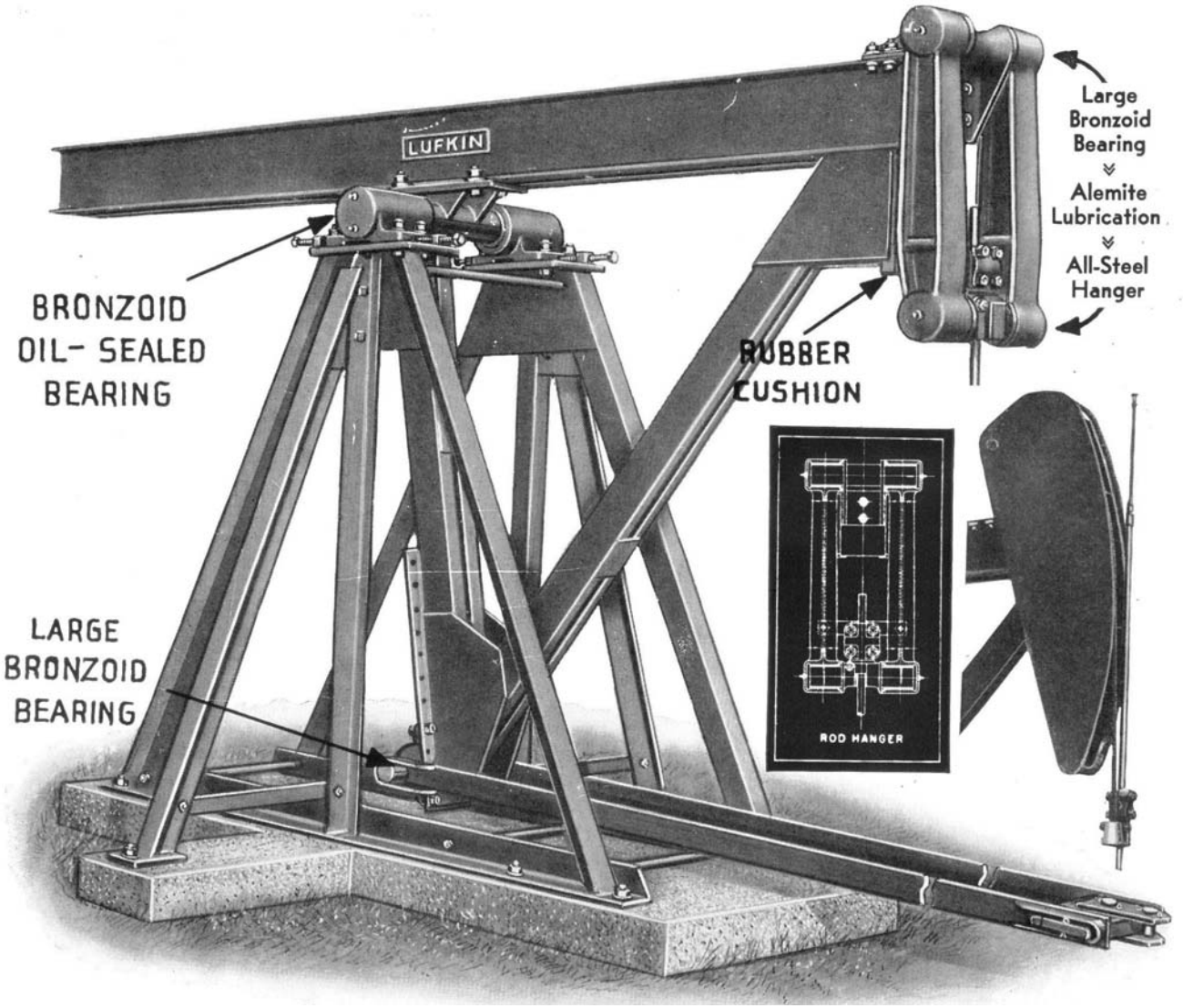
# First Lufkin Built Pumping Unit Central Power Unit



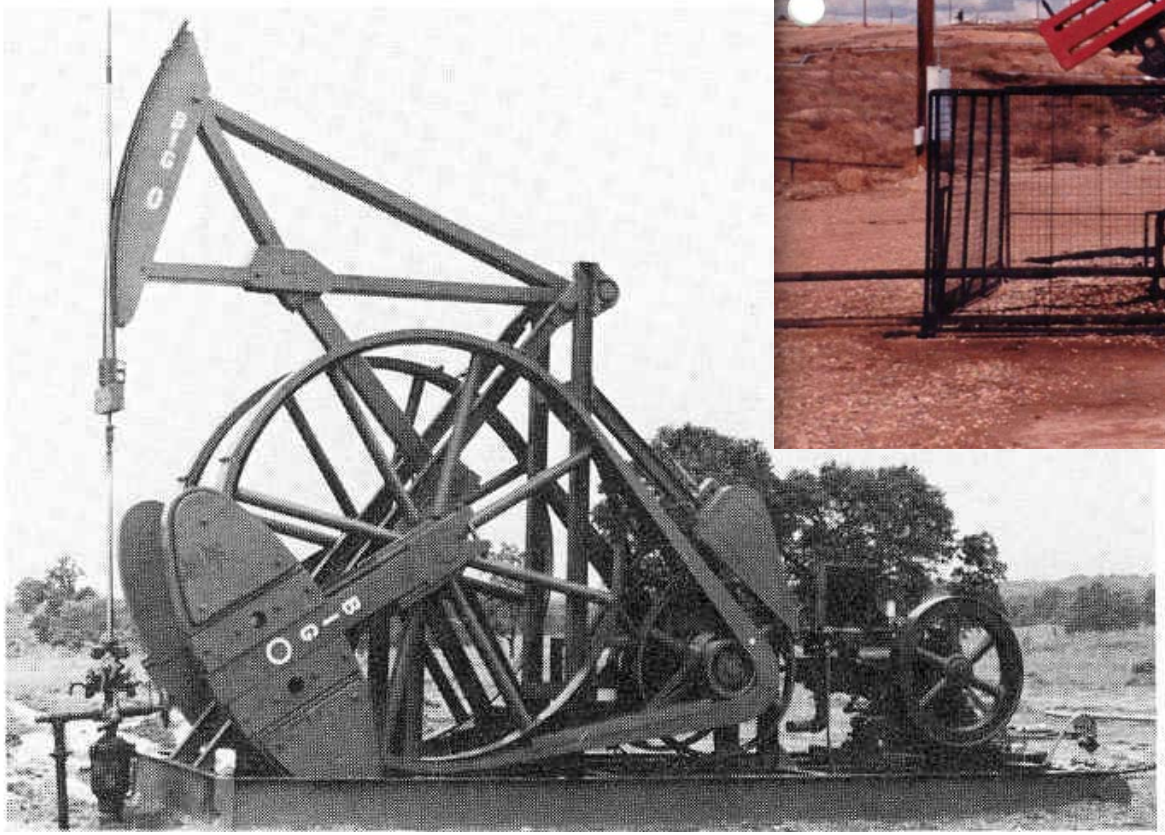
- Built in 1919
- Reducer had worm gearing
- Pumped 30 wells at once

LUFKIN

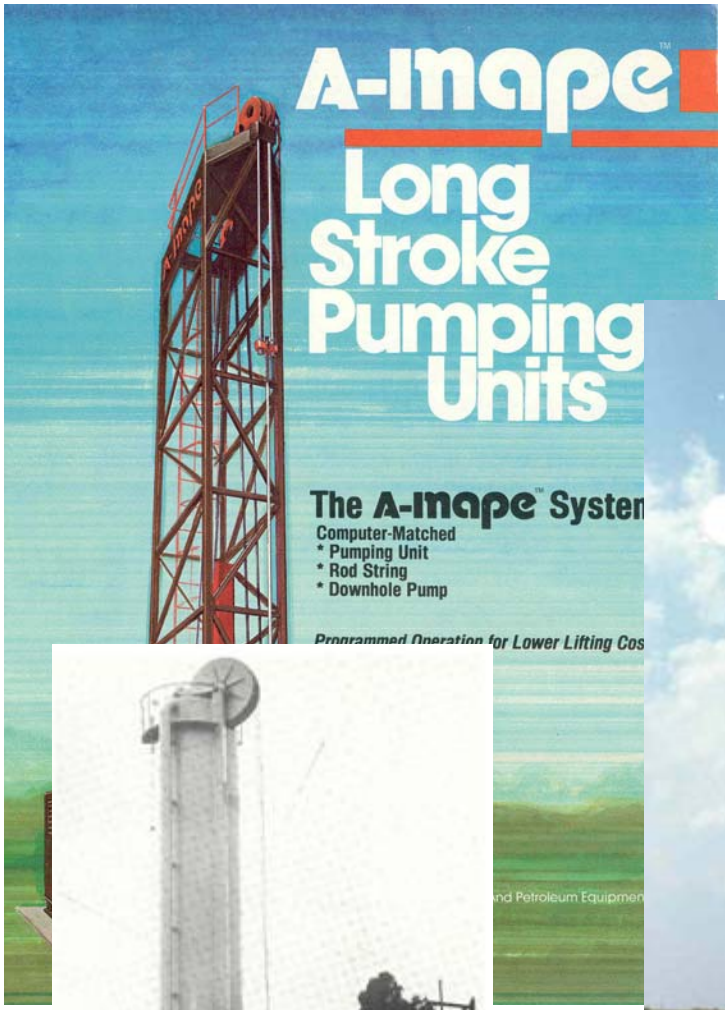
# Lufkin “Pump-Jack”



