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Effective and Efficient Air and Screen Cleaning

V. Harden

EFFECTIVE AND EFFICIENT AIR AND SCREEN CLEANING

Virgil Harden [1/]

Air/screen seed cleaners are the "heart" of any seed conditioning facility and are generally the first type of cleaning equipment to which the incoming seed is exposed. Proper cleaning by the air/screen unit is a must to enable other finishing types of equipment to make the separations for which they were designed.

Air/screen cleaners separate seed from contaminants by the use of fans (aspiration) and screens of perforated metal or wire cloth which are available in a wide range of sizes. Operation of the air/screen cleaner should be fully understood by the operator to enable him to make the best possible separations for the seed being cleaned.

Careful consideration must be given to selecting the proper location in the cleaning plant for the air/screen cleaner and its proper installation.

(1) All models should be securely fastened to a solid, level floor or foundation. The action of the shaker mechanism must be transmitted to the seed being cleaned, not the building or foundation.

(2) The air/screen cleaner should be positioned with the fan discharge openings facing an outside wall and as close to the outside wall as possible to allow for short runs of air ducting.

(3) Ample room should be allowed around the cleaner for the operator to make adjustments and service the machine.

(4) Spouting should not be installed in a position that will interfere with the controls or maintenance. Some parts must eventually be replaced, so allow room to pull all shafts and spouts.

The discussion below show assist the operator in understanding the different parts of the air/screen cleaner and the function of the different adjustments that are available to him for seed separations.

[1/] President, Harden Processing Equipment Sales, Inc., Memphis, Tennesseed.

By comparing Figure 1, "Illustrated Nomenclature", and Figure 2, "Commodity Flow", the operator can best understand the different parts of a typical air/screen cleaner and how separations are effected as the seed passes through the unit from the feed intake to the clean seed discharge. The operator needs to know the types of separations made by the several components of the air/screen cleaner so that he can make the proper settings to obtain the best performance with his unit.

Fans

Precision air/screen seed cleaners are equipped with both top and bottom air separations which assist the screens in cleaning the seed mass.

The top air separation is made as the seed pass from the feed hopper to the top screen in the upper shoe. Air is pulled through the seed mass lifting light trash, stems, pods, straw, cockleburs and a portion of the broken seed or splits which are then dropped in the "settlings" chamber and discharged out the side of the cleaner by a spout or discharge auger. The top air should be set to pull as much of the light contaminants as possible. A proper setting would remove one or two good seed per double handfull of screenings which would let the operator know that he is getting the best possible air separation without losing an excessive amount of good seed.

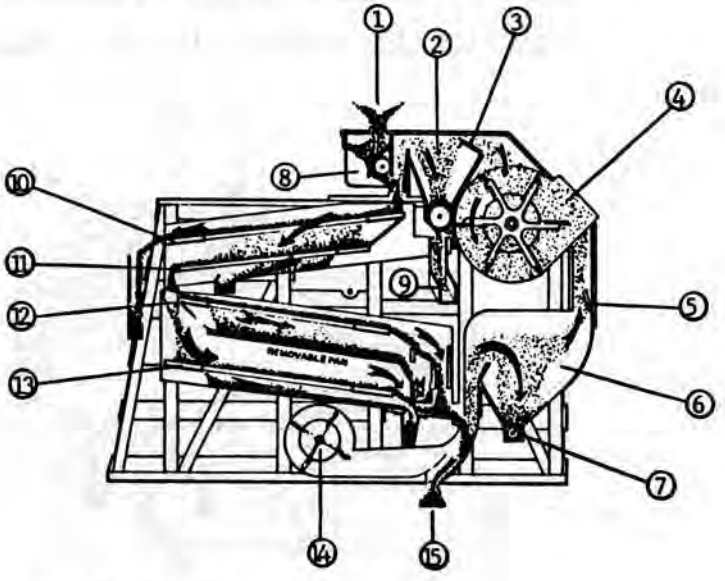
Bottom air separations are made after screen cleaning and just prior to seed discharge from the cleaner. The bottom air lifts any light trash that may be left in the seed commodity. In the cleaning of soybeans, a cleaner with a good bottom fan, properly adjusted, can remove almost all of the "slick" cockleburs that may be left in the seed mass after screen cleaning. As with the top air separation, a proper setting for the bottom fan should also pull out an occasional good seed. If the bottom fan works in conjunction with a top fan, the two fans must be balanced to ensure the most effective and efficient separation. The top fan should pull slightly more cubic feet of air per minute than the bottom fan and proper balance can be set usually with the use of the ribbon indicator.

