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Considerations in Cleaning and Processing Seed

H. C. Potts

CONSIDERATIONS IN CLEANING AND PROCESSING SEED

Howard C. Potts[1]

The purpose of this discussion is to bring into focus the specific considerations which should be made before the cleaning and processing operations are begun.

The removal of undesirable materials from a seed lot is an art based on the application of scientific principles. Just as a doctor must know how your body functions when you are well, the processing manager must have a thorough knowledge of good seed. In good seed, emphasis is placed on (1) genetic purity, (2) mechanical purity, and (3) high germination percentage. In seed processing, primary interest is on improving mechanical purity and germination percentage, because these two factors are most often manifested in different physical characteristics of a seed.

What is seed processing? In the broad sense, it encompasses all the steps involved in the preparation of a harvested seed lot for marketing. In common usage, seed processing refers to (1) preconditioning, (2) cleaning, (3) size grading, and (4) upgrading. During this discussion, the common definition of seed processing will be used.

With these facts in mind, it is now logical to state that the purposes for processing seeds are: (1) to remove contaminants, (2) size-grade to improve plantability, (3) upgrade quality, and (4) apply seed treatment materials. To achieve this purpose, the processor simply decreases the percentage inert matter, other crop seed, weed seed, and poor quality seed present in the original lot. Note that these factors which must be affected by processing are the same as those for which seed are examined under the various seed laws, that is, pure seed, inert matter, other crop seed, weed seed, and germination.

The processing of individual lots of seed is divided into three sequential events: (1) pre-cleaning examination, (2) removal of undesirable materials, and (3) upgrading and/or sizing. The first two steps are essential to effective processing of all lots; the third is

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dependent upon the kind of seed being processed, the nature and kinds of contaminants, the quantity of each contaminant in the raw seed, and the quality standards that must be met.

A basic requisite for effective seed cleaning is the capability of the processor to identify and distinguish the seed to be cleaned from the contaminants that occur in every seed lot. He must also know enough about seed to be able to distinguish between good, healthy seed and those of questionable quality, because at some point in the process, he must make a decision concerning which seed he will keep and those that will be removed from the lot. Thus, the processor's ability to render the desired service is affected by: (1) the processing and handling equipment available, (2) their arrangement within the plant, (3) the operator's skill in operating the equipment, and (4) his knowledge of seed characteristics. Notice that the first two of these factors were fixed when the processing plant was built. Therefore, operational skills and knowledge of seed characteristics are the only variables immediately available to either the processing manager or management to control seed quality.

The Pre-Cleaning Examination

As previously indicated, the first step in processing each seed lot is the pre-cleaning examination. Before giving any consideration to the equipment to be used in cleaning a lot of seed, a representative sample of the lot should be examined to determine the following factors:

1. Differences in physical characteristics
2. Frequency of occurrence of contaminants
3. Size variation of the good seed
4. Flowability
5. Need for pre-conditioning
6. Damaged seed

There is no significance to the order in which these factors are determined.

The primary purpose of the pre-cleaning examination is to determine the separable components of the seed lot. Remember: unless there are distinguishable physical differences among the components of the seed lot, no separation is possible. Thus, it is the components of the seed mixture and not the machine that determines if a particular separation is possible or practical.

Now, let's consider these six factors individually to see how each relates to seed processing. Seed, people, or any solid product, can be separated on the basis or differences of their physical characteristics. There are eight physical characteristics of importance in seed separations. These eight characteristics are: (1) shape, (2) length, (3) size, (4) color, (5) affinity for liquids, (6) electrical charge, (7) surface texture, and (8) specific gravity. Keep in mind that even though physical differences exist and proper equipment is available, it is not what you have but how you use it that determines success in making the desired separation.

Contaminants which have physical characteristics similar to those of good seed are of greatest concern. When examining the seed lot, particular emphasis must be placed on determining the presence of contaminants such as noxious weeds, nematode galls, etc., which could cause the seed to be unusable even though the mechanical purity may exceed 99%. Seeds of noxious weeds, other crops or varieties, common weed seed, damaged seed, and inert matter similar in physical characteristics to those of the good seed, are of descending importance in most seed lots.

Contaminating materials obviously much larger, smaller, or lighter than the good seed are not of great importance except when such materials affect seed flowability or when they represent more than about 20% of the seed lot. Seed lots containing a very high percentage of inert matter or removable crop and weed seed normally must be cleaned at a reduced rate of flow to allow removal of these materials and to avoid flooding of the discharge spouts provided for materials removed from the seed mass.

The frequency of occurrence of contaminants refers to the ratio between the desirable seed or characteristics of a lot and the undesirable. When looking at the seed to be cleaned, a thorough examination may reveal an undesirable characteristic, but it usually is the ratio of good to bad that is important, not the fact that a minor, often-time correctable defect is noted. This is usually a judgment decision, but we are generally willing to give up or overlook one thing to get something we really want.

Depending upon the quality standards to which the seed must be raised, certain contaminants can be ignored. All clean seed will contain a fractional percentage of inert matter. Many lots of seed contain small amounts of other crop seed or common weed seed because the cost of removing these seed exceeds the value that would be added to the seed after the contaminant is removed.

As an example, if the pre-cleaning examination revealed the presence of one oat seed per handful of wheat seed in a lot of non-certified wheat seed, the occasional oat could be ignored.

However, if the wheat seed were to be certified, it would be necessary to remove the oat seed. Thus, the presence of this oat seed would require the use of additional equipment, therefore increasing the cost of processing the certified seed. This same example is equally valid for common weed seed and inert matter, in that the quality standard set by management or, in some cases, by law determines what contaminants must be removed from each seed lot. Ideally, every lot of seed would be 100% pure seed; realistically, 100% purity is not practical, physically or economically.

Variation in size of the good seed is one factor frequently overlooked when examining seed for processing. Research conducted in 1975 showed that the smallest seed in any lot are of little value for reproductive purposes. On the other hand, subsequent research on seed size indicated that the exceptionally large seed, although nice to look at, are not the most desirable for reproductive purposes. Therefore, in seed, what we really want are those large enough to perform their function, but small enough to avoid problems due to size.

For most crops, the better the climatic conditions for seed production, the more uniform the size of the seed. In all species, the more uniform the seed size, the easier the seed are to clean. Effective processors know that different varieties of the same species often differ significantly in average seed size and they adjust the machines accordingly. One of the poorest testimonies to a seed processor is to observe screens marked with the name of a crop. Such marking usually indicates disregard for the natural variation in seed size and the other variable physical characteristics of a seed lot.

Another factor determined during the pre-cleaning examination is flowability. Flowability refers to the ease and uniformity with which seed will flow in the absence of mechanical force. A large sample of the entire lot must be used to determine flowability, because compaction must be considered in addition to the presence of inert material and natural seed appendages. This sample should be drawn by hand because probes often exclude large pieces of inert materials.

Seed must flow uniformly through the equipment before they can be effectively separated from the contaminants. As a general rule, a lot of seed which has an angle of repose-greater than 70 degrees should be pre-cleaned or conditioned before attempting any separation by the air-screen or subsequent processing machines. Anyone who has spent a day or two forcing seed into an elevator or pushing seed through a bin opening will testify for the need of pre-determining the flowability of every seed lot.

Most seed which have been harvested and threshed mechanically will flow through a properly designed processing plant. However, an

occasional lot of any kind of seed may lack the necessary flow characteristics because of natural appendages on the seed, high quantities of coarse inert matter, high moisture content, or poor threshing. Such lots should be pre-conditioned to improve flowability before attempting to clean the good seed.

A factor related to flowability is the need for pre-conditioning. In seed processing, the term pre-conditioning is used in two different contexts. First, it may refer to any method used to circumvent or remove those obstructions which reduce flowability. If long pieces of plants, such as straw or stems, or large quantities of sand or soil are the cause of poor flowability, these are normally removed with a scalper or aspirator. Drying lots which are high in moisture or which contain green plant materials often will give a lot the desired flow characteristics. Of course, corn must be shelled before processing. There are several techniques which can be used to improve flowability, but the method used will depend upon what you want to remove.