# Different Geometry Units

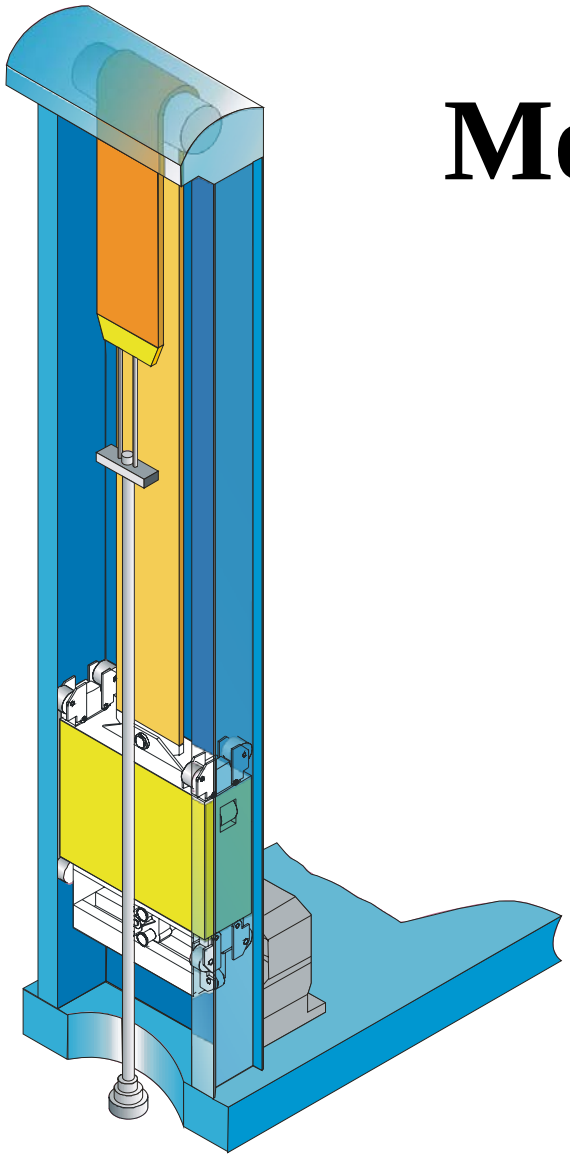



# Tower Units


A-mape
Long Stroke Pumping Units
The A-mape System
Computer-Matched
* Pumping Unit
* Rod String
* Downhole Pump



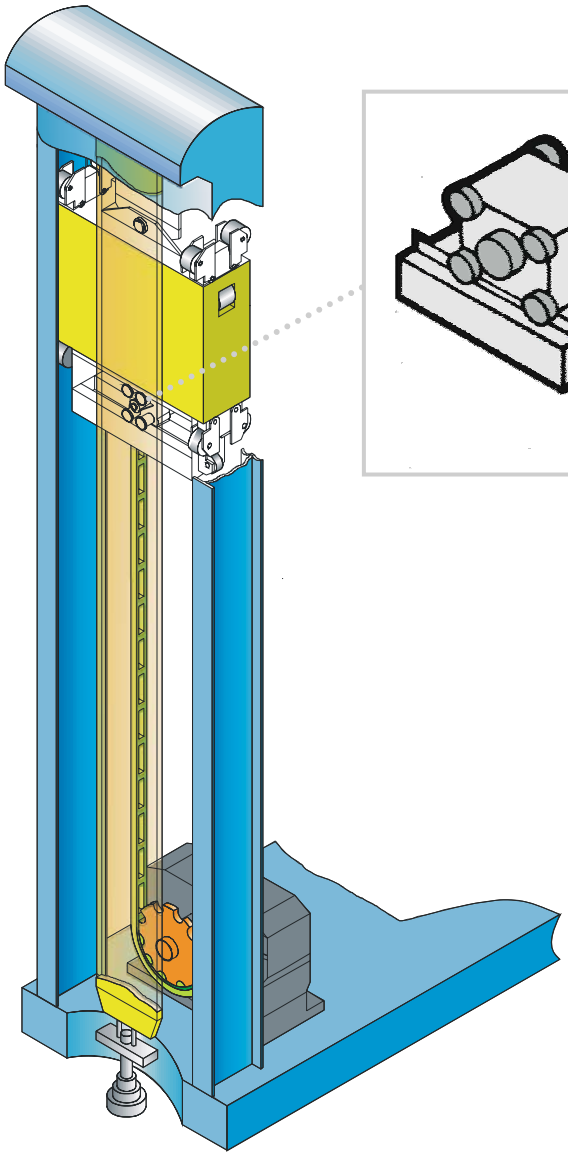
# Rotaflex
# Mechanical Features

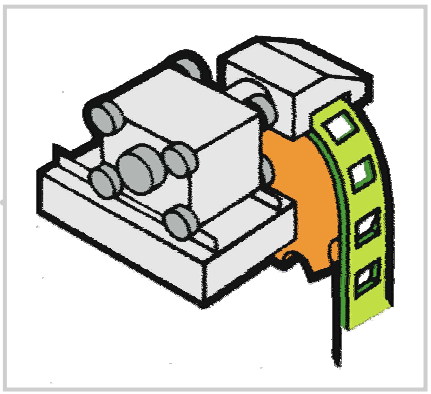


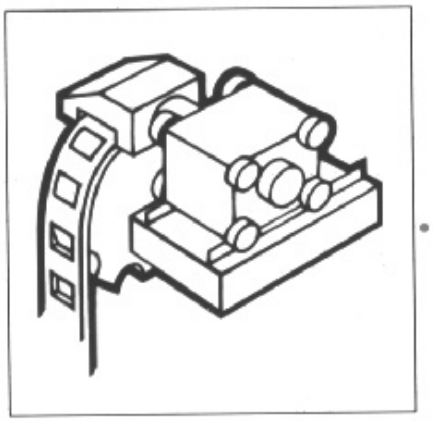
- **Direct**
  **Counterweight**
  **Connection to Well**
  **Load**

