

Gravity Separation

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Gravity Separation – Gravity Table

- Undesirable seed and contaminants are often so similar to the “good” seeds in size, shape, and surface textures that efficient separations cannot be achieved.
- Contaminating seeds or materials differing from the crop seed in *test weight* or *specific gravity* can be separated with a Gravity Separator/Table.



Oliver GT

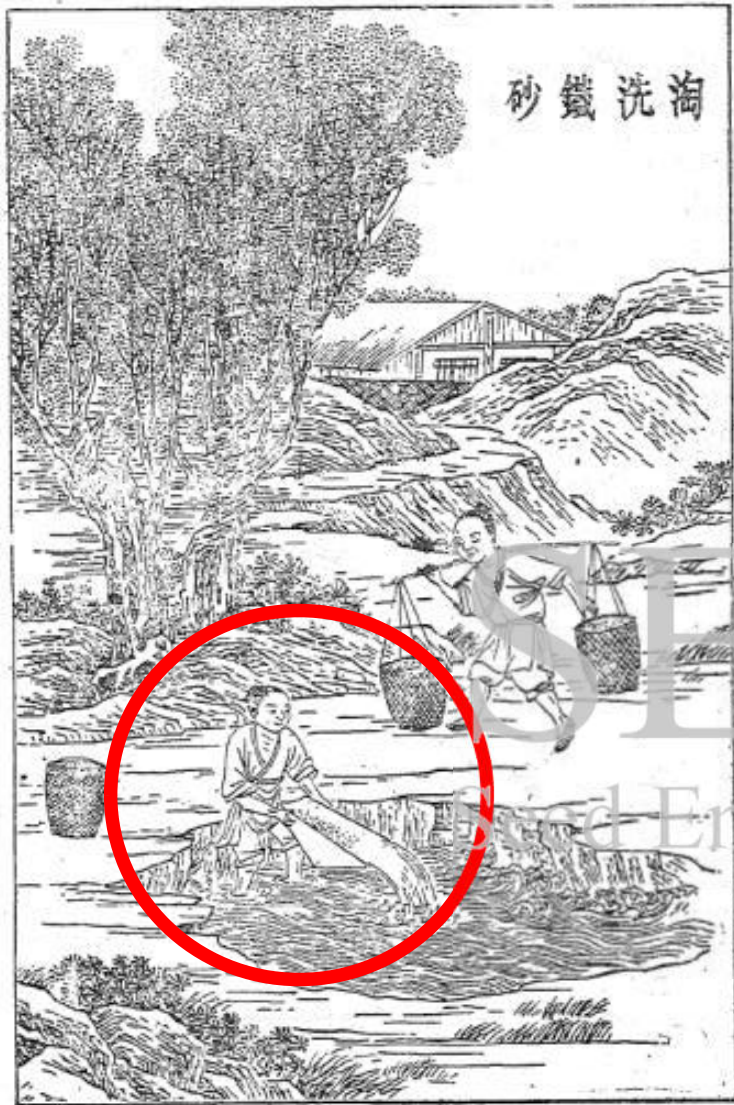