The second meaning applied to pre-conditioning refers to the removal of undesired or unnecessary coverings and appendages from the seed which may interfere with the cleaning process. This type pre-conditioning also serves to improve the appearance of the product. It is customary to hull and/or scarify combine-run seed of many of the small seeded legumes to facilitate cleaning and increase the speed of germination. Awned varieties of oats and barley are normally debearded to improve both flowability and appearance.

The final factor which should be determined during the pre-cleaning examination is damaged seed. There are three main causes of seed damage: (1) insects, (2) disease, and (3) mechanical abuse. Many different things can and do happen to seeds which make them undesirable, or at least reduce their capability to perform as well as undamaged seed.

When insects are active in the seed, the lot should be fumigated before it is cleaned with a fumigant recommended for use on seed. Disease damaged seed are usually lighter in specific weight than healthy seed of the same dimensions. Thus, the presence of more than 2 or 3% damaged seed is an indication to increase the velocity of the final air separation on the air-screen cleaner and the possible need to utilize a specific gravity separator. In most instances, seed lots that require specific process to remove disease damaged seed should be treated with the appropriate fungicide.

Mechanical damage to seed can be classified into three categories: (1) seed destroying, (2) major, and (3) minor. As the name implies, seed destroying damage is mechanical injury which splits or breaks the seed, such as split beans or cross broken seed, causing such seed to be unfit for planting purposes. Usually, these seed

parts can be removed, because breaking changes the physical characteristics.

Major damage is damage to the seed coat or covering which is visible to the naked eye, such as cracked or chipped corn seed and machine-cut cottonseed. Nothing can be done to remove such seed from the lot unless the damage alters the physical characteristics of the seed. When the undamaged seed have smooth seed coats, the damaged seed can frequently be removed by using a machine which separates on the basis of differences in seed coat texture, i.e., magnetic separator or roll mill. Seed having minor damage, such as pin-holes, are not normally noticed in the pre-cleaning examination. A general rule concerning mechanical damage is that for each seed that is split or broken, there will be three other seed which have suffered major or minor damage.

Techniques for Making Pre-cleaning Examinations

Under optimal conditions, the processing manager will have an opportunity to process a sample of each seed lot, using hand screens and/or model equipment. Organizations equipped to conduct such pre-processing tests are among the most efficient in their cleaning and processing operations. Such testing requires advanced sampling and control over delivery of various seed lots to the processing plant. This type sampling and control is not feasible for processing plants engaged in custom cleaning operations or processing seed coming directly from the field.

An intermediate method of making the pre-processing examination is to conduct a routine purity analysis on a sample of the field run seed. This analysis will provide valuable information on the kind and rate of occurrence of various contaminants. However, such factors as comparative physical differences between the good seed and contaminants, variation in seed size, flowability, and damaged seed must still be determined on the basis of a visual examination.

In spite of the more desirable methods of examination listed above, the pre-cleaning examination is most frequently made by simple visual examination of several handfuls of the field-run seed taken at the time the seed are delivered for processing. To make this examination, the seed are poured slowly from hand to hand or spread in a thin layer on a table or floor, in a well-lighted area, and mental notes made concerning potential separation problems. It should be obvious that this method will result in a higher frequency of lots which are below or above desired quality levels after processing than when more detailed methods are utilized.

Precision of the hand method of examination can be increased if the processor knows the approximate weight of his handful of seed.

This can be easily determined if the examiner will weigh several handfuls of seed of the various kinds processed. Greater repeatability can be gained if the operator will close his fingers against the fat part of his hand. For most persons, this will be a sample of one or two ounces.

Regardless of the techniques used for the pre-cleaning examination, it is of vital importance that the processor be thoroughly knowledgeable in seed identification and purity analysis. An experienced operator can closely approximate the percent cleaning loss, mechanical purity of the clean seed, and the probable presence of undesirable seed or characteristics of the processed seed before the seed enter the processing plant by combining his knowledge of seed with that of equipment operation.

The phrase often used by TV star, Flip Wilson, "What you see is what you get," could be considered as a summary to the consideration necessary for seed cleaning and processing. However, our experience both as seed processors and seed control officials, have led us to a slightly different conclusion. Hopefully, you will agree with our conclusion rather than Flip's --"What an operator considers is what he gets, but those things he doesn't consider will finally get him."

Air-screen Machine

The air-screen machine is the basic cleaner in most seed processing plants. Almost all seed must be cleaned by an air-screen cleaner before specific separations can be attempted, and many seed lots can be completely cleaned by this machine. The original hand-powered fanning mills have evolved into many styles and types of air-screen machines. Machine size varies from small, two-screen farm models to large industrial cleaners with 7 or 8 screens, 3 or 4 air separations and capacities up to 6,000 pounds of seed per hour. Small, two-screen models are used on farms, in breeder and foundation seed programs and by experiment stations for processing small quantities of seed. Three and four-screen machines fit into various size operations and are selected for precision as well as greater capacity. The 5-8-screen machines are used primarily for processing grain where high capacities are essential.

When selecting a size and type of air-screen cleaner for a particular operation, several factors must be considered, such as power requirements, amount and kind of seed to be processed and ease of cleaning the equipment.

In order for seed to be separated, cleaned or processed, the components of the lot or mixture must differ in some physical characteristic. In most machines separations are made on the basis of

differences in only one physical characteristic. The air-screen machine, however, effects separations on the basis of differences in size and weight of seeds. This enables the air-screen machine to use three cleaning elements: aspiration, in which light material is removed from the seed mass; scalping, in which good seed are dropped through screen openings, but large material is carried over the screen into a separate spout; and grading, in which good crop seed ride over screen openings, while smaller particles drop through.

To understand and successfully operate any seed processing machine, the operator must know three things: (1) the parts involved in the work of the machine and the operations they perform: (2) the flow of seed through the machine; and (3) the adjustments which affect the precision of the separation and capacity of the machine.

The principles and operation of air-screen cleaners are very similar and easy to work once you have learned the operation of one of them. In the following section we will illustrate and explain the operation of the Clipper 27 which is a two-screen machine and the NW-334 which is a three-screen machine. However, as you may have noted we have spoken of two- and three-screen machines; therefore, you must have a thorough knowledge of screens before you understand the machines.

Screens

Screens in an air-screen machine perform both scalping and screening operations as they separate crop seed from foreign material, other crop seed and weed seed. Screens are constructed of either perforated sheet metal or woven wire mesh. Openings in perforated metal screens may be round, oblong or triangular. Openings in wire mesh screens are square or rectangular.

There are 200 different screens available, each identified by a number indicating its size and shape. By selecting the proper sizes of screens for a particular crop seed, the same air-screen cleaner can be used for cleaning different seeds by merely changing the screen.

Perforated metal screens:

(1) Round openings - Round openings in a perforated sheet metal screen are measured by the diameter of the openings. Perforations of 5 1/2/64 and larger are designated in 64ths of an inch and are available in sizes ranging from 6/64ths to 80/64ths. These screen sizes are commonly designated by using only the numerator of the fraction, i.e., 6, 7, ... 64, 72, or 80, the denominator being understood.

Round openings of 5 1/2/64ths or less in diameter are designated in fractions of an inch, i.e., 1/12, 1/13, 1/14 ... 1/25. Sizes ranging from 1/12th to 1/25th of an inch are readily available.

(2) Oblong openings - Perforated sheet metal screens with oblong or slotted openings are designated by two dimensions, the width and length of the openings. As with round hole screens, openings 6/64ths of an inch and larger in width are measured in 64s of an inch and only the numerator is used. Openings less than 6/64ths of an inch in width are expressed in fractions of an inch. Oblong openings are usually 1/4 inch, 5/16 inch, 1/2 inch, or 3/4 inch in length.

When designating these screens, the width dimension is usually listed first and the length dimension next, i.e., 5 1/2 x 3/4, 6 x 3/4, or 1/22 x 1/2.

Generally, the direction of the oblong openings are in the same direction as the flow of seed on the screen. Screens with large perforations, however, are also available as cross-slots, i.e., slots perpendicular to the direction of the seed flow. Cross-slot screens are particularly useful in separating split beans from varieties that are relatively flat in shape. There is also a 1/22 x 1/2 diagonal with slots oriented to a 45 degree angle to the direction of seed flow. This screen is useful in cases where relatively short seeds are to be separated from slightly longer seed. Over 60 different slotted screens of assorted sizes ranging from 1/24th x 1/2 to 32/64ths x 1 inch are available.