- **Shock Absorbing**
  **Load Belt**

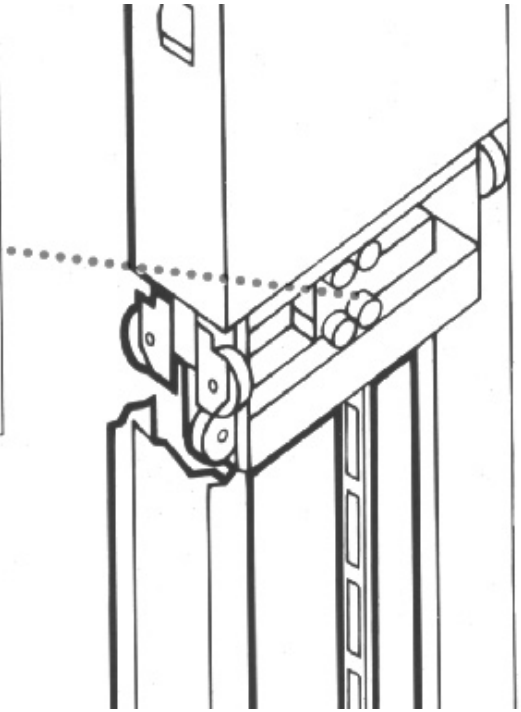
# Mechanical Reversal



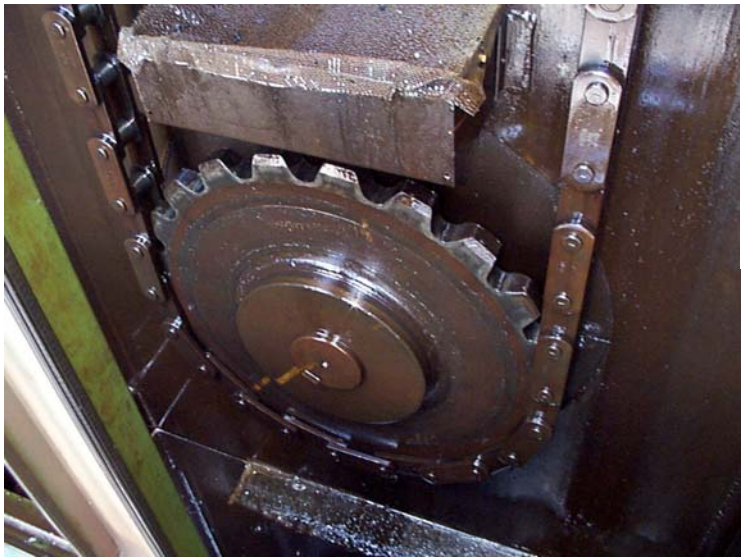


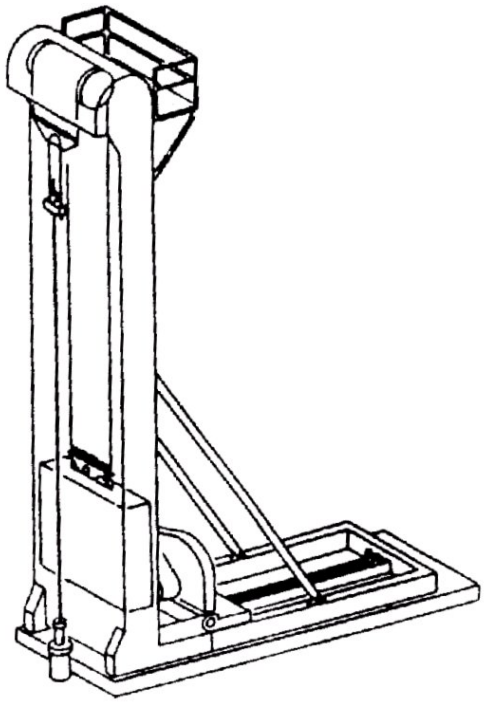


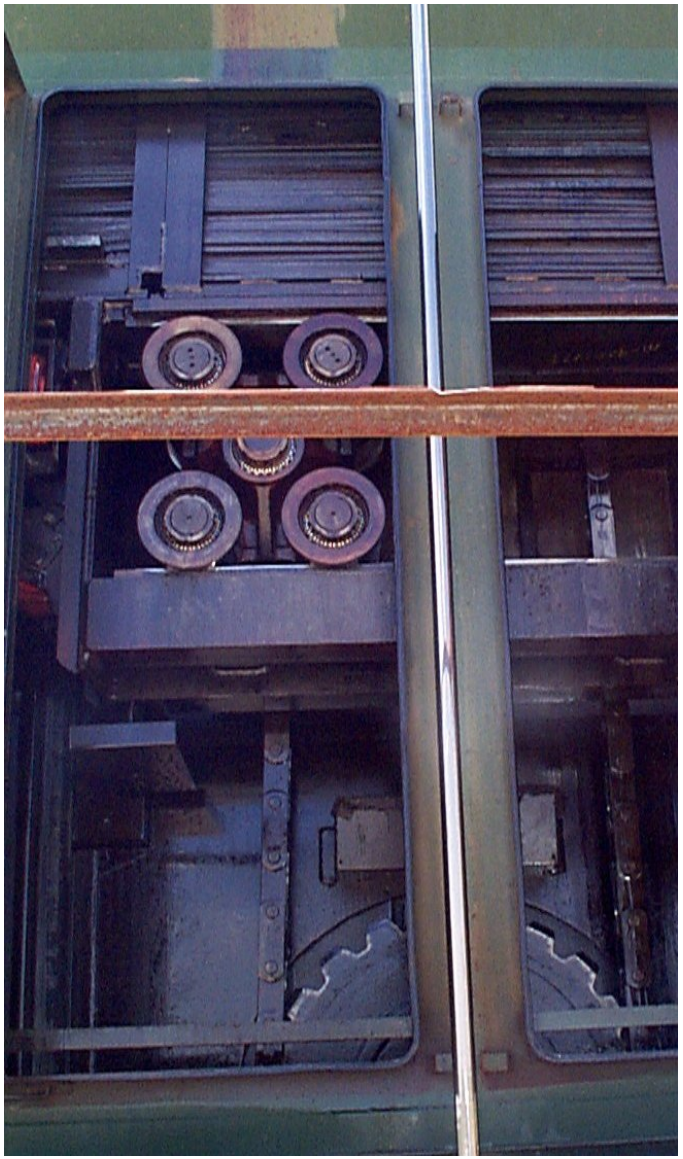
*The ROTAFLEX unit's reversing mechanism is completely mechanical and overcomes past failures in competing long, slow stroke pumping systems.*



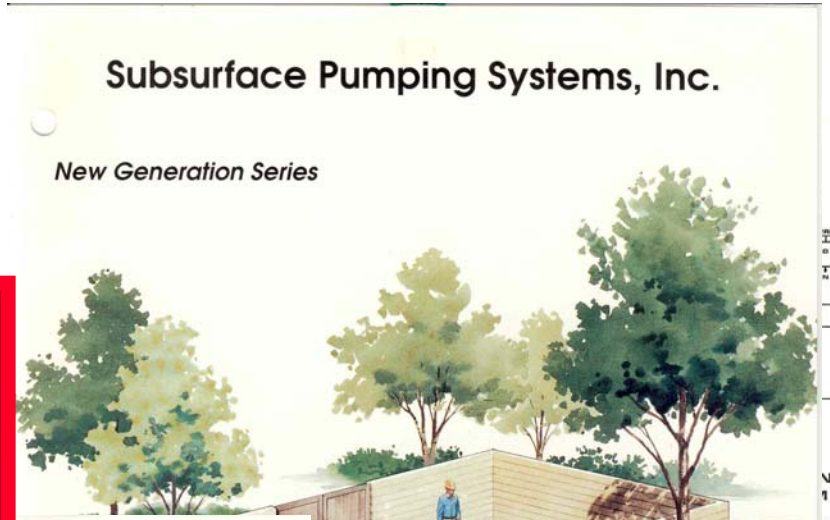
# RotaFlex Pumping Unit

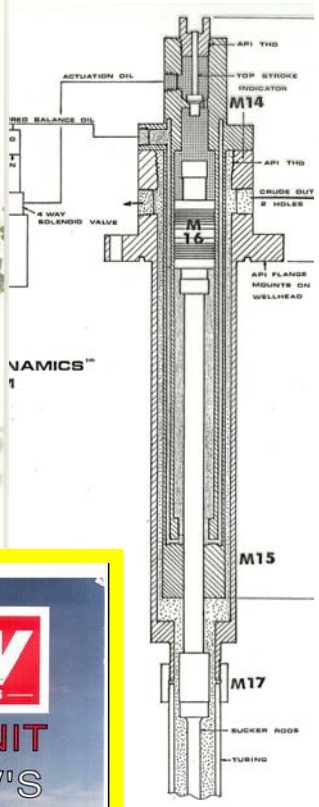


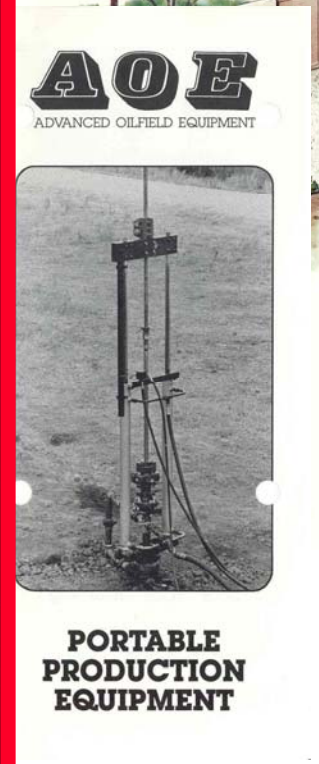




# Hydraulically Powered Units





**Two – in - One**

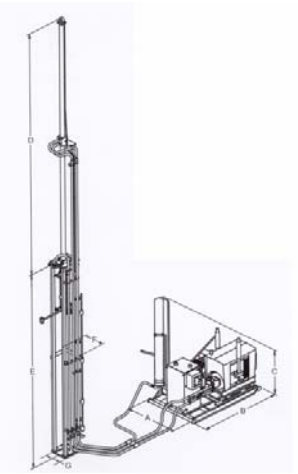
**Three – in - One**

# Smaller Hydraulic Units: CBM? Limited or no Motion at Surface


Dynapump

Dynasave

Economizer



VSH2

VSH2mini

Economizer has no noticeable motion at surface. All are predicted to give more required surface maintenance than regular beam pumps.