Forsberg GT



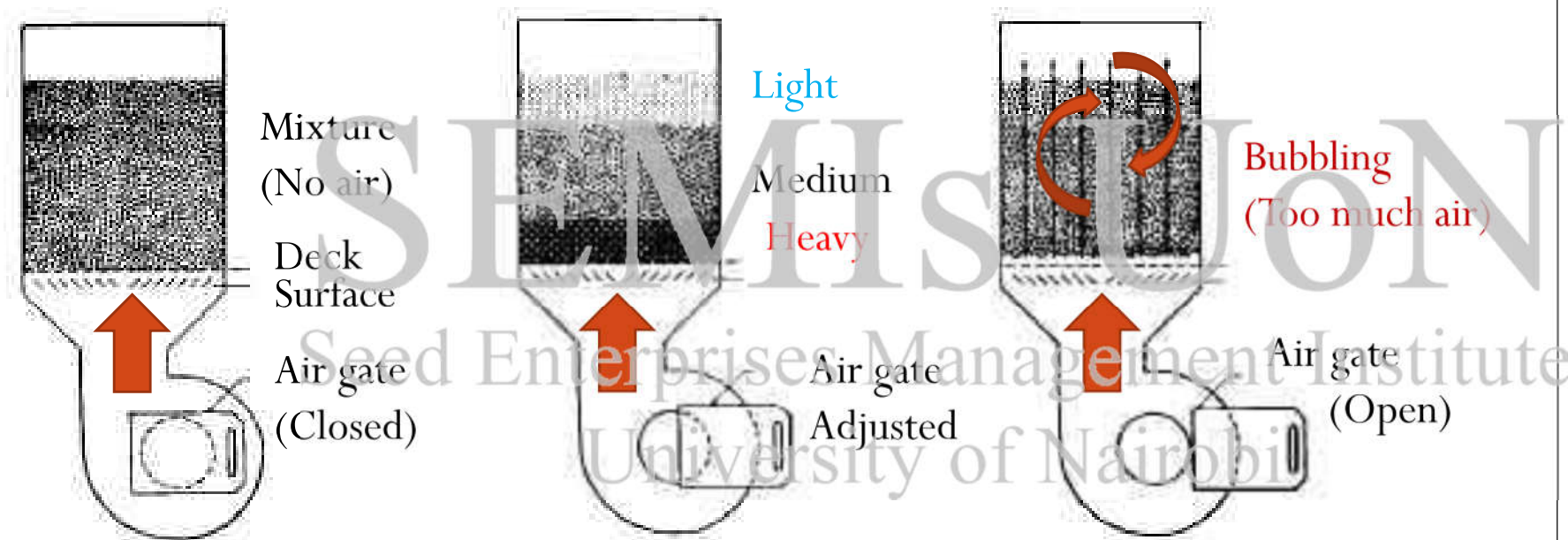
LMC GT

Gravity Separation - Fluidization



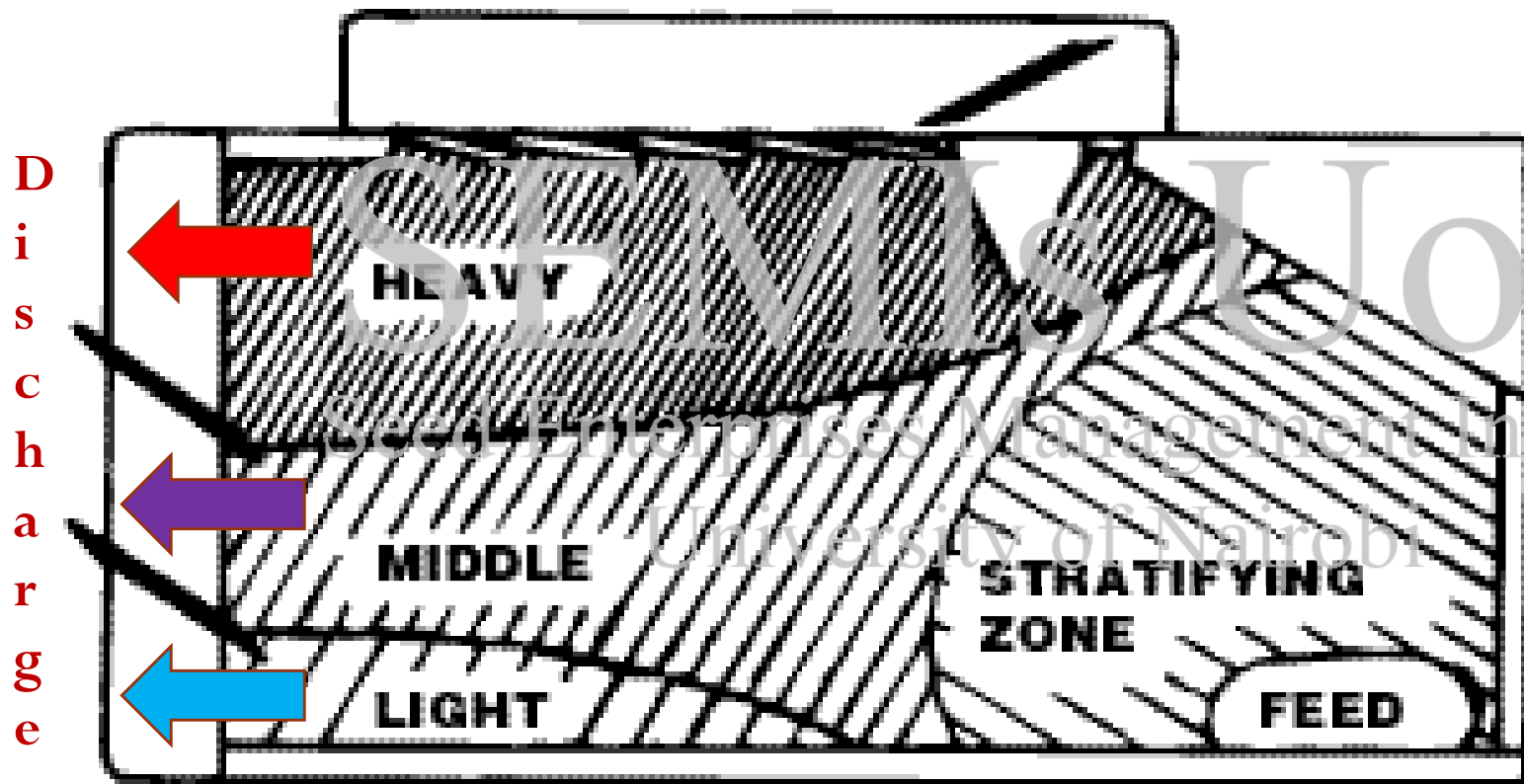
Gravity Separation – Principles

- **Fluidization** (Water vs Air?): Mixture is vertically stratified so that the heavier seeds are at the bottom and the lighter seeds are at the top.



Gravity Separation – Principles

- **Separation**: The light seeds are fluidized on a cushion of air and flow almost like a liquid, they flow toward the discharge end because of the downhill slope. And the heavier seeds move uphill with deck motion.



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Gravity Separation – Rules

- Rule 1. Particles of the same size but differing slightly in specific gravities can be separated.



- Rule 2. Particles of the same specific gravities but differing in the size will be graded according to the size of the particles.