The maximum effective capacity of any air/screen cleaner can only be achieved if both top and bottom fans remove as much of the contaminants and off-grades as possible thereby reducing the work load on the screens of the cleaner.

Handling of the Air

Improper air trunking installation from the cleaner and into the dust house or collector causes up to 90% of the difficulties associated with the air separations. Sharp turns, improper junctions, poor connections and poor collection equipment will all contribute to air deficiencies in an air/screen cleaner.

CLIPPER SUPER X2958-D & SUPER X5868-D
AIR SCREEN CLEANERS
Illustrated Nomenclature

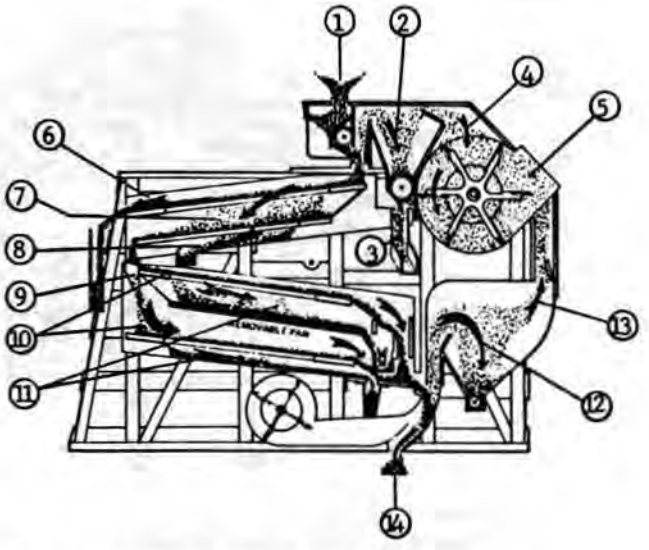


1. Feed Inlet
2. Top Air Settlings Chamber
3. Adjustable Top Air Valve
4. Top Suction Fan
5. Adjustable Back Air Valve
6. Bottom Air Settlings Chamber
7. Bottom Air Trash Discharge
8. Feed Hopper
9. Top Air Trash Discharge
10. Top Screen, Upper Shoe
11. Bottom Screen, Upper Shoe
12. Top Screen, Lower Shoe
13. Bottom Screen, Lower Shoe
14. Variable Bottom Blast Fan
15. Clean Seed Discharge

Figure 1. Nomenclature of typical 4-screen air/screen cleaner.

CLIPPER SUPER X2958-D & SUPER X5868-D
AIR SCREEN CLEANERS

Commodity Flow - Scalp, Sift, Sift, Sift



1. Seed Mass Inlet To Hopper
2. Top Air Heavies Settling Chamber
3. Top Air Side Discharge
4. Top Air Lights & Fines
5. Air Discharge To Cyclone Or Dust House
6. Scalpings Over Top Screen, Upper Shoe (Scalp)
7. Seed Mass & Fines Over Bottom Screen, Upper Shoe
8. Fines Through Bottom Screen, Upper Shoe (Sift)
9. Seed Mass Flow Divider
10. Seed Mass Over Top & Bottom Screens, Bottom Shoe
11. Fines Through Top & Bottom Screens, Bottom Shoe (Sift-Sift)
12. Bottom Air Heavies Settling Chamber
13. Bottom Air Lights & Fines To Top Fan & Cyclone
14. Cleaned Seed Mass Discharge

Figure 2. General flow of materials through a 4-screen air/screen cleaner.