LUFKIN

## CHURCHILL® BRAND BEAM BALANCED PUMPING UNITS


# SPECIAL APPLICATION PUMPING UNITS

# Trailer Mounted

**Portable units are used for temporary applications and for testing wells to determine accurate inflow performance characteristics before designing a permanent installation.**

**Type:**
**A - AIR BALANCE**
**B – BEAM BALANCE**
**C – CONVENTIONAL**
**M – MARK II**

## Pumping Unit Description

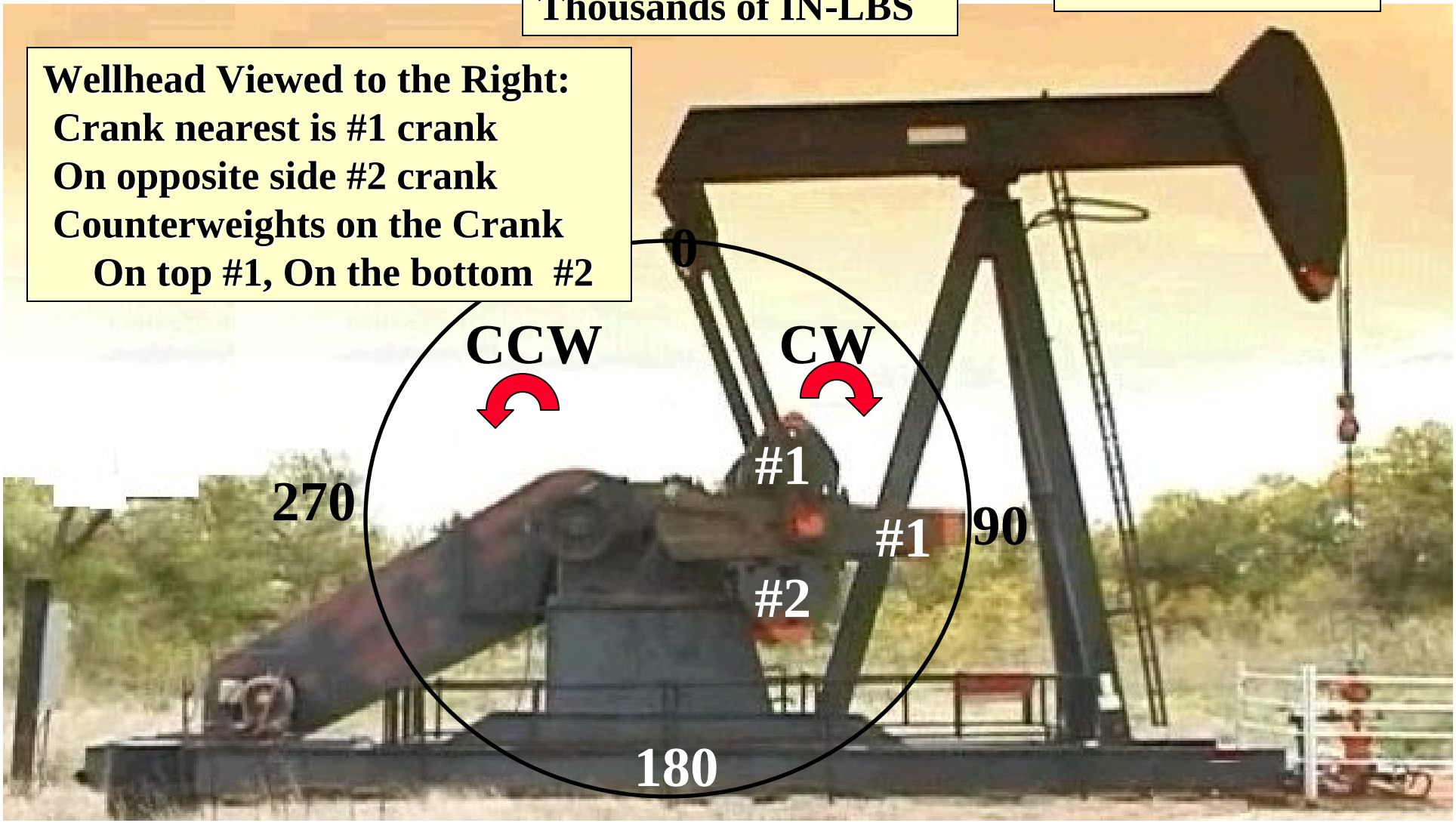
# C-320D-256-100

**Maximum Stroke Length in Inches**

**Peak Torque Rating in Thousands of IN-LBS**

**Structure Rating in 100s of LBS**

**Wellhead Viewed to the Right:**
**Crank nearest is #1 crank**
**On opposite side #2 crank**
**Counterweights on the Crank**
**On top #1, On the bottom #2**



# API Designation

- **C-456-256-100**

- **C- Conventional; Prefix to indicate type of unit**
- **456 – Gearbox capacity on thousands of inch-lbs.**
- **256 – Beam load capacity in 100 lbs.**
- **100 – maximum stroke length.**

# Rod Pumping Unit Classes

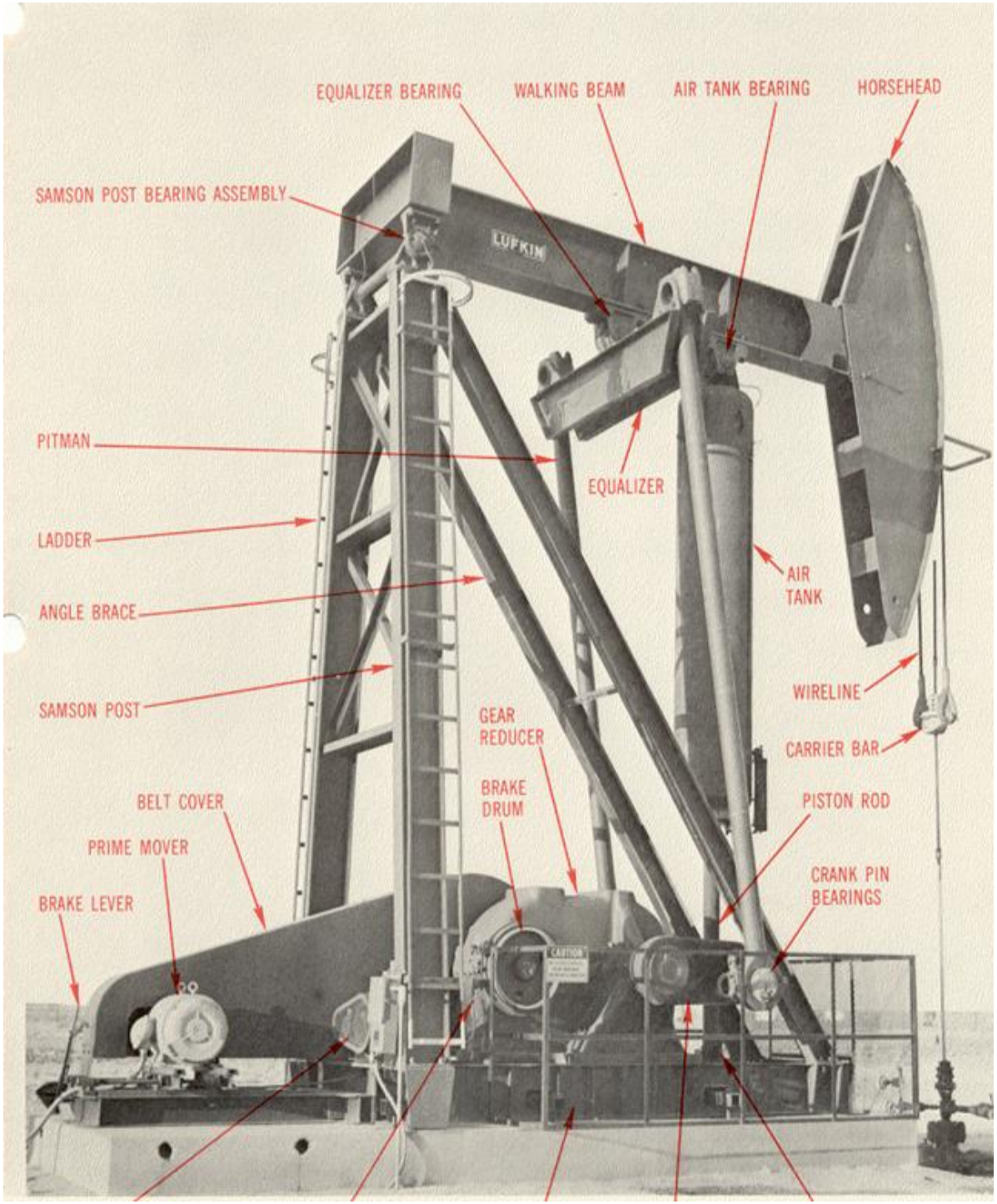
Defines the geometry and the balancing method.