(3) Triangular openings - Two different methods are used to measure triangular perforations. In one case, the length of each side of the equalateral triangle is measured and designated in 64ths of an inch. In the second method the screen opening size is the diameter of the largest circle that can be inscribed within the triangular opening -also in 64ths of an inch and designated with a number followed by the letter V, i.e., 4 1/2 V, 5 V, 7 V, etc.

It follows then, that two triangular screens with the same numerical side designation may not necessarily have the same size openings. For example, triangular screens with designations of 7 Tri., 8 Tri., 9 Tri., 10 Tri., and 12 Tri. have openings identified by the length of the side of the triangle. These same openings measured by the circle-diameter methods would be identified as 4 1/2 V, 5 V, 5 1/2 V, 6 V, 6 1/2 V and 7 V, respectively.

Wire Mesh Screens

(1) Square Mesh - Square openings in wire mesh screens are measured by the number of openings per inch in each direction. A 9 x 9 screen has 9 openings per inch. Available sizes range from 3 x 3 to 60 x 60. Since numbers on these screens do not increase consecutively, this range includes about 27 different screens.

(2) Rectangular Mesh - Rectangular openings in wire mesh screens are measured in the same way as square wire mesh screens. A 3 x 6 rectangular wire mesh screen will have 3 openings per inch in one direction and 6 openings per inch in the other. Rectangles formed by the wire mesh are parallel to the direction of seed flow. Approximately 50 different rectangular wire mesh screens are available in these sizes:

2 x 8 to 2 x 12, 3 x 14 to 3 x 21, 4 x 15 to 4 x 36 and 6 x 14 to 6 x 60. Openings of 18 x 20 and 20 x 22 are also available.

CLIPPER 27

Title: Introduction to the operation of an air-screen seed cleaner.

Purpose: The purpose of this exercise is to introduce the student to the various parts and principles of operation of a simple air-screen seed cleaner.

In addition to knowing the basic principles by which undesirable materials can be separated from a mass of seed, it is just as important to be familiar with the machines that are used for making various separations by utilizing some difference in the physical characteristic of the seeds and undesirable materials. In studying the machines the student should become familiar with the various machine parts,the adjustments, and the flow path that the seed follow going through the machine.

Procedure: A model 27 Clipper air-screen seed cleaner will be used in this exercise. Read the description of the machine and its operation. Then study the questions and answers pertaining to the parts, adjustments and operation. In doing this read the question and its answer and then follow through by inspecting the machine so that you can actually visualize the information presented in the answer.

Description of Model 27

The cleaning operation of the Model 27 cleaner consists of two screens, one top and one bottom screen, and one air separation. The two screens are mounted in a box-like device called a shoe. Both screens are positioned so that they slope in the same direction. The shoe is attached to two eccentrics that imparts a vibrating movement to it. The rate of vibration is constant.

Underneath each screen are two brushes that press lightly against the underside of the screens. The brushes move from side to side sweeping the underside of the screens to dislodge any seeds that become stuck in the screen perforations. The brushes are held in a brush carriage that rolls on a rail called a brush track. The height of the brushes can be adjusted by a lever at the side of the machine.

An air-stream for making the air separation is generated by a fan located under the discharge end of the bottom screen. The strength of the air-stream can be regulated by the adjustable sliding doors at each end of the fan housing and also by the speed of the fan. The speed of the fan is adjusted by the variable diameter pulley between the pulley on the fan shaft and the driving pulley on the main drive shaft.

Flow Path of Seed Through the Machine

The seed to be cleaned are placed in the elevator hopper and elevated to the feed hopper on the cleaner. The seed are then fed from the feed hopper to the top screen. The openings in the top screen are large enough for the major crop seed and the smaller material to pass through. The trashy material larger than the crop seed pass over the top screen and discharge at the side of the machine. From the top screen the seed and small materials fall onto the bottom screen. The small undesirable materials pass through the screen and discharge at the side of the machine. The major crop seed pass over the screen and fall through the air-stream which blows out any light material remaining mixed with the seed.

The air-screen cleaner has completed its cleaning operation. The seed now go into the inclined auger conveyor and are deposited into a bag or another elevator or machine for further processing.

Question - Answer Study Guide

1. What is the name and model of this machine?
   Ans. Clipper 27 Farm Size Cleaner

2. What is the name of the manufacturer?
   Ans. Ferrell-Ross Company, Saginaw, Michigan

3. How is the volume of seed going into the elevator controlled?
   Ans. By the sliding gate control at the bottom of the elevator hopper.

4. What are the major parts of the feed hopper and what are their functions?
   Ans. a. Hopper box - To contain the seed.
   b. Feed roller - to help force the seed from the hopper at a uniform rate.
   c. Adjustable feed gate - controls the volume of seed discharging from the hopper.

5. Can the rotation at the feed roller be stopped without stopping the machine?
   Ans. Yes By disengaging the cluth on the feed roller drive shaft.

6. What is the purpose of stopping the feed roller without stopping the machine?
   Ans. There are times when it is desired to have the machine running to clean seed from the screen or to make adjustments without seed being fed to the screens. By disengaging the clutch to stop the feed roller the feed is stopped without stopping the machine or closing the adjustable feed gate.

7. How many screens are there in the machine and what is the size of the screen frame?
   Ans. Two screens in the machine. The screen frame is 34 x 42 inches.

8. Do the screens slope in the same direction?
   Ans. Yes

9. Can the angle at which the screen slope be changed?
   Ans. No. The slope is fixed on this machine.

10. What is the purpose of the 8-inch section of solid metal at one end of the screen?
    Ans. The solid section is called the spreader section. This part is always placed at the high end of the screen so that when the screen is used in the first position the seed falling from the feed hopper will fall on the solid part and spread into a thin layer before moving onto the perforated screen. Also it causes the seed to be farther down the screen when they pass through the openings and helps to prevent the seed from bouncing back over the end of the screen.

11. How many brushes are there under each screen?
    Ans. Two

12. Can the height of the brushes be raised and lowered?
    Ans. Yes

13. How can the pressure at which the brushes press against the underside of the screen be adjusted?
    Ans. The pressure of the brushes against the screen is determined by the height of the track on which the brush carriage travels. The height of this track can be set at different positions by a lever on the side of the machine. There is a separate lever for each pair of brushes.

14. Is it necessary to change the height position of the brushes when removing or putting in screens?
    Ans. Yes The brushes should be moved to the lower position before moving a screen in or out. After a screen is placed in the shoe the brushes are raised to press gently against the screen.

15. What is the purpose of the gaps in the screen brushes?
    Ans. The gaps are in the brushes to provide space for the cross supports under the screen. The screens should be positioned so the gaps are under the cross supports when the brushes are in the raised position. If the gaps and cross supports are not in proper alignment some of brush bristles will be pressed against the supports and damaged. Also, this will prevent the brush from making good contact with underside of the screen.

16. How are the brushes made to move back and forth under the screen?
    Ans. The brush carriage is driven by two cables that have one end attached to the carriage and the other end to a chain belt under the shoe. As the chain belt moves around the pulleys the carriage is pulled in one direction when the point of attachment is on top of the belt and then the opposite direction when the point of attachment goes around a pulley and is on the bottom side of the belt. It is important to have the cables at proper length so that when the belt attachment is at the extreme ends the brushes are at the side of the shoe at their point of extreme travel.

17. How are the screens made to vibrate back and forth?
    Ans. The shoe is attached to two eccentrics on the main drive shaft. These eccentrics are off-center bearings that impart a back and forth movement to the shoe that contain the two screens.

18. Do the two screens move in the same direction at the same time?
    Ans. Yes. Because both screens are in the same shoe and they move with the shoe.

19. What is the function of the top screen?
    Ans. The top screen removes the material larger than the major seed. The perforation are of such size that the seed and smaller material can pass through the perforations. The larger materials slide over the perforations and discharge off the end of the screen and out of the machine at a spout on the side.