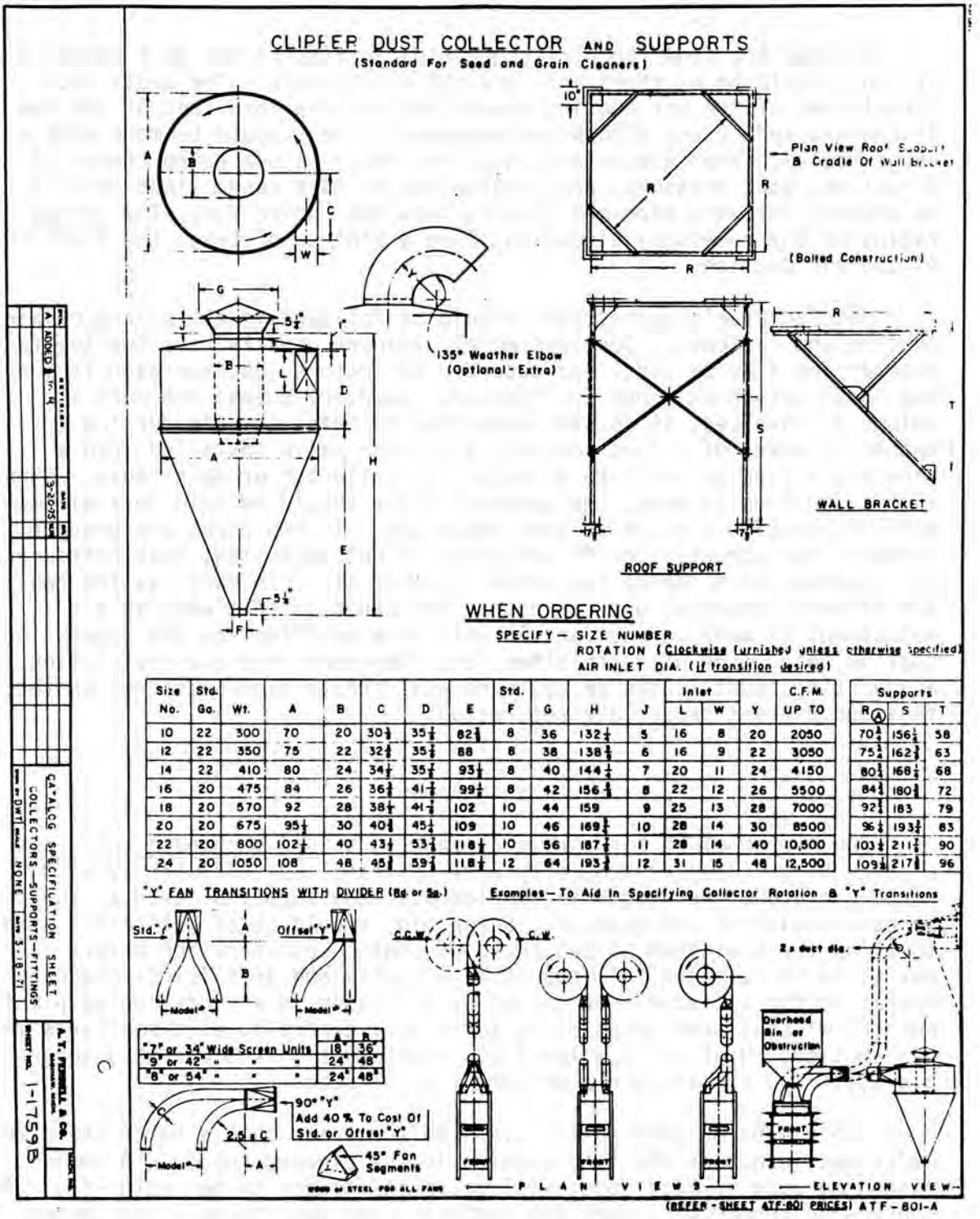
Air ducting from the air/screen cleaner fans to the dust house or cyclone should be as short and straight as possible. The cross sectional area of the air ducting should not be less than that of the fan discharges and if any elbows are necessary, they should be made with a large radius. When elbows are installed which have a sharp change of direction, back pressures are created and in most cases light chaff will be dropped into the pipe and finally plug the entire run. The inside radius of any necessary elbow should be a minimum of twice the diameter of the air ducting.

Manufacturer's suggestions should be followed in the sizing of air ducting and cyclones. Dustless model cleaners usually have two top fans discharging side by side, and separate collectors, one for each fan, are the ideal set-up as shown in Figure 3. However, unless too much air volume is involved, it is less expensive to bring the air ducting together by means of a junction with a divider valve installed into a single air pipe to run into a single air collector or dust house. When such a junction is made, the approach angle should be held to a minimum and the junction divider is very important. If the pipes are brought together too abruptly, or if a divider is not installed, back-pressures are created which impede the proper flow of air. In fact, as the two air streams converge, one can oppose the other so that when an air adjustment is made on one fan, it will have an effect on the separation that is being made with the other fan. Remember that any restriction in air ducting, dust houses or cyclones will create back-pressures on the fans and prevent proper air separation.

Feed Hopper

The hopper of an air/screen cleaner is a feed mechanism only, not a surge bin. Cleaners generally work best and most efficiently with a surge bin above the hopper to provide a steady supply of seed to the hopper portion of the cleaner. Surge bins should be of sufficient size to allow for a minimum of two hours of continuous operation before having to be refilled. All too often a costly and inefficient cleaning operation for a seedsman is caused by a cleaner in a conditioning plant running without seed because the surge bin, generally of a smaller size, has emptied. High and low level bin indicators in the overhead surge bin will help to maintain a uniform flow of seed.

