Wire Drawing Machinery

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Reference: WAI, *Ferrous Wire*, Volume 1, Chapter 9
Introduction

- The class will provide descriptions, illustrations, and general information on various types of drawing machines.
Topics of Discussion

- Brief look at the evolutionary developments of the draw machine.
- Emphasis and detail will be given to the modern continuous draw machine and it’s auxiliary equipment.
- Factors needed to design or select a new machine.
The Machine Has Evolved but the Biggest Change Is in Die Design
Standard Vertical Bull Block
Morgan Horizontal Bull Block
Vaughn Horizontal Bull Block feeding Screw Machine
New Single Block Bull Block
Single Block With Guard Open
Inverted Bull Block

Inverted Bullblock with Pressure Rolls & Special Die Box

**FEATURES—**
- **BLOCK RANGE**—42” dia. to 22” with puller plate
- **WIRE RANGE**—2” dia. and smaller
- **MATERIAL TYPES**—High/low carbon steel and alloys
- **LINE SPEED**—Up to 600 fpm (182 mpm)
- **OPTIONAL ITEMS**—Internal built-in puller-grip, 2 position shuttle turntable, 2 position indexing turntable
Inverted Bull Block
Inverted Bull Block
What Will My Bull Block pull?

SR = Motor’s Base Speed ÷ Gear Ratio

Ft/min = SR x K ( k= block circumference in ft)

( example a 30” block = 7.854 ft)

Die Pull = HP x 33,000 ÷ Ft/min

Example A 30” BB with 150hp motor base speed 400 and a 15:1 gear ratio would have a Die Pull of 23,638 lbs.

400 ÷ 15 = 26.67

26.67 x 7.854 = 209.4

150 x 33,000 ÷ 209.4 = 23,638 lbs. Die Pull
Once you know DP you can calculate what you can draw

$$DP = 43.56d^2 SK$$

- $d$ = diameter after draft in inches
- $S$ = Tensile strength before draft
- $K$ = a factor which varies with % reduction as shown in table 8A-I page 263 of the Ferrous Wire Volume 1 WAI handbook

<table>
<thead>
<tr>
<th>% reduction</th>
<th>K</th>
<th>% reduction</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>.0081</td>
<td>28</td>
<td>.0120</td>
</tr>
<tr>
<td>20</td>
<td>.0097</td>
<td>32</td>
<td>.0134</td>
</tr>
<tr>
<td>26</td>
<td>.0115</td>
<td>36</td>
<td>.0155</td>
</tr>
</tbody>
</table>
Example with the Die Pull of 26,638   DP = 43.56d² SK

Can we draw .750” C1018 from .910” which is 32% reduction?

DP = 43.56 x .750² x 75,000 x .0134
DP = 43.56 x .5625 x 75000 x .0134
DP = 24.50 x 75,000 x .0134
DP = 1837687 x .0134
DP = 24,625
Answer Yes!
Additional Old Bull Blocks

- Single Block, One die. Block set to have a Riding Stripper

- Double Block, 2 Dies
  Collapsible Riding Stripper used to remove the wire

Important: That the drafting between the two dies be accurate, in order to control the bow going into the last die.
Newer Double Deck Block Bull Block

WELD MESH ROLLING LINE – SMORGON
How to Determine Drafting on a Double Deck block

- Measure the diameter of each block
- Divide the smaller dia. By the large Dia. \( \times 100 \)
- Subtract the answer from 100 %
- Add 1 to 2% to % reduction for slippage.

Example:
- 18” small dia. \( \div \) 28” large Dia. \( =.643 \times 100=64.3 \)
- 100% - 64.3% = 35.7 % reduction of area
1% for slip = 36.7% reduction between the 2 dies
Alternative To The Double Deck Bull Block with Variable Drafting
When three or more consecutive reductions are required, The Continuous Draw Machine or Multi-hole machine is the next choice in production. Continuous Machines can be either be of the Slip type usually for wet draw or Non-Slip usually for dry draw.

The dry draw continuous machines falls into 4 categories: Accumulation Machines, Full Stroke Dancer, Limited or Short Stroke Dancer, and Direct Through or Back pull Machines.
OTO (Overhead Take –Off) Accumulator Machine
BB or Double Block Accumulator Machines
BB with Motorized Transfer Pulley

VARIABLE TENSION FRICTIONLESS
Transfer Ring Drive

NON-FRICTION DRIVE:
- Eliminates friction material replacement
- Saves up to 35 HP per block
- Reduces heat input to block
- Eliminates asbestos dust pollution

WIRE TENSION CAN BE VARIED WHILE RUNNING
REDUCES TOP BLOCK OVER-RUN WHEN STOPPING
EASIER THREADING
- Less operator effort with no time penalty
EASIER MAINTENANCE
- Very long service intervals
Smoother Operation
- Less wire snatch
LOWER RUNNING TENSION
LOWER INERTIA

LASHING WIRE DETECTOR
AIR MOTOR
BELT GUARD
TRANSFER RING
TOP BLOCK
BOTTOM BLOCK
DIODE
12 Die combination block size BB Machine
A Full Stroke Dance Machine is really a controlled Accumulator Machine.

this Vaughn Motoblox®
draws large diameter steel wire
at speeds up to 2000 fpm.
9 Die Vertical Axis Full Dancer
11 Die 200 mm Blocks Dancer Machine
11 Die 200 mm Block Dancer machine
Limited or Short Stroke Dancer Machines
Vertical Axis 1200mm Blocks
Limited Dancer Machine Vertical Axis
Limited Dancer Horizontal Axis 900 mm Blocks
Back Side of Horizontal Machine
Horizontal Limited Dancer 14
Die 180mm blocks
Horizontal Modular Limited Dancer