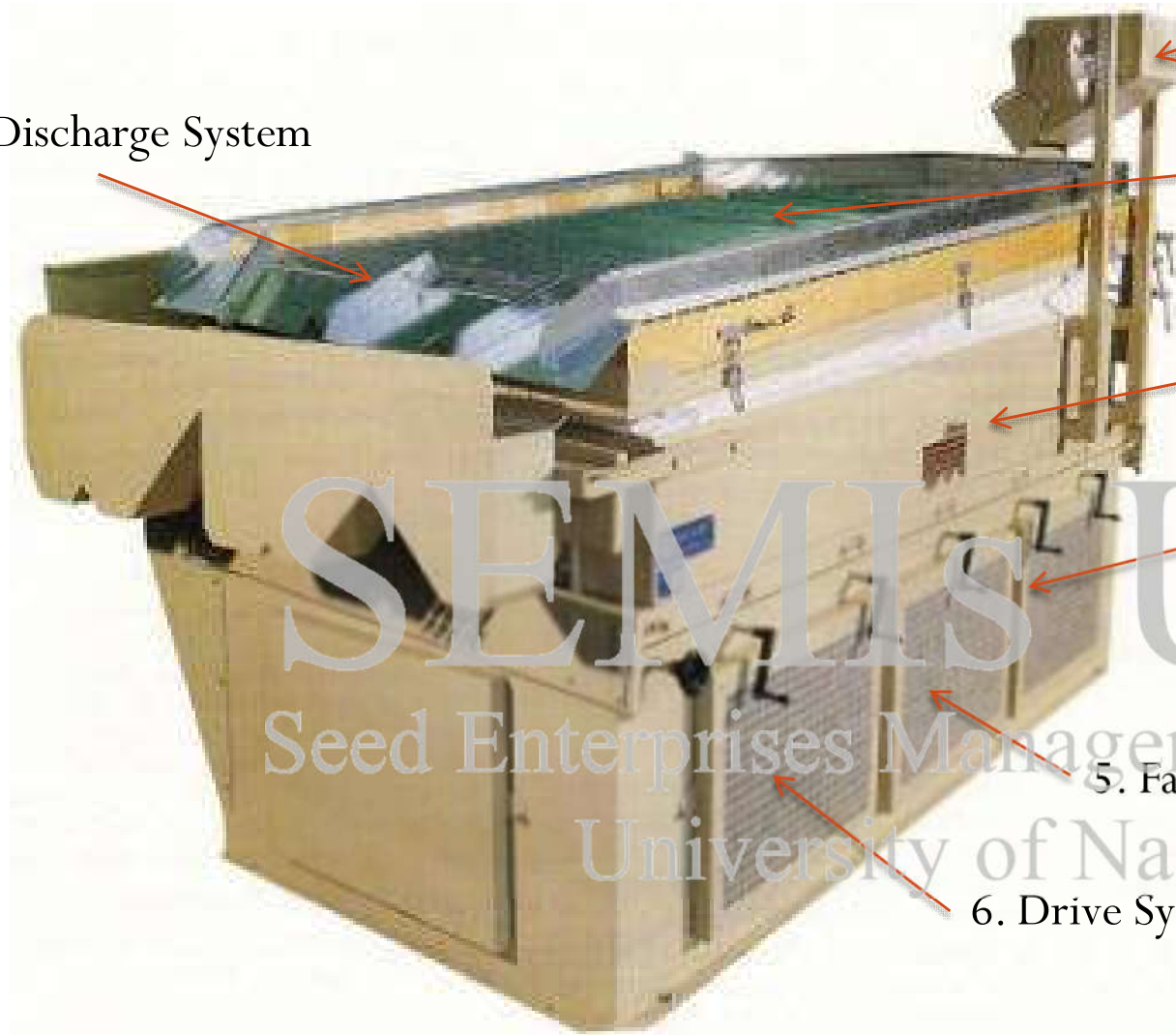


- Rule 3. Particles differing in specific gravities and also differing in size cannot be efficiently separated!



Gravity Separation – Machine

7. Seed Discharge System



1. Feed hopper

2. Porous Deck

3. Air Chest

4. Base and Frame

5. Fan(s)

6. Drive System

Gravity Separation – Parts

1. **Feed Hopper:** Seed flow from a surge bin to a feed hopper which meters a uniform stream of seed onto the corner of the deck opposite the discharge side. The feed hopper is adjustable for different feed rates.
2. **Porous Deck:** The deck is a lightweight removable and interchangeable frame which provides the surface on which seeds are separated. The deck is covered with a porous material such as cloth, wire screen, perforated sheet which allows air to pass through.



Gravity Separation – Parts

3. Air Chest: It is an airtight, shallow, boxlike plenum chamber mounted inside the frame and beneath the deck. Air pressure built up in the air chest forces air up through the porous deck.
4. Base and Frame: The base section is bolted to a solid foundation to keep the machine from shaking (walking machine?) The frame provides structural support for all other parts of the machine



Gravity Separation – Parts

5. Fan(s): One or more fans pull air from outside the machine and force it into the air chest. Pressure and vacuum gravity separators operate on the same principle, but the fan is mounted _____ (where?)
6. Drive System: The upper part of the air chest to which the deck is attached is mounted on rockers which allows it to rock back and forth with the deck. The speed of the motion can be controlled by a variable speed drive.
7. Discharge System: The banking rails hold the seeds on the deck until they reach the discharge end.