- Beam Units
  - C- Conventional or Crank Balanced
  - A- Air Balanced
  - M- Mark II
  - RM- Reverse Mark
  - B- Beam Balanced
- Non Beam Units
  - RX-Rotaflex
  - HY-Hydro-Lift

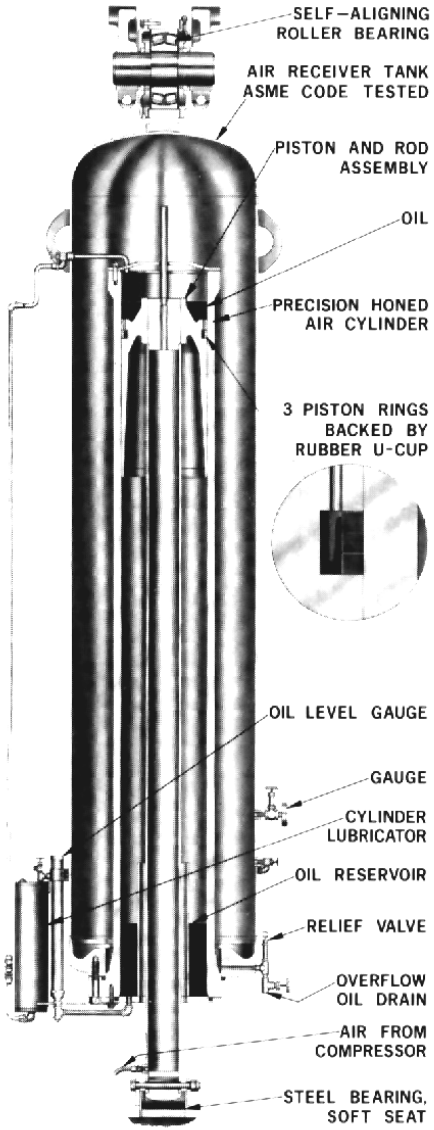
RotaFlex and Hydro Lift units have been designed to operate over relatively long strokes (up to 30feet) and at low pumping speeds 2 to 4 strokes per minute.

# AIR BALANCE UNIT

- **Best for deep wells needing large CB**
- **Use where max stroke lengths are required**
- **Hi volume applications**
- **Remote locations, platform / test units**
- **Most flexible in making counterbalance adjustments**



# Air Balance Tank

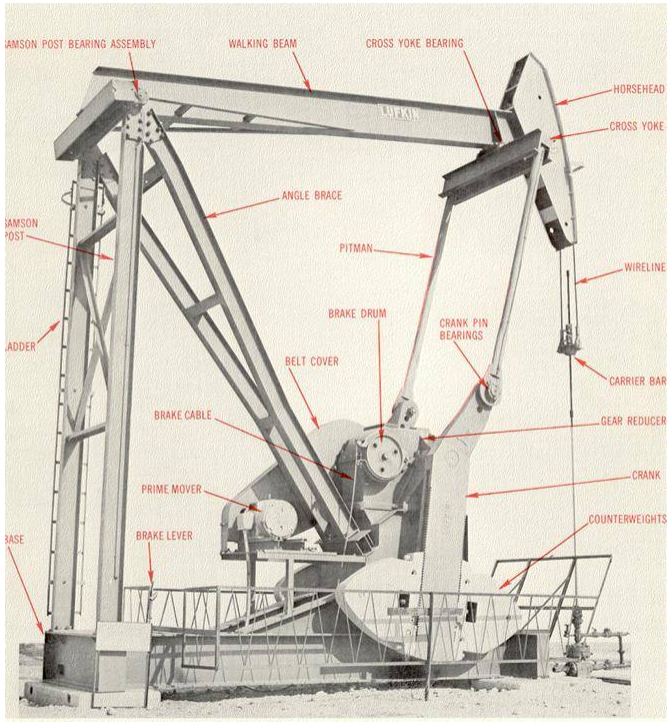



**Passive system.**

**The pressure increases as the chamber moves down on the stationary  piston rod.**

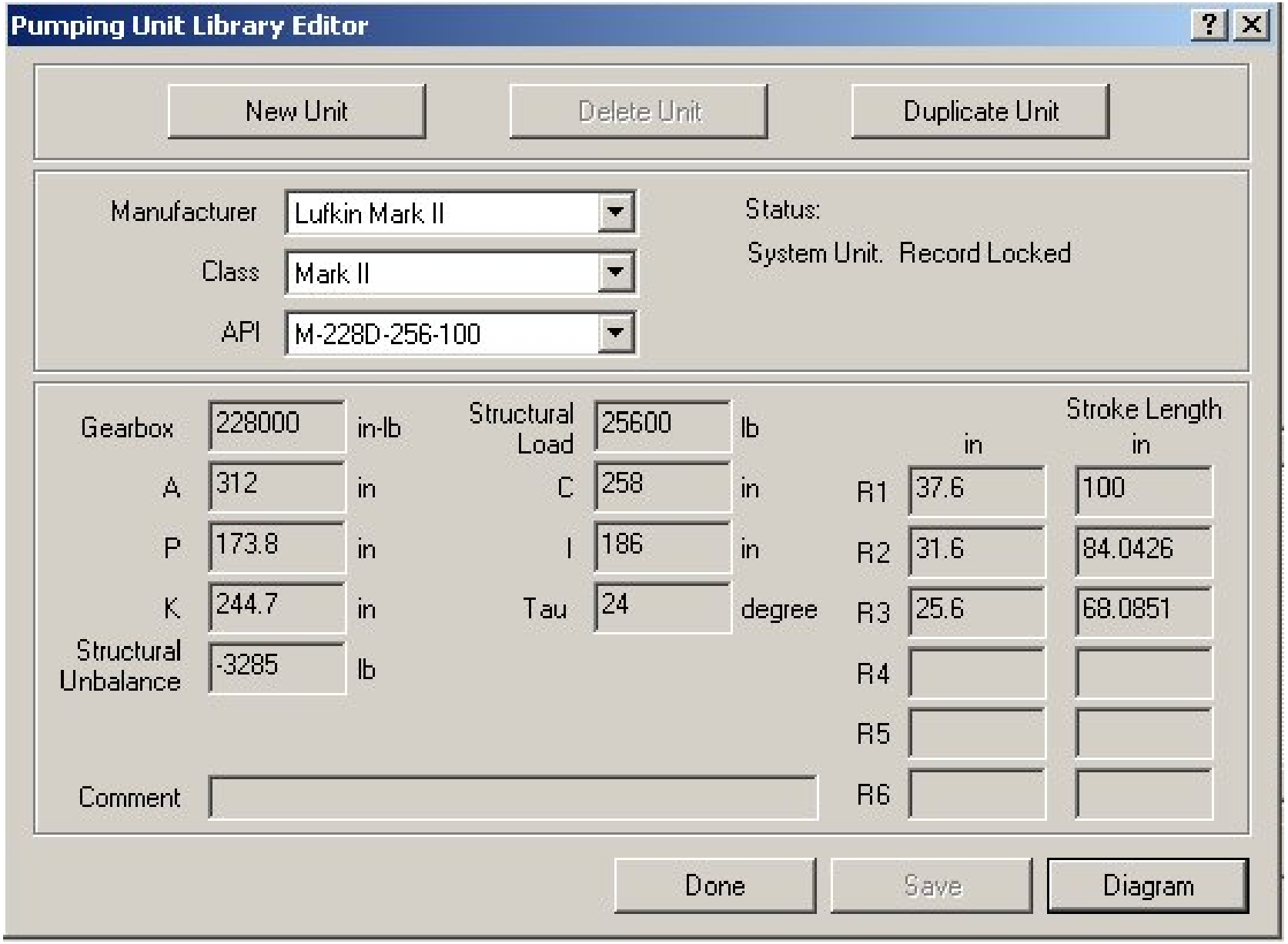
**The chamber pressure may be adjusted using a small compressor.**