The discharge gate in the overhead surge bin should be of the same width and length as the feed opening in the cleaner hopper. A small discharge gate or feed spout will cause the hopper to be center-fed. A center-fed hopper will feed the incoming seed mass to only the center portion of the top (scalping) screen causing the cleaner to "lose" almost one-third of its available perforated screen area. Efficiency is accordingly lessened as the capacity of the screening portion of the cleaner is only about two-thirds of the cleaner's capability. A center-fed hopper will also decrease the efficiency of the top air separation as the air flow will tend to pass around the seed mass, not through it.



Size No.	Std. Ga.	Wt.	A	B	C	D	E	Std. F	G	H	J	Inlet L	Inlet W	Y	C.F.M. UP TO
10	22	300	70	20	30⅜	35⅛	82⅜	8	36	132¼	5	16	8	20	2050
12	22	350	75	22	32⅜	35⅞	88	8	38	138½	6	16	9	22	3050
14	22	410	80	24	34⅜	35⅞	93⅛	8	40	144¼	7	20	11	24	4150
16	20	475	84	26	36⅛	41⅞	99⅛	8	42	156⅜	8	22	12	26	5500
18	20	570	92	28	38⅛	41⅞	102	10	44	159	9	25	13	28	7000
20	20	675	95½	30	40⅜	45⅛	109	10	46	169⅛	10	28	14	30	8500
22	20	800	102⅛	40	43⅛	53⅞	118⅛	10	56	187⅞	11	28	14	40	10,500
24	20	1050	108	48	45⅜	59⅞	118⅛	12	64	193⅜	12	31	15	48	12,500

Supports R (A)	S	T
70¼	156½	58
75¼	162⅜	63
80½	168½	68
84½	180½	72
92½	183	79
96⅛	193½	83
103½	211⅞	90
109½	217⅜	96

	A	B
"7" or 34" Wide Screen Units	18"	36"
"9" or 42" " " "	24"	48"
"8" or 54" " " "	24"	48"

Figure 3. Recommendations on ducting and dust collection.

Specially built hoppers are available if only one type of seed is to be cleaned on the air/screen cleaner, i.e., corn hopper, cotton seed hopper. Brush, roll-reed and variable speed hoppers are generally best when several types of seeds such as soybeans, wheat and rice are to be cleaned.

Seed Flow Over Screens

The most common seed flow over precision air/screen cleaners having four screens is the SCALP-SIFT, SCALP-SIFT system as in Figure 4, which shows a typical seed soybean cleaning setup. However, some precision air/screen cleaners are equipped with multiple seed flow options. For example, a four-screen cleaner could have additional flow options of SCALP-SCALP, SCALP-SIFT or SCALP-SIFT, SIFT-SIFT.

Three scalping screens might be used if the seed mass to be cleaned is heavily laden with or consists mostly of large foreign materials requiring multiple scalpings with perforations of different sizes and contains only a small portion of brokens, weed seeds and sand. Some seed sizing can also be accomplished by the use of the SCALP-SCALP, SCALP-SIFT plan.

Two scalping screens and two sifting screens are used when the seed mass to be cleaned has about an even mixture of large and small contaminants.

One scalping screen and three sifting screens might be the operator's choice when the larger portion of the foreign materials is smaller than the good seed and has to be sifted from the seed mass. Many lots of seed beans and seed grains fall into this category.

Screen Selection

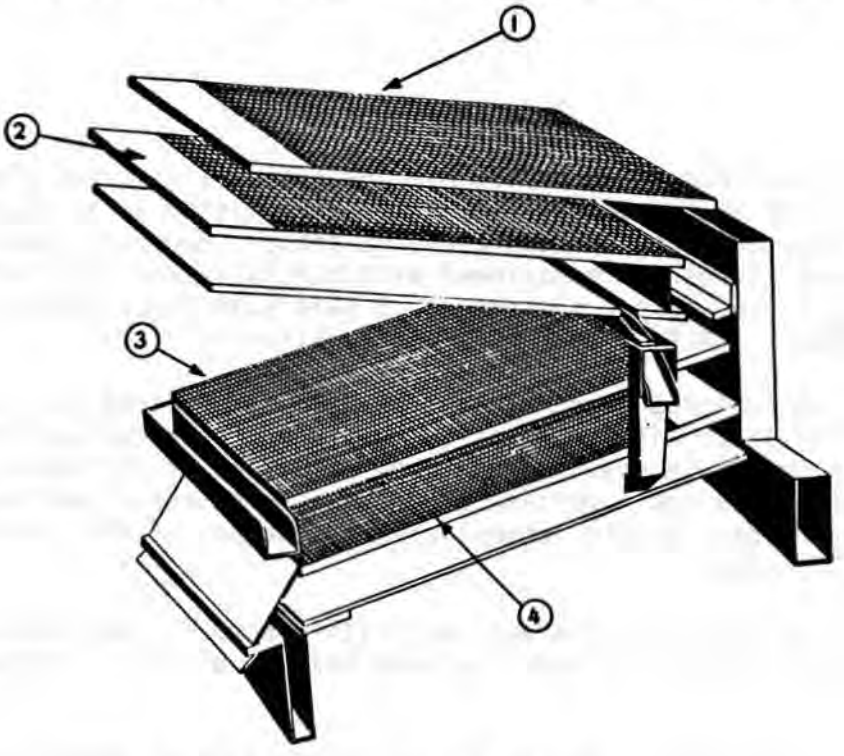
Over two-hundred different screen sizes are available to the seedsman for selection of the proper screen openings to meet his particular needs (Figure 5). Perforated metal sheets are offered in oblong (slot), round, oblong cross (cross slot), and triangle shapes. Wire cloth sheets have both square and oblong openings.