Gravity Separation – Controls

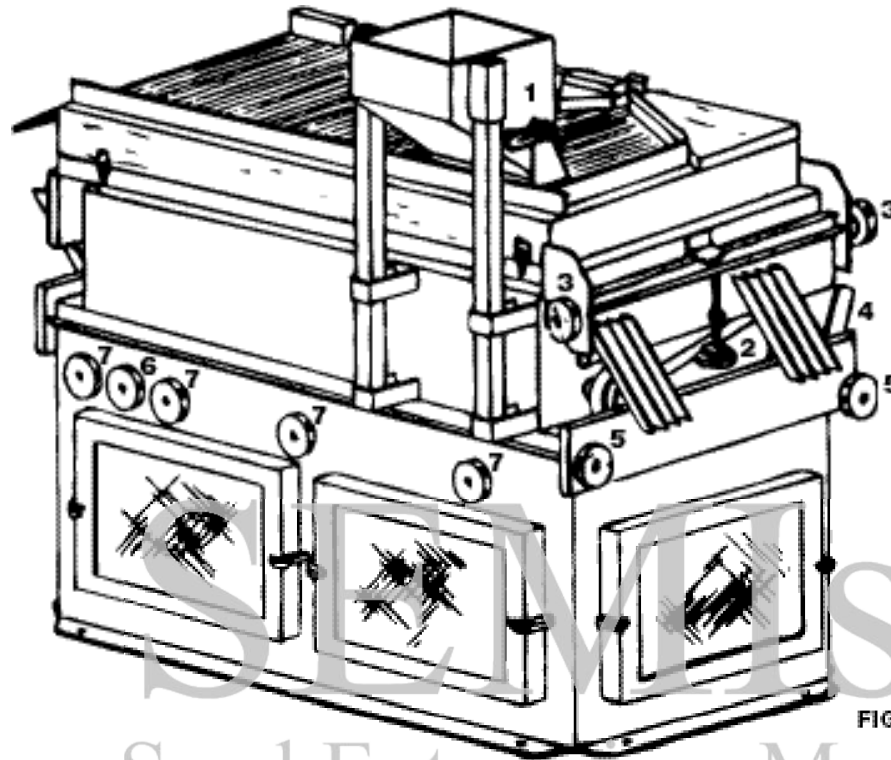
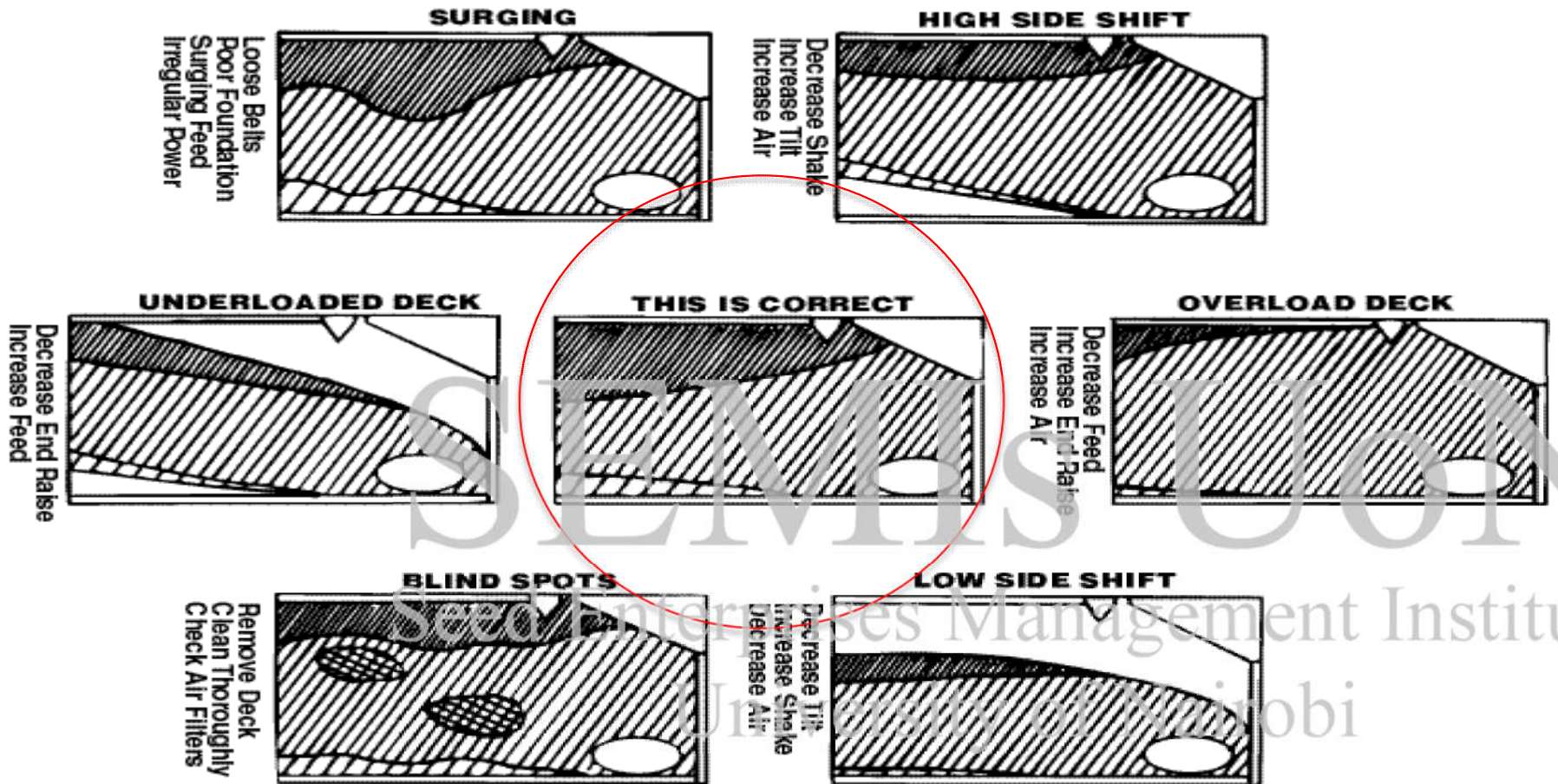