_Ferrous Wire Drawing “HST” Machine_  
(modular construction)
Close View of Horizontal Modular
MTX dry 12 Die drawing machine

- Compact design
- Integrated electrical cabinet
- New transmission system
MTX Modular 4 block unit
MTX Modular Back Side Electrical Drives
Complete Modular Block Housing Drops In
Back Pull or Direct Through Machine
We’ll take a look at the individual components of the Modern Continuous Draw Machine
Steel Frame for Vertical Axis Machine with OTO position
Safety guards

Fully enclosed environmental as on the right

Or reinforced Mesh type directly below
Gear Boxes and Block Housing
Gear Box and Inner Block
Inner block of Narrow Gap Cooling System on 450mm Block
Drawing of Narrow Gap Cooling Block
Motors on Floor Bases at back of Machine
AC Motor with Blower & Brake
Closer Look at the Brake
Motors Mounted to a 1200 mm Machine
Wet Die Box for Removal of Residual Draw Lube
Die and Soap Box Rotating Die
Pneumatic Soap Stirring Mounted on Side of Die Box
Electric Soap Stirring Mounted on back of Die Box
Quick Change Die Cassette
OTO Block First Position for Quick Stopping When Rod Tangles
Self Cleaning Laser Wire Measuring Gauge
Electrical Control Cabinets
PLC Systems Replace the Old Relay Logic Control Functions
Common DC Bus used with DC/AC Inverters
Operator Control Panels
Operator Control Panel Attached to Machine
To Complete the wire drawing process the wire must be packaged to meet the next production process or customer needs

- This is done with one of the following:
  - Lift-Off Riding Stripper
  - Deadblocks with die
  - Coilers without die
  - Spoolers
Riding Stripper
**Vertical Deadblock**

- The draw die and wire straighteners are mounted to the rotating plate with coil lowering device underneath.
Horizontal Axis Deadblock
Horizontal Deadblock Flyers

- Draw Die
- Casting Device
The flyer can be gear or belt driven
Horizontal DB/Pattern Lay
Horizontal DB with Coil Lowering Pattern Lay Unit
DB with Coil Accumulation for uninterrupted automatic run
Horizontal Axis Spoolers
Dual Horizontal Spoolers
Dual Spooler Opened Up
Dual Vertical Axis Spooler
Stationary Horizontal Rod Payoff (Boom Flipper)
Vertical Rod Payoffs
Horizontal Flyer-Type Rod Pay-Off
The Pusher Part of the Flyer-Type Pay-Off & Loading End
Horizontal Powered Payoff
Wet Draw Machines

- Slip Accumulation
- Variety of Types basic difference is in capstan arrangement (Cone or Tandem) and method of lubricating dies and blocks (Tilting Immersion or Spray Style)
Cone Style Tilting Immersion
Close Up of Tilting Immersion
Cone Style Spray Type
Tandem Capstans
Requirements for Designing a Machine to Fit Your Needs

- Starting Material Size & Tensile or Carbon Content
- Finish Size & Tensile if Known
- Speed you want to run at
- How you want to Take-up or Package the finish wire (spools, carriers, etc.)
- Size of finish package (spool size, carrier arbor size and height, Weight required)
- The above information for all jobs to run on that machine
Once that information is gathered there is software to:

- Determine the number of blocks needed
- Calculate the horsepower required to run all duties at a given speed.
- Knowing HP manufacturer can determine block size for proper cooling
- Finally the gear ratio and gear box selection is made
### Software Printout

#### MTS 610-8+ROT 610 Results:

<table>
<thead>
<tr>
<th>Entry diameter: mm</th>
<th>Block Diameter</th>
<th>Reduction</th>
<th>Reduction Speed</th>
<th>Tensile</th>
<th>Pull Power</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit diameter: mm</td>
<td>mm</td>
<td>mm inch</td>
<td>% reduction %</td>
<td>N/min</td>
<td>mm²/kg</td>
<td>psi</td>
</tr>
<tr>
<td>Number of blocks: N°</td>
<td>3.00</td>
<td>mm</td>
<td>% reduction</td>
<td>m/sec</td>
<td>ft/min</td>
<td>kg</td>
</tr>
<tr>
<td>Final speed: m/sec</td>
<td>5.00</td>
<td>7.13</td>
<td>0.281</td>
<td>2.71</td>
<td>542.18</td>
<td>126</td>
</tr>
<tr>
<td>Carbon content %</td>
<td>0.80</td>
<td>6.27</td>
<td>0.247</td>
<td>22.69%</td>
<td>22.69%</td>
<td>3.51</td>
</tr>
<tr>
<td>Reduction last block</td>
<td>0.14</td>
<td>5.66</td>
<td>0.223</td>
<td>18.46%</td>
<td>36.96%</td>
<td>4.30</td>
</tr>
<tr>
<td>Production Theoretical Kg/h</td>
<td>3059.44</td>
<td>5.25</td>
<td>0.207</td>
<td>14.00%</td>
<td>45.78%</td>
<td>5.00</td>
</tr>
<tr>
<td>Production Practical Kg/h</td>
<td>2447.55</td>
<td>2447.55</td>
<td>2447.55</td>
<td>5.00</td>
<td>1000.00</td>
<td>153</td>
</tr>
</tbody>
</table>

#### Production Practical / day Ton/day 58.74

#### Production Practical / month Ton/month 1409.79

#### Inst. Power kW 90

#### Days per month days 24

#### Efficiency % 80

#### Production practical per shift Kg/8 hours 19580.4
Reference

- Wish to thank the following for pictures:
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  - EMC

- A color copy of this presentation can be viewed & downloaded at: www.knottco.com

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