# MARK II UNIT

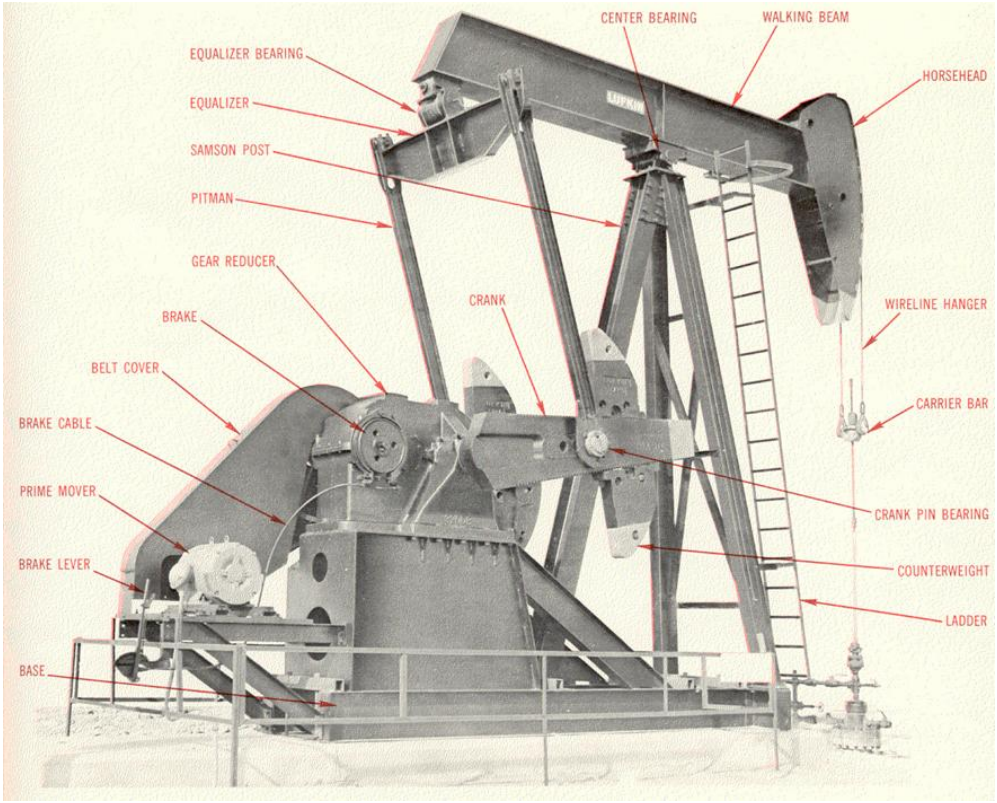

- **May increase production**
- **Deep high volume production**
- **Steel rods (may compress FG)**
- **Medium to small subsurface pumps**
- **Use with POC**
- **High gravity/ low GOR fluids**
- **Less peak torque**
- **216” Max Stroke, 1,824,000 in-lbs GBT max rating**

# TWM – API Dimensions Data Base



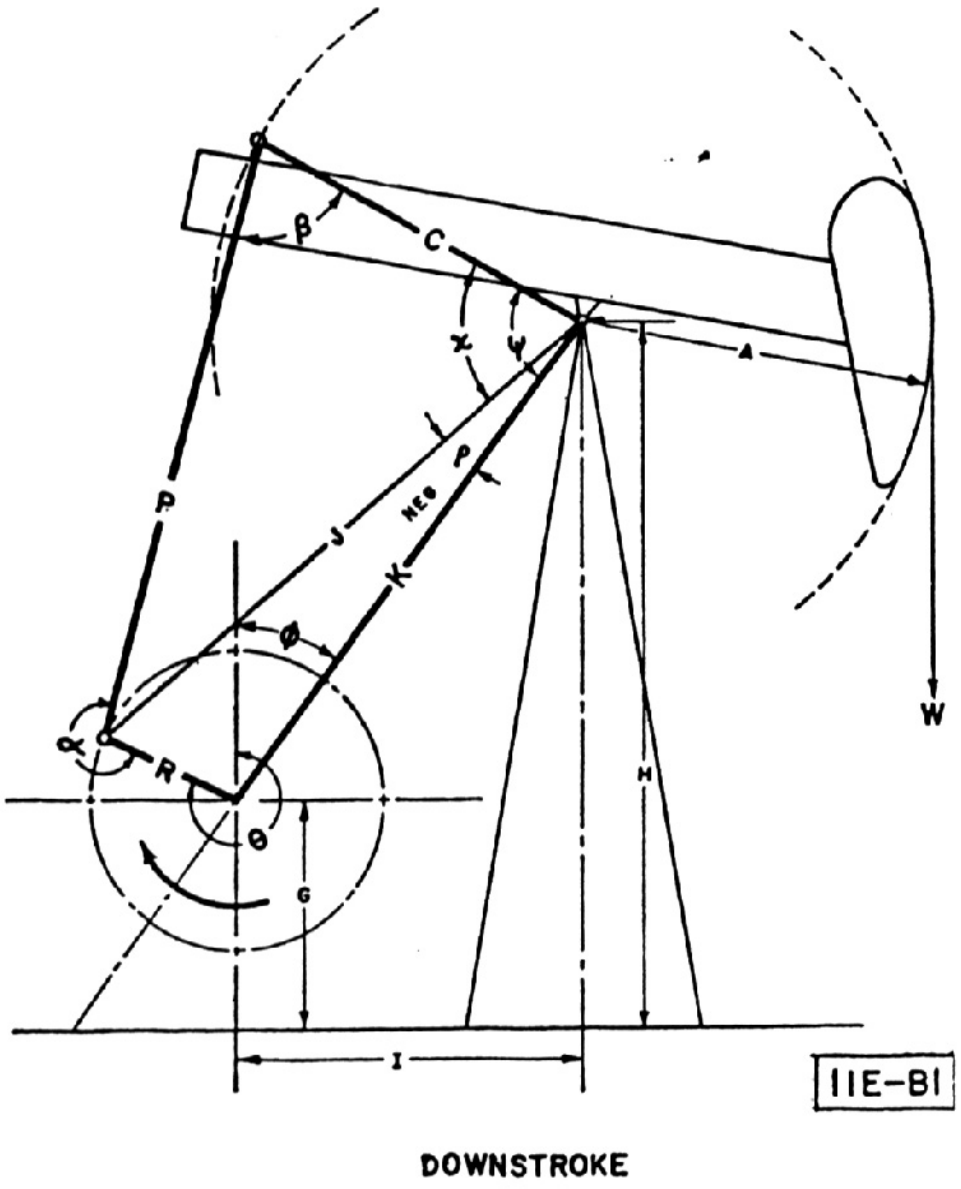
# Reverse Mark

**Reverse Mark is a modified conventional unit where the gearbox has been displaced forward so that the angle between the crank arm and the pitman is at 90 degrees when the cranks are level. This results in a faster downstroke than the upstroke.**




# CONVENTIONAL UNIT

- **Use in shallow wells, high speed units**
- **Fiberglass rods can be used**
- **Lowest initial cost**
- **Better for fluid pound**
- **Good salvage**
- **Large diameter subsurface pumps in shallow wells**
- **Low gravity fluids, relatively high GOR**
- **Stroke Length to 260”, GBT to 1824000 in-lbs**