20. What is the function of the bottom screen?
    Ans. The bottom screen removes the materials smaller than the major crop seed. The screen perforations are small enough that the major seed cannot pass through but materials smaller than the seed can. The small material passes through the perforations and falls to the bottom of the shoe and discharge out at the side of the machine. The major crop seed pass over the perforations and dischar off the end of the screen into an air-stream.

21. How many fans are there on the machine and where located?
    Ans. One. The fan is located underneath the discharge end of the shoe and screens.

22. What is the function of the fan?
    Ans. The fan generates an air-stream of such strength to blow out any light trash or seeds not removed by the screens.

23. Can the strength of the air-stream be regulated? If so how?
    Ans. Yes. The strength of the air-stream is determined by the volume of air put out by the fan. The volume of air can be regulated by the sliding gates at the ends of the fan housing and by changing the speed of the fan.

24. How can the speed of the fan be changed?
    Ans. The speed of the fan can be changed by adjusting the jack-shaft pulley control located between the fan pulley and the pulley on the drive shaft. Moving the control level will change the direction of the jackshaft pulley and will cause the fan to run faster of slower depending upon whether the diameter of the jackshaft pulley is increased or decreased when the control level is moved.

25. Where do the clean seed go after passing through the air-steam?
    Ans. The clean seed fall into the inclined auger elevator which elevates the seed up to the bagging attachment that deposits the seed into a bag.

26. Draw a diagram showing how power is transmitted from the motor to the eccentrics,feed hopper, fan, and bagging auger. Starting at the motor calculate the speed of the eccentric shaft, large pulley on feed hopper, and auger.

Use the equation $D_1 \times R_1 = D_2 \times R_2$ where
D_1 = diameter of motor pulley
R_1 = speed of motor pulley in revolutions per minute
D_2 = diameter of pulley being driven
R_2 = speed (RPM) of pulley being driven

Crippen NW-334, Air-Screen Cleaner

The Crippen NW-334 is an air-screen cleaner that consists of three screens and two air separations. The letters NW identify the type of cleaner and the number 334 indicates the number of screens used in the cleaner and the width of the screen frame. In this case the first digit "3" tells us that the cleaner has three screens as mentioned above, and the next two digits tell us that the screens are 34 inches wide. A picture of the NW-334 is shown in Figure 1. Two diagrams showing some of the major parts of the cleaner and the flow of seed through the cleaner are shown in Figures 2 and 3. A description of the cleaner will be given beginning at the top where the seed enter the cleaner and progress downward to where the clean seed discharge from the cleaner.

Feed Hopper

The feed hopper is a box-like device at the top of the machine that holds the seed before they are fed to the screens. Inside and at the bottom of the hopper is a revolving feed roller that pulls the seed from the hopper. Above the roller is an adjustable gate that controls the volume of seed the roller pulls from the hopper. Moving the gate upward will increase the opening between the roller and the bottom edge of the gate and thereby increase the volume of seed flowing from the hopper. As the gate is moved downward, the space between the roller and gate is decreased and the volume of seed is thereby decreased. The gate is controlled by a crank at the side of the machine frame.

An agitator is located in the center of the hopper above the feed roller. The agitator is a horizontal shaft extending through the hopper and has several fingers about 4 inches long along the side of the shaft. The purpose of the agitator is to prevent the seed from bridging over above the feed roller. It also mixes the incoming seed mass better which enables the seed to flow more uniformly from the hopper.

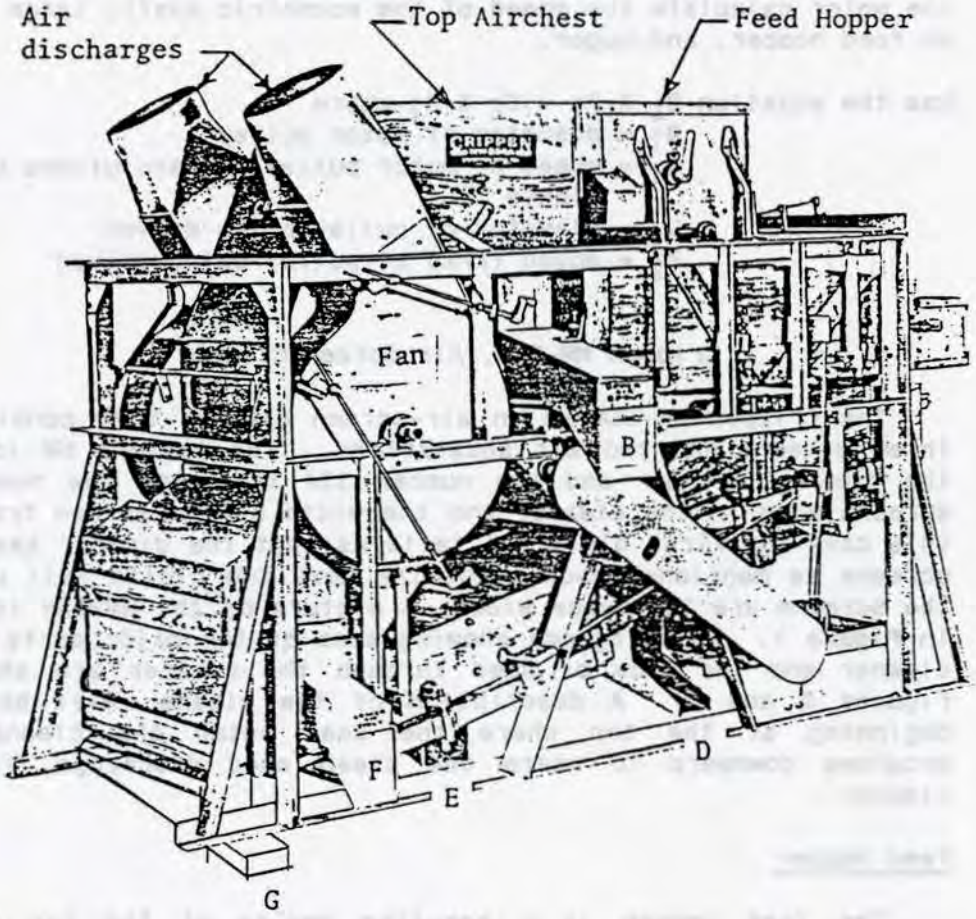

Figure 1. Crippen NW-334, air-screen cleaner. 3 screens-2 air separations provide either: a. 2 scalpers and 1 bottom screen, b. 1 scalper and 2 bottom screens.