When selecting screens for any kind of seed or grain cleaning, it is always necessary to take into consideration the condition of the commodity and the foreign material mixed with it. Frequently it is necessary to use screens that will remove a small percentage of the good seed with the foreign material in order to make the product marketable.

It is advisable to have an office tester and an assortment of hand testing screens available. By testing a small amount of seed prior to conditioning, the operator can determine in advance the best perforation

FOUR SCREEN CLEANING

TOP SHOE: Scalp-Sift BOTTOM SHOE: Scalp-Sift



1. Top Screen, Upper Shoe
2. Bottom Screen, Upper Shoe
3. Top Screen, Lower Shoe
4. Bottom Screen, Lower Shoe

TYPICAL SOYBEAN CLEANING RECOMMENDATIONS

Shakershaft Speed - 405 to 420 RPM

Screen Location		Screen Pitch
1	22 Scalps off pods and trash.	Steep
2	12 Drops morning glories, pigweed, and other small weed seed.	Flat
3	19 or 20 for very close screening.	Medium
4	10 x 3/4 drops cleaned splits since the weed seed have already been dropped by the 12 round screen in the upper shoe.	Flat

Figure 4. Common pattern of seed flow over screens in a 4-screen air/screen cleaner.

screen sizes

CLIPPER SCREEN SIZES

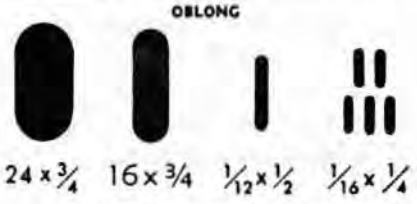
PERFORATED METAL SHEET									WIRE CLOTH			
ROUND HOLES			OBLONG HOLES		TRI-ANGLES	OBLONG CROSS SLOT	ROUND HOLE HALF SIZES	OBLONG HALF SIZES	SQUARE OPENINGS	OBLONG OPENINGS		
Fractions	64ths		Fractions	64ths	64ths	THESE SIZES STOCKED ONLY IN 36" x 53¼" SHEETS						
	6	24	1/24x½	4¾x¾	5		5½	7½x¾	3x3	2x7	4x8½	6x14
1/25	7	25	1/22x½	5x¾			6½	8½x¾	5x5	2x8	4x15	6x15
1/24	8	26	3/64x5/16	5½x¾	9	8x¾	7½	9½x¾	7x7	2x9	4x16	6x16
1/23	9	27	1/20x½	6x¾	10	9x¾	7½	10½x¾	8x8	2x10	4x18	6x18
1/22	10	28	1/18x¼	6½x¾	11	10x¾	8½	11½x¾	9x9	2x11	4x19	6x19
1/21	11	29	1/18x½	7x¾	12	11x¾	9½	12½x¾	10x10	2x12	4x20	6x20
1/20	12	30	1/18x¾	8x¾		12x¾	10½	13½x¾	12x12	3x14 Sp.	4x 21	6x21
1/19	13	31	1/16x¼	9x¾	Double Triangle	13x¾	11½	14½x¾	14x14	3x16	4x22	6x22
1/18	14	32	1/16x½	10x¾			12½		15x15	3x16 Sp.	4x24	6x23
1/17	15	34	1/15x½	11x¾	10		13½		16x16	3x17 Sp.	4x26	6x24
1/16	16	36	1/14x¼	12x¾	11		14½		17x17	3x21	4x28	6x25
1/15	17	38	1/14x½	13x¾			15½		18x18		4x30	6x26
1/14	18	40	1/13x½	14x¾			16½		20x20		4x32	6x28
1/13	19	42	1/12x½	15x¾			17½		22x22		4x34	6x30
1/12	20	44		16x¾			18½		24x24		4x36	6x32
	21	48	1/22x½ Diag.	17x¾			19½		26x26			6x34
	22	56		18x¾			20½		28x28			6x36
	23			19x¾			21½		30x30			6x38
				20x¾			22½		32x32			6x40
				21x¾					34x34			6x42
				22x¾					36x36			6x50
				24x¾					38x38			6x60
									40x40			18x20
									45x45			20x22
									50x50			
									60x60			

In order to complete our service to you, Ferrell-Ross offers over 200 different size screens in the above listing.