FIGURE 5

- LEFT HAND MODEL
1. Feed Rate Control
 2. End Raise Control
 3. Clamping Knob, End Raise
 4. Side Tilt Adjustment Handle

5. Side Tilt Clamping Knob
6. "More Speed" Control Knob
7. "More Air" control Knob

Gravity Separation – Adjustments



Same separation results can be achieved with different adjustments, it is an ART!

Rectangular, Multiple Fans

- Feed Rate
- Air Volume
- Eccentric Speed
- Deck Side Slope
- Deck End Slope
- Variable Airflow Levels
- Discharge Dividers



Trapezoidal, Adj. Pitch Posts

- Feed Rate
- Air Volume
- Eccentric Speed
- Deck Elevation
- Deck Run-off
- Feed, End, and Cull Post Pitch
- Discharge Dividers



- Eccentric Displacement is also adjustable on a few machines, and is used to help compensate for seed size variations

Gravity Separation – Deck Surface

Gravity Deck Material Selection

- Deck surface is critical for traction needed to convey seed up deck slope
 - Deck opening size must prevent plugging of deck openings
 - Use Proper Mesh Size for Product
 - 8 or 10 Mesh – large seeds
 - 12 mesh – soybean/wheat
 - 16 mesh – small grains
 - 30 mesh – small seeds
 - Cloth deck – very small seeds
 - Urethane coatings for large seeds
 - High Wear Applications
 - Better Traction, Lower Shake Speed
- 
- Riffle strips may be used for large seeds

Gravity Separation – Automation (Dr. Shyy's US Patent)

United States Patent [19]

Misra et al.

[11] Patent Number: 5,024,334

[45] Date of Patent: Jun. 18, 1991

[54] METHOD AND MEANS FOR GRAVITY TABLE AUTOMATION

[75] Inventors: Manjit K. Misra; Yuh-Yuan Shyy, both of Ames, Iowa

[73] Assignee: Iowa State University Research Foundation, Inc., Ames, Iowa

[21] Appl. No.: 363,727

[22] Filed: Jun. 9, 1989

[51] Int. Cl.³ B07C 5/342; B03B 4/00

[52] U.S. Cl. 209/557; 209/467; 209/472; 209/489; 209/491; 209/502; 209/503

[58] Field of Search 209/557, 567, 571, 576, 209/577, 580, 586, 587, 589, 592, 598, 552, 484, 489, 491, 496, 502, 499, 422, 691, 694, 695, 471, 472, 458, 459, 490, 479, 477, 503, 474-476, 467