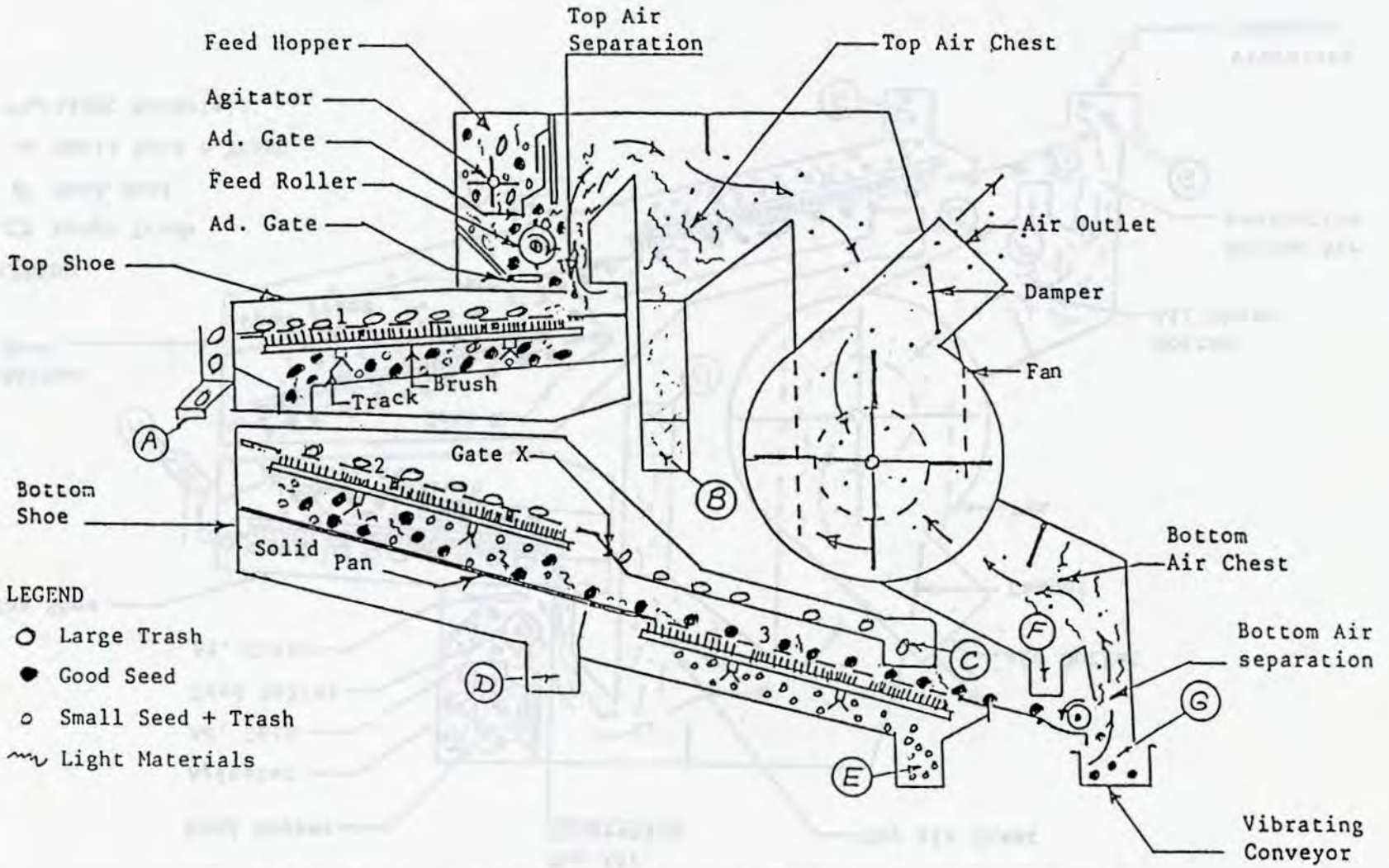

Figure 2 - Crippen NW-334 air-screen cleaner with second screen used as a second scalper.

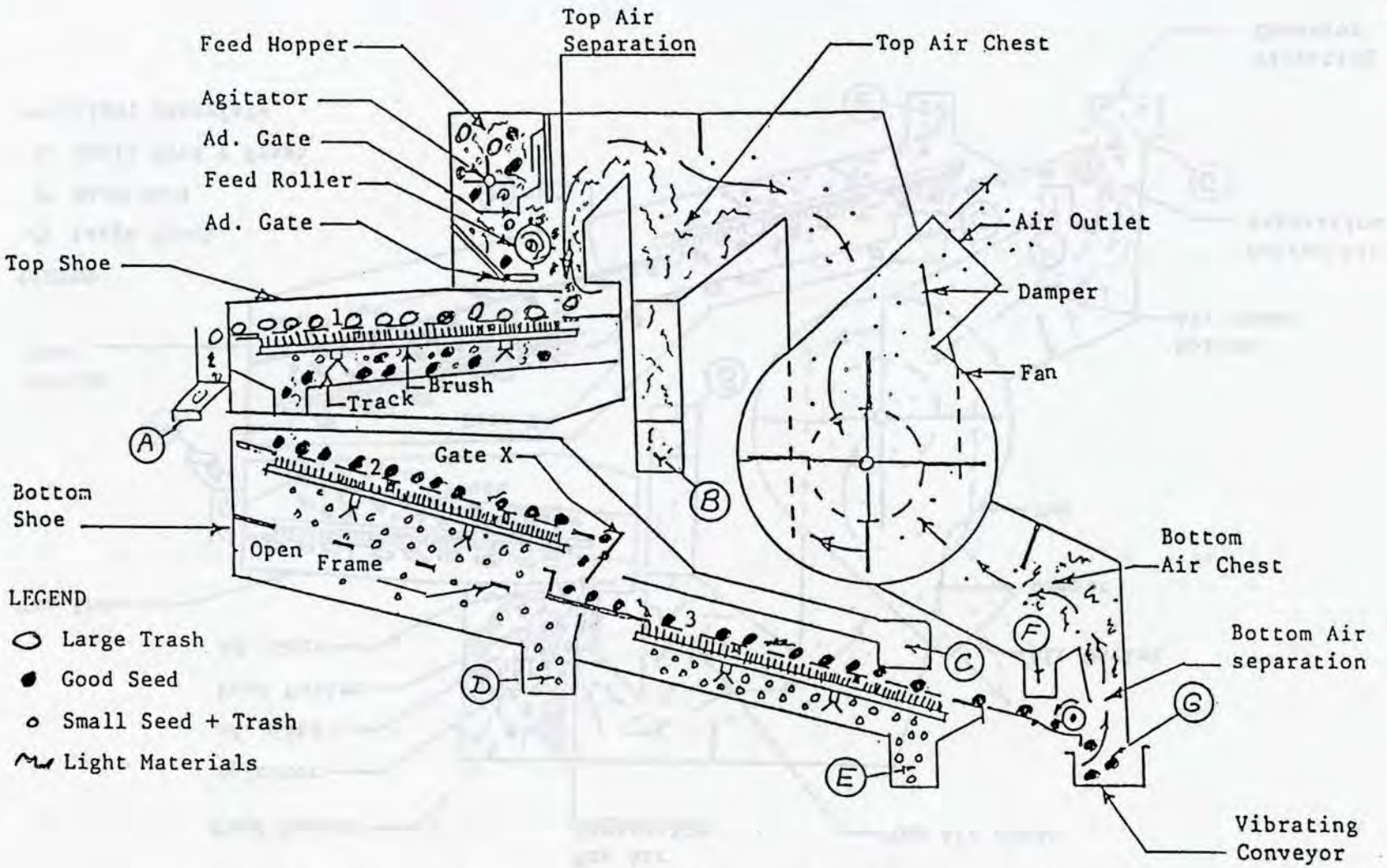

Figure 3 - Crippen NW-334 air screen cleaner with second screen used as the first bottom screen.

The feed mechanism can be stopped by disengaging the clutch on the left side of the feed hopper. The clutch provides a means of stopping the flow of seed to the screens without stopping the entire machine.

Fans and Airstreams

The Crippen NW-334 has two fans. The purpose of the fans is to generate two airstreams to remove the light trash, dust, and light seed from the crop seed. One of the airstreams is called the top airstream while the other one is known as the bottom airstream. The fans are located on the sides at the back and top of the machine frame. The left hand fan generates the top airstream, the right hand fan generates the bottom airstream. The left and right and positions are determined by facing the end of the cleaner where the screens are placed in the cleaner.

The top air separation occurs at the bottom of the feed hopper. As the seed fall from the feed hopper, they pass through the top airstream which is strong enough to lift out the dust and light trash before the seed reach the first screen. Removing this light material before the seed reach the screens reduces the work load of the screens which enables the screens to be more efficient in making a separation and also reduces the dust pollution in the area around the machine.

The bottom air separation occurs at the back of the cleaner just as the seed discharge off the lower end of the third screen. The purpose of the bottom airstream is to remove any light seeds and heavier trash not removed by the top airstream. The bottom airstream should be strong enough to lift out a good seed occasionally.

The strength of each airstream is controlled by a damper in the discharge duct of each fan. The positions of the dampers are adjusted by two cranks on the right side of the cleaner. Closing the dampers will reduce the strength of the airstreams whereas opening the dampers will increase the strength.

Two large air chests are located between the inlets to the fans and the position where the air separations are made. As the airstreams pass through these air chests, the velocity of the air will decrease to the extent that the light materials lifted from the seed will settle to the bottom of the chests and then discharge from spouts B and F leading from the bottom of the chests to the side of the cleaner. A free swinging door is attached to the end of each spout. The swinging doors serve as an air lock to prevent the fans from pulling air in through the spouts instead o through the opening where the air separation is made. The top air

chest has an adjustable door inside by which the lifted materials can be directed to the spout at the side of the cleaner or into the bin and be blown to a collector some distance from the cleaner.