A Few Typical Styles and Screen Perforation Sizes. See Above List for Larger, Smaller, and Intermediate Sizes.
(Notice: Openings illustrated are not scaled to exact size)

"Clipper" perforated and wire cloth screens are the *best* seed cleaning screens you can buy. Tolerance differences are kept to minimum and the design of each opening is exactly right to make a precision separation.

"Clipper" wire cloth screens are electroplated after weaving with a non-corrosive metal to give the best possible rust protection as well as strong resistance against normal wear.



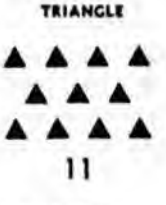


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Figure 5. Screen perforation sizes and shapes available for air/screen cleaners.

sizes or meshes to use, just what separations can be made with the screens, and what foreign materials will need to be removed by air. One can also determine what benefit, if any, would be derived from re-running any part of the stock which cannot be improved by a change in setting in the original run.

In general, the openings of the upper (scalping) screen should be small enough to just allow the seed being conditioned to pass through while retaining all larger material. The openings of the lower (sifting) screen should be of the largest perforation or mesh that will hold up the seed product, yet, sift out the broken and immature kernels, sand and small weed seeds.

Picture the screens in an air/screen cleaner as being vibrating conveyors! The seed or foreign materials move down the screen until they encounter a perforation large enough to drop through, or if they do not, continue to the end of the screen where they are discharged. The smaller the particle in relation to the perforation size, the nearer the feed end of the screen it will pass through, whereas the larger the particle is the nearer the discharge end of the screen it will pass through if it is not larger than the perforation.

The action and flow of the seed mass as it travels down the screen can be regulated by the use of "variable shoe shake" and "adjustable pitch".

Variable Shoe Shake

The variable shoe shake controls the action of the seed as they travel down the screens with the speed of the shake determining the amount of turbulence imparted to the seed mass. There must be enough turbulence to enable smaller particles to find their way to the bottom layer so that they can then pass through the screen openings. Turbulent action is desirable in both the scalping and sifting portion of the cleaner, but is most important in the sifting section.

Air/screen cleaners having the variable shoe shake feature permits the operator to select from a wide, continuous range adjustment of screen movement from 300 to 450 vibrations per minute to impart the proper amount of turbulence to different kinds of seed for best conditioning results. For instance, fast shake is needed to make grass seed flow over wire screens, but a slower shake insures best sifting of weed seeds from evenly shaped, smooth flowing seeds and grains.

Adjustable Pitch Screens

Screen pitch determines the speed of seed mass flow over the screens. Because of the multiplicity of seed sizes and shapes as well as the per-

centages, sizes and shapes of foreign materials, precision air/screen cleaners with adjustable pitch screens allow the operator to select the best screen pitch for the seed lot he is conditioning.

As is evident in Figure 6, the steeper the pitch the less contact the seed mass will have with the screen during its travel from the feed end of the screen to the discharge end. A steep pitch is generally used on a scalping screen to "walk" larger trash to the discharge before it can turn up on end and pass through the perforations. An example would be straw, sticks, stems and pods "walking" over the screen with soybean seed passing through the perforations. As the scalping portion of the screen cleaning operation is faster than sifting, good seed usually pass through the perforations by the time they have traveled approximately one-third to half-way down the screen.

The use of canvas aprons will help to keep straw, sticks and stems laying flat on top of the scalping screen so they will not have a tendency to turn up on end and pass through the perforations (Figure 7). Or, an operator may want to "blank off" the lower portion of the scalping screen in some cases by using unperforated metal sheeting (i.e., blanks). The "blanking" method generally causes some loss of good seed over the screen.

The flatter the pitch the more contact the commodity will have with the screen during its travel from the feed end of the screen to the discharge. Medium to flat pitch is generally used on the sifting screen to be sure small foreign particles come into contact with the screen a sufficient number of times to find a perforation opening and drop to the sand pan under the sifting screen. The sifting operations in air/screen cleaning determine capacity and the flatter the pitch of the sifting screens the lower the capacity. Therefore, the operator should adjust the pitch of the sifting screen just flat enough to make the desirable separation. Do not use the flattest pitch available when a medium pitch setting will do the job if you're interested in good capacity as well as good cleaning.