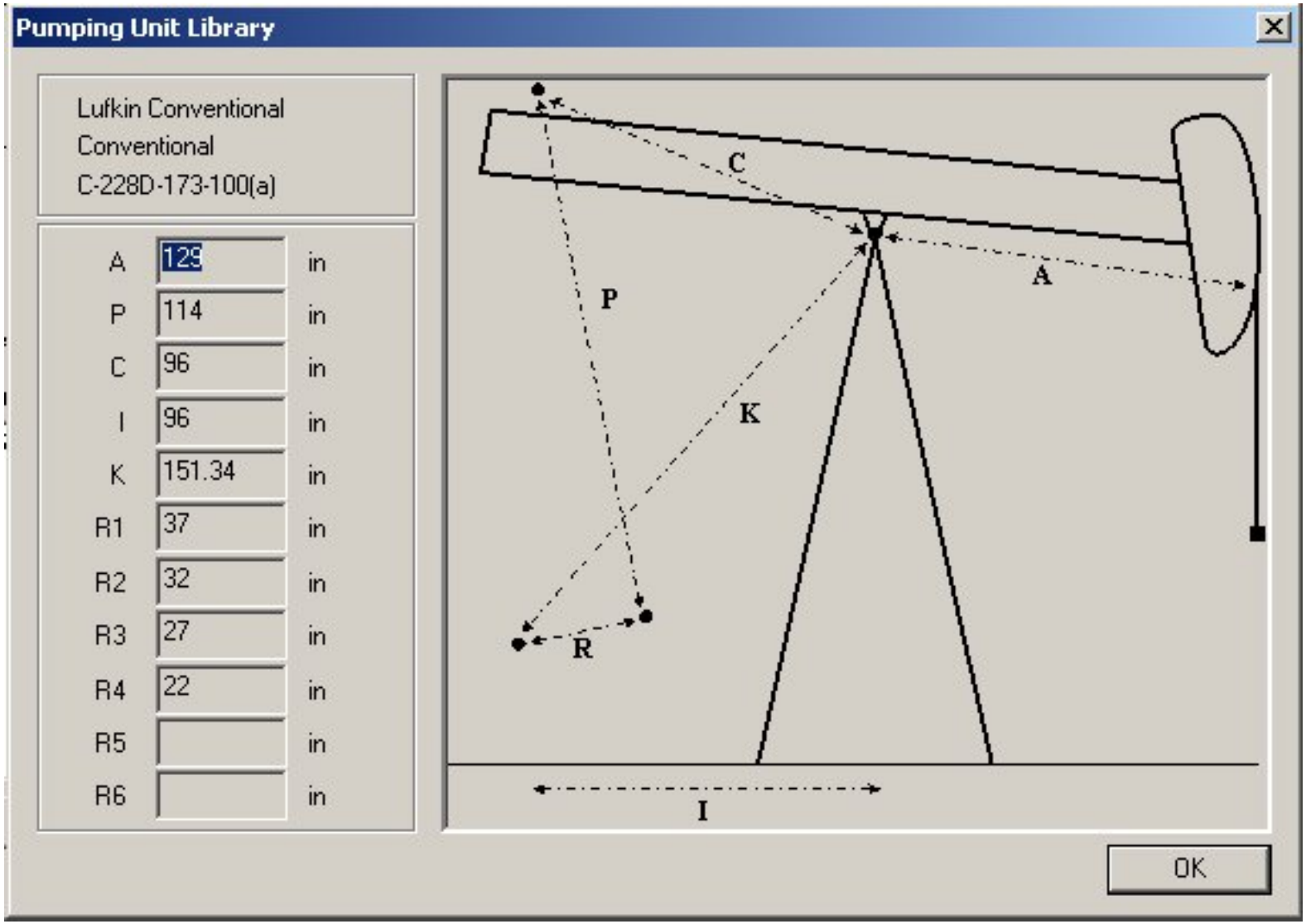



Geometry defined by the dimensions of the various linkages as specified in the API RP11-E.

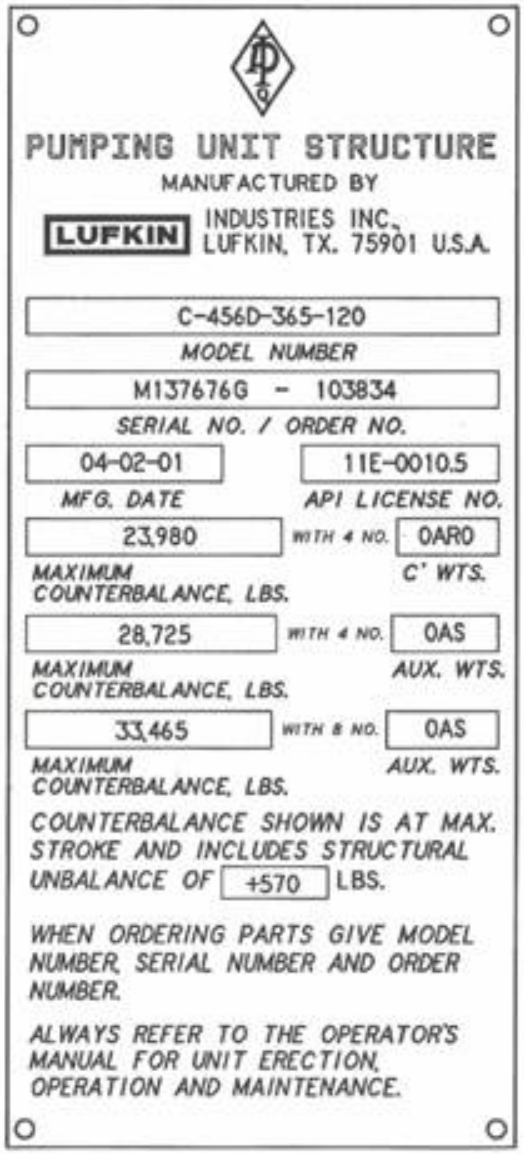
Polished rod stroke is calculated as a function of the crank angle and dimensions.

Stroke variation is obtained by changing the radius of rotation (R) by moving the wrist pin on the crank arm to different positions.

# Conventional Unit API Dimensions



# Unit Name Tags



PUMPING UNIT STRUCTURE

MANUFACTURED BY

LUFKIN INDUSTRIES INC.
LUFKIN, TX. 75901 U.S.A.

C-456D-365-120
MODEL NUMBER

M137676G - 103834
SERIAL NO. / ORDER NO.

04-02-01 — MFG. DATE
11E-0010.5 — API LICENSE NO.

23,980 — MAXIMUM COUNTERBALANCE, LBS. — WITH 4 NO. 0AR0 C' WTS.

28,725 — MAXIMUM COUNTERBALANCE, LBS. — WITH 4 NO. 0AS AUX. WTS.

33,465 — MAXIMUM COUNTERBALANCE, LBS. — WITH 8 NO. 0AS AUX. WTS.

COUNTERBALANCE SHOWN IS AT MAX. STROKE AND INCLUDES STRUCTURAL UNBALANCE OF +570 LBS.

WHEN ORDERING PARTS GIVE MODEL NUMBER, SERIAL NUMBER AND ORDER NUMBER.

ALWAYS REFER TO THE OPERATOR'S MANUAL FOR UNIT ERECTION, OPERATION AND MAINTENANCE.

PUMPING UNIT GERR REDUCER

MANUFACTURED BY

LUFKIN INDUSTRIES INC.
LUFKIN, TX. 75901 U.S.A.

C-456D-365-120
MODEL NUMBER

M137676G - 103834
SERIAL NO. / ORDER NO.

456,000 — PEAK TORQUE RATING IN THOUSANDS OF INCH-POUNDS
29.041 — GEAR RATIO

04-02-01 — MFG. DATE
11E-0010.5 — API LICENSE NO.

GERR REDUCER LUBRICATION

BEFORE OPERATING LUBRICATE PER THE FOLLOWING INSTRUCTIONS:

1. FOR TEMPERATURES DOWN TO 0° F USE AN SAE 90 EP OR AN AGMA 5 EP PREMIUM MILD EXTREME PRESSURE LUBRICANT (PREFERABLY A SULPHUR-PHOSPHOROUS TYPE) WITH RUST AND OXIDATION INHIBITORS AND AN ANTI-FOAM AGENT. POUR POINT OF THE OIL SHOULD BE 5° F OR LOWER.

2. FOR TEMPERATURES DOWN TO -30° F USE AN SAE 80 EP OR AN AGMA 4 EP PREMIUM MILD EXTREME PRESSURE LUBRICANT (PREFERABLY A SULPHUR-PHOSPHOROUS TYPE) WITH RUST AND OXIDATION INHIBITORS AND AN ANTI-FOAM AGENT. POUR POINT OF THE OIL SHOULD BE -15° F OR LESS.

3. CHANGE THE OIL SEMIANNUALLY OR AS INDICATED BY OIL ANALYSIS.

4. MAINTAIN THE OIL LEVEL ABOVE THE LOW MARK ON THE GAUGE BUT DO NOT FILL THE GEAR REDUCER ABOVE THE HIGH MARK ON THE GAUGE.