[56] References Cited

U.S. PATENT DOCUMENTS

3,406,824 10/1968 Forsberg .
3,693,794 9/1972 Oetiker 209/467
3,888,351 6/1975 Wilson .
3,888,352 6/1975 Kulseth .
3,933,249 1/1976 Welsh et al. 209/557
4,265,744 5/1981 Weiffen 209/496 X
4,316,799 2/1982 Satake 209/580 X
4,652,362 3/1987 Mueller 209/44.2
4,765,489 8/1988 Satake 209/557

FOREIGN PATENT DOCUMENTS

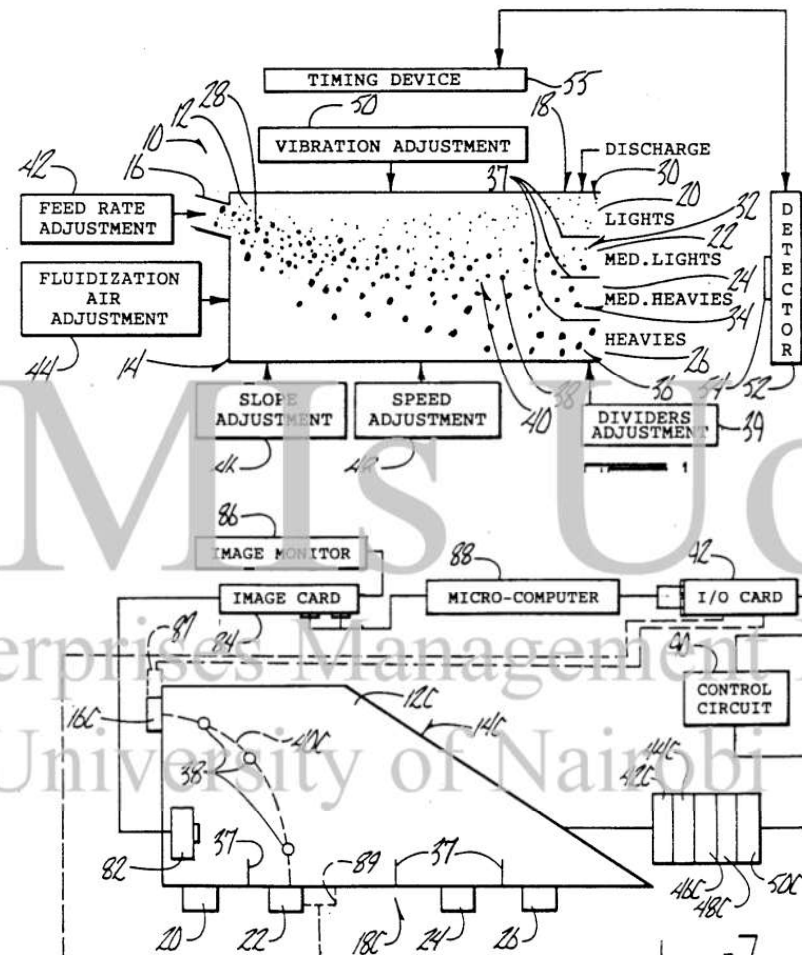
623481 5/1979 U.S.S.R. 209/491
1258487 9/1986 U.S.S.R. 209/489

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Voorhees & Sease

[57] ABSTRACT

A system for gravity table separation including a gravity table for separating materials and a detector operatively associated with the gravity table for detecting the movement of control particles with respect to the gravity table during its operation. The control particles are of a known characteristic. By calibrating the desired movement of the control particles through the table, any misalignment or deviance of that movement during operation is detected, and adjustments can be made to the operation of the table to bring the control particles back to the desired movement. The separation process can then be controlled to bring about optimum efficiency. Also, the detector can be interfaced with a control component which can automatically adjust the operation of the table in response to whether the control particles are following the desired movement through the table.

13 Claims, 6 Drawing Sheets



Gravity Separation – ISU Video



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Questions?



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