Screen Blinding

Screen blinding is another major cause of poor cleaning with an air/screen cleaner. Screen blinding generally occurs on the sifting screens as small immature seeds and broken kernels that are close to the same size as the screen openings become lodged in them. Naturally, if the perforations in the screen are blocked or blinded by foreign materials, the sifting screens cannot perform their task. Therefore, the operator should make sure that the screen cleaning brushes are properly adjusted with sufficient pressure so that the bristles just touch the bottom of the screen. The brushes should not be adjusted to a pressure that makes the bristles bend over.

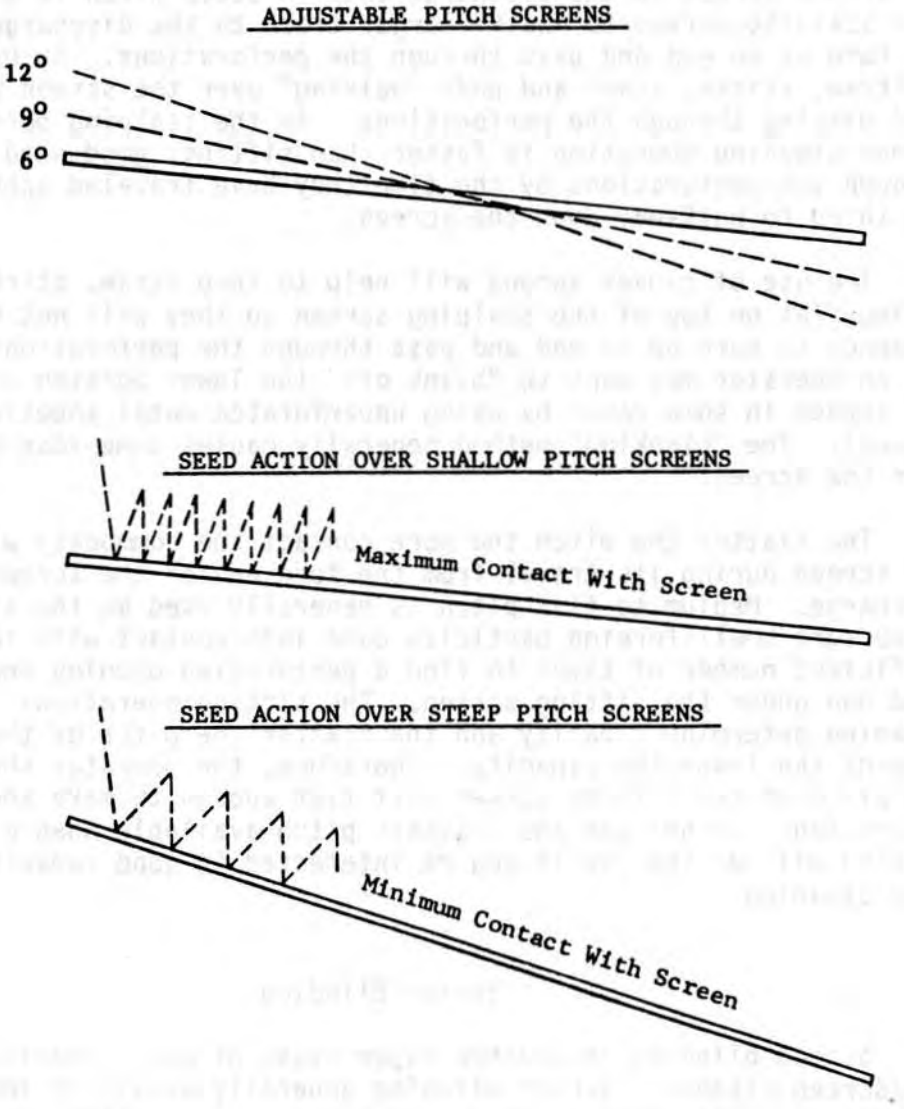

Figure 6. Effect of screen pitch on seed action over screens.

The screens should be checked for blinding at least two or three times during the day. Sometimes the screens become so heavily blinded when cleaning that they need to be removed from the cleaner and hand-cleaned before resuming the cleaning operation.

Screen blinding can also cause problems with other pieces of finishing equipment in the seed plant. For example, if a seedsman is using a disc separator following the air/screen cleaner to remove peas and vetch from wheat and the screens in the air/screen cleaner are blinded, the pockets in the disc machine will pick up an excessive amount of the immature seeds and broken kernals still in the seed mass instead of the peas and vetch for which it is designed.