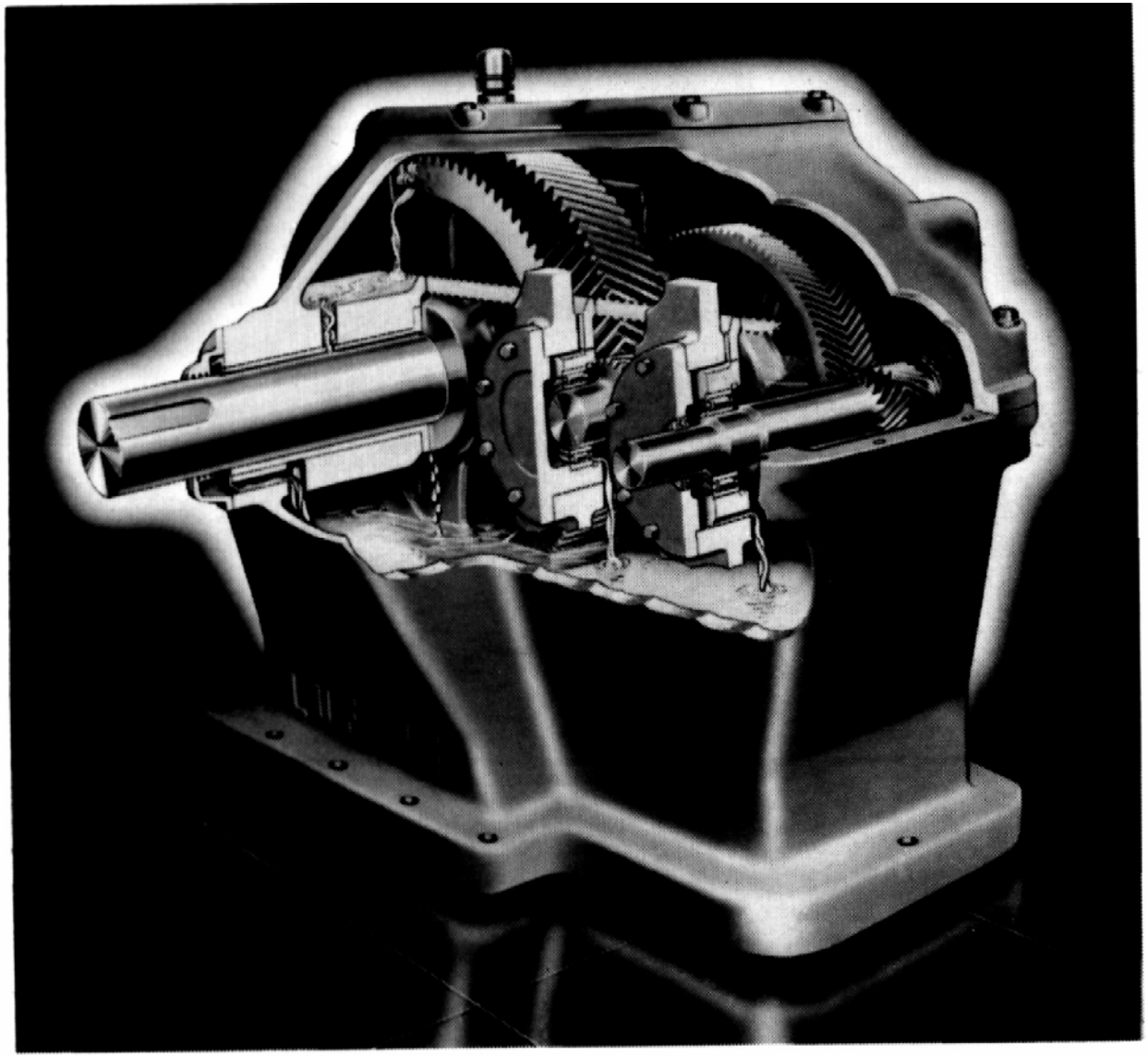
THIS UNIT REQUIRES 55 GALLONS

WHEN ORDERING PARTS, GIVE MODEL NUMBER, SERIAL NUMBER AND ORDER NUMBER.

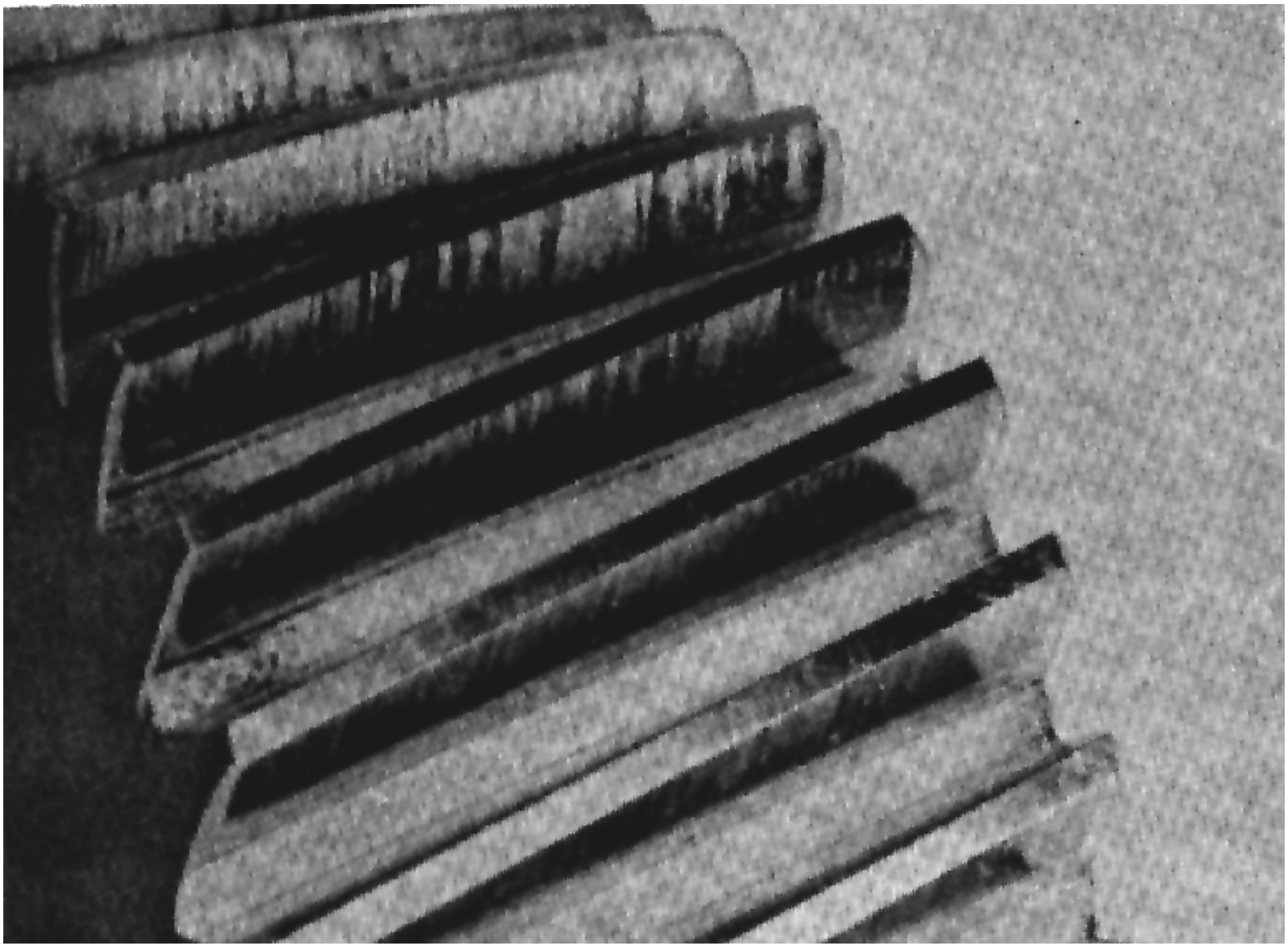
# Many Variables Effect Gear Life

1. Pumping speed
2. Lubrication quality
3. Full pump or pounding conditions ( and how badly unit is pounding)
4. Type of prime mover
5. Cyclic load factor
6. Counterbalance

Typical double reduction gearbox. Gear ratio about 40 to 1. Lubrication by oil bath requires a fixed direction of rotation in some designs.



Gear tooth wear is generally not uniform. Changing direction of rotation (if possible) distributes the wear more evenly.



Corrosion pitting caused by poor maintenance of the lubricating oil.