Shoes and Eccentrics

The Crippen NW-334 has two shoes. Shoes are box-like parts in which the screens are placed. The shoes are placed one above the other. The top shoe contains only one screen that slopes downward toward the front of the cleaner. The second shoe which is under the top shoe contains the second and third screens that slope downward toward the back of the cleaner. Each shoe is supported by four flexible hangers--two on each side. These flexible hangers allow the shoes to be vibrated back and forth. The purpose of the vibration is to cause the seed and other materials to move along the screens. The shoes are caused to vibrate by four eccentrics--two per shoe--mounted on a central drive shaft between the two shoes. An eccentric is an off-center bearing. The eccentrics are connected to the shoes by arms between the eccentrics and the shoes. As the drive shaft rotates the eccentrics imparts a vibrating movement to the shoes.

The rate of vibration of the shoes can be varied by means of a variable diameter pulley on the left end of the drive shaft. Increasing the tension on the drive belt will cause the belt to run deeper in the pulley--decreasing the effective diameter--and will increase the rate of vibration. Decreasing the tension on the belt will cause the belt to run more toward the outside of the pulley--inceasing the diameter--and thereby decrease the rate of vibration. Turning the crank will change the position of the idler pulley running against the drive belt and will thereby change the tension of the belt which will in turn change the diameter of the variable diameter pulley which will cause a change in the rate of vibration.

Screens

The screens used in the Crippen NW-334 are 34 inches wide by 44 inches long. The types and sizes of the openings in the screens are the same or similar to those discussed in a separate section pertaining to screens.

The screens are supported inside the shoes by a small steel angle along the sides inside the shoes. The screens are held tightly in place by wood clamp strips above the sides of the screens. When the clamps are pulled forward, they press down along the top edges of the screen pressing it against the steel angles underneath. There is a pistol hook on the end of each clamp that can be hooked over the end of the screen and thereby hold the screen tightly in place.

Screen Cleaning Brushes

Two brushes are located underneath each of the screens. The purpose of these brushes is to prevent seeds or other materials from becoming wedged in the screen openings. The brushes press firmly against the underside of the screens and move from side to side sweeping the underside of the screen. This sweeping action pushes out any seed that becomes wedged in the openings and thereby keeps all the screen openings clear.

The brushes are held in a brush carriage that rolls along two angle iron tracks. The pressure at which the brushes press against the screen is adjusted by raising or lowering the height of the brush tracks. The ends of the tracks are supported and secured by support brackets located on the machine frame at the sides of the shoes. By loosening the bolts in these brackets, the brush track can be set at the desired height. As the brushes become worn from use, the brushes are raised enough to give the desired brush pressure under the screens. Once brush tracks have been raised to the desired height, the bracket bolts are tightened again to hold the tracks at the correct height.

The brushes are caused to move back and forth by small cables attached between the brush carriages and a chain-belt drive mechanism underneath the bottom shoe. As the chain-belt rotates around the two pulleys, the cables are pulled from one end of the belt to the other which in turn pulls the brush carriage from one side of the shoe to the other.

The brushes have two gaps in the bristles. The brushes should be positioned in the cleaner so the gaps will fit evenly under the supports in the screen frame. If the gaps do not fit under the support as they should, some of the bristles will be pressed up against the supports and damaged. Also, the brushes will not have the proper pressure on the underside of the screen and cannot keep the openings clear.

Screen Tappers

Screen Tappers are hammer-like devices located above the screens and slowly taps a wood strip in the center of the screens. The purpose of the tapping action is to jar the screens vertically which will aid in moving the seed and other materials along the screens. These are especially helpful when cleaning light seeds or when there is trash in the mixture that is slow in moving down the screens. The tappers are driven by a cam device on the left side of the machine. The cam raises the tappers to their maximum, height and then suddenly allows them to fall. Additional force can be added to the tapping action by increasing the

tension of the "tapper tension spring" located on the right side of the machine frame. The tappers can be disengaged by locking them in the up position with the "tapper lock" on the right side at the front and top of the machine frame.

Flow Path of Seed Through the Machine

The seed to be cleaned are fed into the elevator at the front of the cleaner. The elevator lifts the seed vertically and deposits them in the hopper on top of the cleaner. The revolving feed roller in the bottom of the hopper pulls a wide stream of seeds the width of the screens from the hopper. The roller turns in such a direction that the seed flow over the roller. As the seed fall from the roller they fall through the top airstream before reaching the top screen. The airstream has sufficient strength to lift out the dust and light trash which is blown into the top air chest. The air velocity decreases in the chest and allows the light trash to settle out and discharge from spout B on the right side.

After the seed have passed through the top airstream, they fall onto the top screen. This screen is commonly called a scalper. The screen openings are large enough for the principle crop seed with the small materials to pass through. The large trash that is too large to pass through the screen slides on down the screen and discharges through spout A at the front of the cleaner. The principal crop seed and small materials fall to the bottom of the top shoe and slide toward the front of the shoe to an opening where they fall onto the second screen.

The second screen in the Crippen NW-334 can be used as either another scalping screen or as a bottom screen to sift out part of the smaller materials. The method for using the second screen as a scalper will be described first.

Second Screen as a Scalper

To use the second screen as a scalper, select a screen with openings large enough for the principal seeds to pass through but slightly small than the openings in the first screen. Place the screen in the top position in the second shoe. Next select a bottom screen for the third screen position which is at the lower end of the bottom shoe. This screen must have openings large enough for the small materials to pass through but small enough that the principal seeds will pass over. Place this bottom screen in the lower position of the bottom shoe and push to the lower end of the shoe. Since the third screen is forward of the second screen, it is necessary to place a solid pan under the second screen to catch the seed falling through the second screen and direct them onto the third screen. There is a special pan for

this purpose and it is placed in the second position in the bottom shoe and directly behind the third screen.

Any materials larger than the principal seeds will slide over the second screen to the lower end. To direct the large materials to the discharge spout C, gate X is placed in the open position (Figure 2).

As mentioned earlier, the seed and small materials passing through the second scalper fall onto the solid pan and then slide down onto the bottom screen. The smaller materials will pass through the openings of the bottom screen and discharge from a spout E under the screen. The seeds pass over the bottom screen and as they discharge from the end of the second shoe they pass through the second airstream. This airstream lifts out any remaining light seeds or trash. The lifted materials are carried into the bottom large air chest where the light materials settle out from the airstream and discharge at spout F.

After passing through the bottom airstream, the seeds fall into a vibrating conveyor that conveys them to an elevator. The elevator can convey the seeds to a bin above another machine or back to the initial elevator to recirculate the seed through the cleaner again as done in teaching and demonstrations.

Second Screen as a Bottom Screen

To use the second screen a bottom screen, select a screen with openings smaller than the principal crop seed. Place the screen in the top position of the second shoe. Next select another bottom screen for the third screen position. The openings in the third position can be the same size or slightly larger than the openings in the second screen. Place this screen for the third screen position in the lower position of the bottom shoe and push to the lower end of the shoe. Now that small materials will be passed through the second screen, an open screen frame is placed under the second screen behind the third screen. This open fame allows the small material passing through the second screen to fall to the bottom of the second shoe and discharge at spout D. Gate X at the end of the second screen is placed in the open position to divert the principal crop seeds passing over the second screen down and onto the third screen Figure 3. As the seeds pass over the third screen, any remaining small seeds and other materials will pass through the screen and discharge at spout E. After passing over the third screen, the seeds fall through the second airstream where the remaining light materials are lifted out as described earlier. The clean crop seeds then fall into the vibrating conveyor that conveys the seeds to an elevator to be transported elsewhere.

When to Used the Second Screen as a Bottom Screen or Scalper

Whether to use the second screen as a bottom screen or a scalper can best be determined by making a precleaning analysis of the seed to be cleaned. If there is a large amount of materials larger than the principal crop seeds to be removed, the second screen would be used as a scalper. On the other hand, if there is a large quantity of materials smaller than the principal crop seeds, it would be better to use the second screen as a bottom screen. The final decision would be based upon the skill and sound judgement of the processing manager.

Name: _____

Date: _____

ABE 6863 Seed Processing Machinery
Exercise No. _____

Title: Introduction to the principle parts and adjustments of an air-screen cleaner.

Purpose: The purpose of this exercise is to familiarize the student with the operational features of the Crippen NW-334 air-screen cleaner.

Procedure: Study the construction and operation of the Crippen NW-334 by locating the various parts, and adjustment and learning the purpose of each. Answer the following questions as you study the machine and flow diagrams.

1. Name and model of the machine is NW-334 manufactured by the Crippen Manufacturing Company, Inc. address Alma, Michigan 48801.

2. How many screens are used in the machine? 3.

3. What is the size of the screen frame? 34 x 44 inches.

4. A shoe is the box like part in which the screens are placed and helded. How many shoes are in the cleaner? 2.

5. Do the two shoes travel in the same direction at the same time? No Why? By traveling in opposite direction the shoes are counter balanced for smoother operation.

6. How are the screens held tightly in the shoes? By the screen clamps pressing down on edge of screen.

7. Examine the inside of the feed hopper. How are trashy seed prevented from forming an arch above the feed roller? The revolving agitator with spikes along the side keeps seed mass from packing.

8. What is the purpose of the feed roller? To feed the seed from the hopper. Do the seed discharge over or under the roller? Over the roller.

9. How is the quantity of seed discharging from the feed hopper regulated? By the height of the adjustable gate above the feed roller.

10. Is the principle feed control gate above or below the feed roller? above .

11. What is the major purpose of the gate underneath the feed roller? To empty out any seed remaining in the hopper.

12. How can the flow of seed from the feed hopper be stopped without stopping the machine or closing the feed gate? disengage the feed roller clutch to stop feed roller.

13. When might an operator want to stop the flow of seed from the feed hopper before stopping the machine? Before changing a screen. This allows all the seeds to move off the screen.

14. How are seeds prevented from wedging (becoming stuck) in the screen perforation ? The brushes sweeping the underside of the screen dislodge seeds that get stuck.

15. How are the screen brushes made to move back and forth underneath the screens? Chain belt drive imparts back and forth movement to cables attached to brush carriage.

16. How can the pressure at which the brushes press against the underside of the screens be adjusted? By raising the track that the brush carriage rolls on.

17. What is the purpose of inducing vibration to the screens of a cleaner? Aids in getting material to pass through the screens and causes seed to flow down screens.

18. Is there a means of inducing more vibration to the screens in addition to that provided by the vibration of the shoes? yes . How? The screen tappers add a vertical vibration to the screen and causes the seed to bounce more. This aids is in preventing seeds from lodging in the screen openings, causes light material to flow down screen better, and assist small material in passing through screen.

19. How many fans does the cleaner have? 2 . How many air separations does the cleaner have? 2 . Where are the air separations made on the cleaner? Below feed hopper and at end of third screen. Which fan is used for each separation? Left-hand fan upper air. Right-hand fan lower air.

20. When a mixture of heavy and light weight seeds fall into a high velocity airstream, the light seeds are lifted out in the

airstream. How are the light seeds separated from the airstream? As the air passes through the large chamber just above the air entrance the velocity decreases and the solid materials settle out.

21. Can the rate of horizontal vibration of the shoes be changed? Yes. How? By changing tension of the belt that drives variable pulley on shoe drive shaft.

22. Do the fans operate at a constant speed or can the speed be varied? Constant . What is the speed of the fans? 900 RPM.

23. How is the strength of the airstream adjusted? By changing the position of the damper in the air passage. Is this adjustment on the inlet or outlet side of the fan? Outlet .

24. Where does the dust and light trash that passes through the fans go? Cyclone dust collector where the trash settles out. The dust-ladden air is vented through a pipe to outside of building.

25. The second screen can be used as either a bottom screen o a close scalper. Study the section "Selective Screen Arrangements" in the handout. It has instructions for making the adjustments necessary for setting up a screen arrangement for either use.

26. What is the purpose of gate "X" at the end of the second screen? To direct material passing over the second screen to discharge spout or seed to third screen.

27. In which arrangement would the solid pan be placed ahead the third screen? When the screen is used as a close scalper.

28. What is the purpose of having the solid pan under the second screen? The crop seed pass through the second screen onto the solid pan that directs the seed to the third screen.

29. What would be used in place of the solid pan when the second screen is used as a bottom screen? An open screen frame. Why? Small material passing through second screen needs to discharge from discharge spout at side of machine.

30. When would the second screen be used as a bottom screen? When there is a large amount of material smaller than the crop seed to be removed.

31. Can the slope of the screens be changed? No .

32. What is the purpose of the free swinging door at the end of the discharge spouts for the upper and lower air streams? To act as an airlock and prevent air from entering through spout instead of passing through seed.

33. What is the purpose of the rubber roller at the end of the third screen? To act as air seal and direct all the airstream through the seed.

34. What is the purpose of the gate inside the air chest (see lever) above the upper air discharge spout? To direct material lifted by upper airstream to side spout or to fan to be blown into cyclone.

35. Can the force at which the tappers hit the screen be adjusted yes How? By the tension of the spring on the tapper drive shaft.

36. What is the purpose of the long wood strip on top and in the center of each screen? For the tapper to hit. Otherwise the tappers would make a hole.

SEED TREATMENT CALIBRATION

I. Basic Facts To Know Before Calibrating a Seed Treater.

All seed treatments are quoted in dry ounces or in fluid ounces (per 100 pounds, or per bushel). Remember, there is a difference between dry ounces and fluid ounces.

16 dry ounces = 1 lb.
128 fluid ounces = 1 gal.

1 fluid ounce = 30 cc's. Example: At a rate of 3 fluid ounces per cwt, you are actually applying 90 cc's per cwt.

When slurries are made by mixing wetable powder chemicals with water, the treater is then applying the slurry in fluid ounces of the TOTAL mix.

Chemical cup sizes are measured in cc's. Sample: Setting the dump weight to apply 3 fluid ounces (90 cc's) per cwt:

15 cc	16 pound dump
10 cc	11 pound dump
7.5 cc	8 pound dump
5 cc	5.5 pound dump
2.5 cc	3 pound dump

II. Accurate Calibration of a Seed Treater.

With no chemical in the metering tank, run 100 pounds of seed through the treater and count the number of times the weigh-pan dumps. Divide 100 pounds by the number of times the weigh trips.

This gives you the number of pounds of seed per dump of the weigh pan. Record the numerical setting of the weight on the weigh pan aim for future use.

Determine how much liquid your treater metering cups or bucket will dump onto the seed each time the weigh-pan arm trips by manually tripping (without seed) the weigh-pan arm a specific number of times.

Catch the amount of chemical that is dumped in a measuring cup. Divide the amount of chemical caught by the number of times you tripped the weigh-pan. This gives you the amount of chemical delivered per dump of the weigh-pan. (Record for future use).

After completing operation one and two, you will know exactly what your treater is presently set at.

Remembering that there are two ways to vary the dosage of chemical to seed, either change the setting of the weight on the weigh-pan arm...(raise weight to increase amount of seed dumped or lower to decrease) OR replace existing cup in metering tank with another size cup to deliver more or less chemical per dump as necessary. For additional information on calibration, use calibration instruction manual furnished with special note for WETTABLE POWDER chemicals that must be mixed with water. Most wettable powders are applied at the rate of 1 to 5 dry ounces per 100 pounds of seed. Normally, a chemical to water mixing rate is not quoted on the label, so you will have to experiment to suit yourself. Example:

> A chemical cup goes on the rate of two dry ounces per 100 pounds of seed. The seedsman has found that mixing five pounds of chemical (30 dry ounces) with one gallon of water, gives him the slurry consistency that he desires

Then, it must be kept in mind that the total volume of slurry (in this case, approximate 1.2 gallons) is enough to treat 40 cwts (4,000 lbs.) of seed.

So. . .

> 1.2 gals. = 153.6 fl. oz.

And. . .

> 153.6 fl. ozs. (153.6}40)= 3/84 fl. oz./ per cwt. seed

Then. . .

> Just use the techniques covered earlier.

TWO METHODS FOR CALCULATING RATIO OF WETTABLE POWDER SEED TREATMENT CHEMICAL TO WATER FOR SLURRY APPLICATION

Most wettable powder seed treatment chemicals are applied at a rate between one (1) and five (5) dry ounces per 100 pounds of seed. The dosage rate is, of course, obtained from the label. Normally a chemical and water mixing ratio is not stated or suggested on the label. Following are two (2) methods you may use to calculate the proper powder to water ratio to obtain the desired slurry dosage per 100 pounds of seed.

Method A

To determine the correct amount of wettable powder chemical to use to make one gallon of liquid slurry, divide 128 by the number of fluid ounces of liquid you desire to apply per 100 pounds of seed; and then multiply the result by the number of dry ounces of the chemical the label tells you to apply to 100 pounds of seed.

Example:

$$\frac{\text{128 fluid ounces per gallon}}{\text{fluid oz. liquid to be applied/cwt}} \times \text{Dry ounces of chemical desired per cwt.}$$

= Dry Ounces of Wettable Powder to use to make one gallon of slurry

For example: $\frac{128}{15.6} \times 1.5 = 12.3$ Ounces wettable powder chemical to use to make one gallon of slurry

NOTE: Be sure you bring total slurry volume up to one gallon, rather than starting with one gallon of water and adding wettable powder to that. This is because adding the powder will "displace" some liquid volume - as a rule of thumb, most wettable powders "displace" about 7 fluid ounces of liquid volume per pound of powder added.

Method B

Some seedsmen may desire to "experiment" for themselves to obtain a slurry consistency they like. Once they decide on a powder + water mixture ratio, they must keep in mind the number of dry ounces of wettable powder they originally added to the water. This determines the number of hundred weights they must treat with the slurry volume they now have.

Example:

A chemical is applied at the rate of two (2) dry ounces per 100 pounds of seed. The seedsman has found that mixing five pounds of chemical (80 dry ounces) with one gallon of water, gives him the slurry consistency that he desires.

Then, it must be kept in mind that the total volume of slurry (in this case approximately 1.2 gallons) is enough to treat 40 cwts (4,000 lbs.) of seed (since the original powder dosage is 2 dry oz/cwt and you have mixed 80 oz. into the slurry).

So. . .1.2 gallons total slurry X 128 fl oz/gallon =

153.6 fl oz.

And. . .

$$\frac{153.5 \text{ fl ozs}}{40 \text{ cwts. seed}} = 3.84 \text{ fl oz/ per cwt. seed}$$

ENHANCING SEEDLOT QUALITY BY USE OF AN AIR SCREEN CLEANER

Jim Stanelle[1]

The term "enhancement of seedlot quality" can have various interpretations, therefore, some definitions may be necessary:

*enhancement - bringing to a higher level by removing undesirables,

*seedlot - a homogeneous mass of seeds, and

*quality - a level of purity.

With these terms defined, we can now interpret the enhancement of seedlot quality, or seed conditioning as "removing everything in the pile of seeds that shouldn't be there." That can include removing inert material, common weed seeds, noxious weed seeds and other crop seeds, which are all considered contaminants. It also includes the upgrading process by removal of as much as possible of the deteriorated seeds, other variety seeds, damaged seeds and off-sized seeds. The removal of these contaminants, as well as the upgrading process, produces a seed that, after treating, bagging, and testing becomes a high quality marketable product. The removal of undesirables in a seedlot is accomplished because the impurities are in some way physically different from the desired seeds. The most common physical differences used in seed separations include:

*size - overall size as well as length, width or thickness,

*weight - density and surface area in relation to size,

*surface texture, and

*shape.

Most machines that are used to clean seeds make a separation based on one of these differences. The air-screen cleaner, in contrast, makes separations based on several physical differences including overall size, width and thickness as well as weight in

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relation to surface area. Because a very high percentage of impurities can be removed by the air-screen cleaner, this type of machine has become the primary and most used piece of seed conditioning equipment.

The air-screen cleaner is really two machines in one -- the air portion and the screen portion. The screens make the size, width and thickness separations and also make some degree of shape and length separations. The latter separations can be accomplished to a degree if the level of contamination is low by making specific adjustments to the cleaner. However, they are better made by using equipment more specific to that purpose. Round hole screens make an overall size separation as well as a width separation and are most normally used as top or scalper screens. Slotted or oblong screens make a separation based on seed thickness and are mainly used as bottom or sifting screens. When conditioning very small seeds, wire mesh screens are used: square screens for width separations and rectangular screens for thickness separations. Triangular perforations are used to remove triangular-shaped impurities and are used as a sifting screen. By combining two or three different perforation types on one screen deck, several types of separations can be made while the seeds are traveling over one screen.

The air portion of the air-screen machine removes impurities by differences in weight and surface area. This is probably the oldest type of seed cleaning, dating back to the winnowing done in Biblical times. Since a large suction will remove almost all impurities (including a large amount of good seeds), the air separation has become the most misused part of the seed conditioning system. Air should be set to remove light impurities to a point where a few good seeds are removed as well. From that point, screens and other equipment should be allowed to finish the job.

Air-screen cleaners used for precision seed cleaning should have a minimum of two air separations: one as the seeds are metered to the screens and the second as the finished product leaves the bottom sifting screen. This allows for the most precision separation with a minimum of seed loss.

Since we are dealing with large volumes of air, a ducting system must be used to remove the air and the impurities that it contains. Obstructions will decrease the quality of the separation. Therefore when designing air ducting, care should be taken to maintain correct pipe diameters and to use a dust collector which is appropriately matched to the cleaner. Care should also be taken to avoid sharp corners and long runs of ducting from cleaner to collector. Under no circumstances should more than one cleaner be connected to a single collector.

The hopper on an air-screen cleaner is an integral part of the cleaner because it governs the flow rate through the machine. Other purposes of the hopper include maintaining a consistent flow through the top air separation and providing for an even distribution across the entire screen width. Hoppers should be chosen to avoid seed damage as well as for easy clean out. Most hoppers can be adjusted mechanically to start or stop the seed flow and a variable gate to adjust the rate of flow. In addition, a variable speed control on the feed roll can give more accurate flow changes for some seeds.

Variable screen pitch is a feature which can help the operator perform more precise and efficient seed cleaning. Steep screen pitch can increase cleaner capacity, decrease separation opportunities (especially on scalping screens), and increase ball action if ball tray screen cleaning is used. Flatter pitch (more often on sifting screens) can increase the separation opportunities and, therefore, increase the precision.

Shoe shake speed, like screen pitch, will also increase the capacity and ball action as the speed increases. Separation opportunities will increase with speed. However, a very high speed may cause the seeds to bounce on the screens too much and, thus, diminish these opportunities. The best range of speeds for a clipper would be 410 to 425 RPM.

Screen cleaning is an important aspect of the air-screen cleaner. Without some sort of screen cleaning, screen blinding will occur, causing decreased capacity and precision. This is due to less open area on a blinded screen as well as increased down time to manually clean the screens. Brushes have been the standard method of screen cleaning for the industry until the past few years. Brushes did a fair job but could not dislodge tightly wedged seeds from the perforations. To alleviate this problem, ball trays have become more widely used in recent years because, in most cases, the positive forces keep the screens cleaner. Tappers and corn rollers have also been used to clean screens in specific situations.

Seed flow patterns through the cleaner may or may not be easily changed within existing cleaners. Small farm model cleaners may only have one scalp and one sift screen while larger production cleaners may have the seeds exposed to two or three scalpers and an equal number of sifters as well. In addition, some larger machines allow for the seed flow to be split to two or more identical shoes giving higher capacity, particularly for crops where separation may not be difficult. The type of seed flow pattern selected is influenced by the amount of precision needed, types of impurities and the desired capacity of the machine.

The parts of the air-screen cleaners that have been discussed may or may not be available for every model or brand of cleaners and

adjustments for those parts will vary from machine to machine. Operator's manuals and equipment representatives should be consulted to insure correct operation.

There is no one ultimate setting for the air-screen cleaner. Different seedlots present different problems and require different settings. An experienced cleaner/operator uses all the options and adjustments available to assure that the final product is high quality seeds.