By taking periodic samples of screenings from the air/screen cleaner as well as from finishing equipment such as spirals, disc separators and gravity tables, the operator can determine if the screens have blinded. However, the best method would be to periodically stop the feed input to the air/screen cleaner and visually inspect the screens.

Screen Dams

Screen dams are thin pieces of wood or metal that are attached across the top of the screen to retard the sliding motion of the seed mass traveling down the screen (Figure 7). Dams cause the seed mass to be heavily sifted so that the small weed seeds and broken kernels will work their way to the bottom of the seed mass and through the perforations as expected.

Dams will generally permit running a heavier layer of seed on the sifting screen with the assurance that better separation and greater capacities will be obtained. They are also commonly used on the sifting screens of "fixed-pitch" machines when round shaped seeds are cleaned.

Counter-Balance

Most commercial air/screen cleaners are made with counter-balanced construction. That is, they are generally made with two shoes (which hold the screens) that shake in opposite directions during operation. Some of the cleaners obtaining this action use two eccentric shafts, one for each shoe. Should your cleaner be of this type and vibrate excessively or seem to lunge during operation, it could be that the machine is "out-of-time". Figure 8 shows that to correct the problem, one must align the keyways in the eccentric hubs opposite each other. If the top eccentric shaft keyway is up, the bottom eccentric shaft keyway must be down.

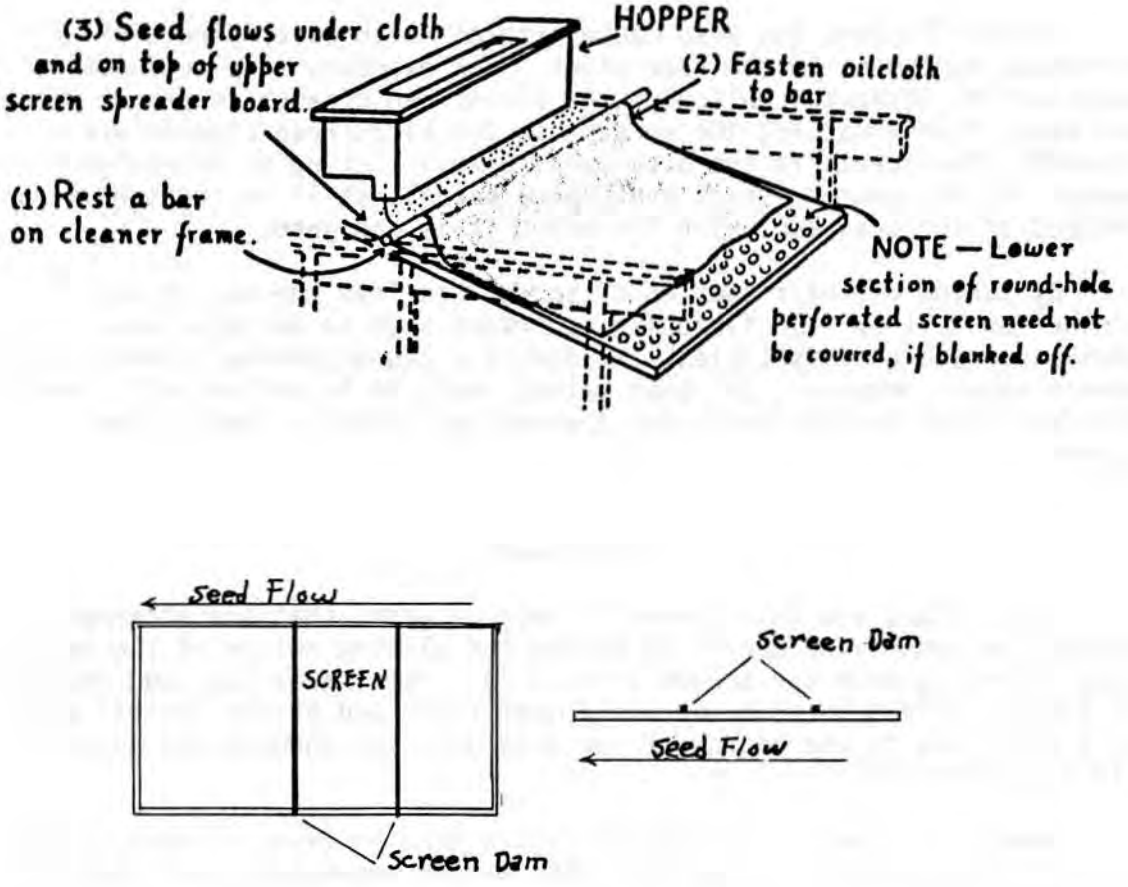

Figure 7. Top: canvas apron or oil cloth on top scalping screen; Bottom: screen dams to improve action of seeds on screens.

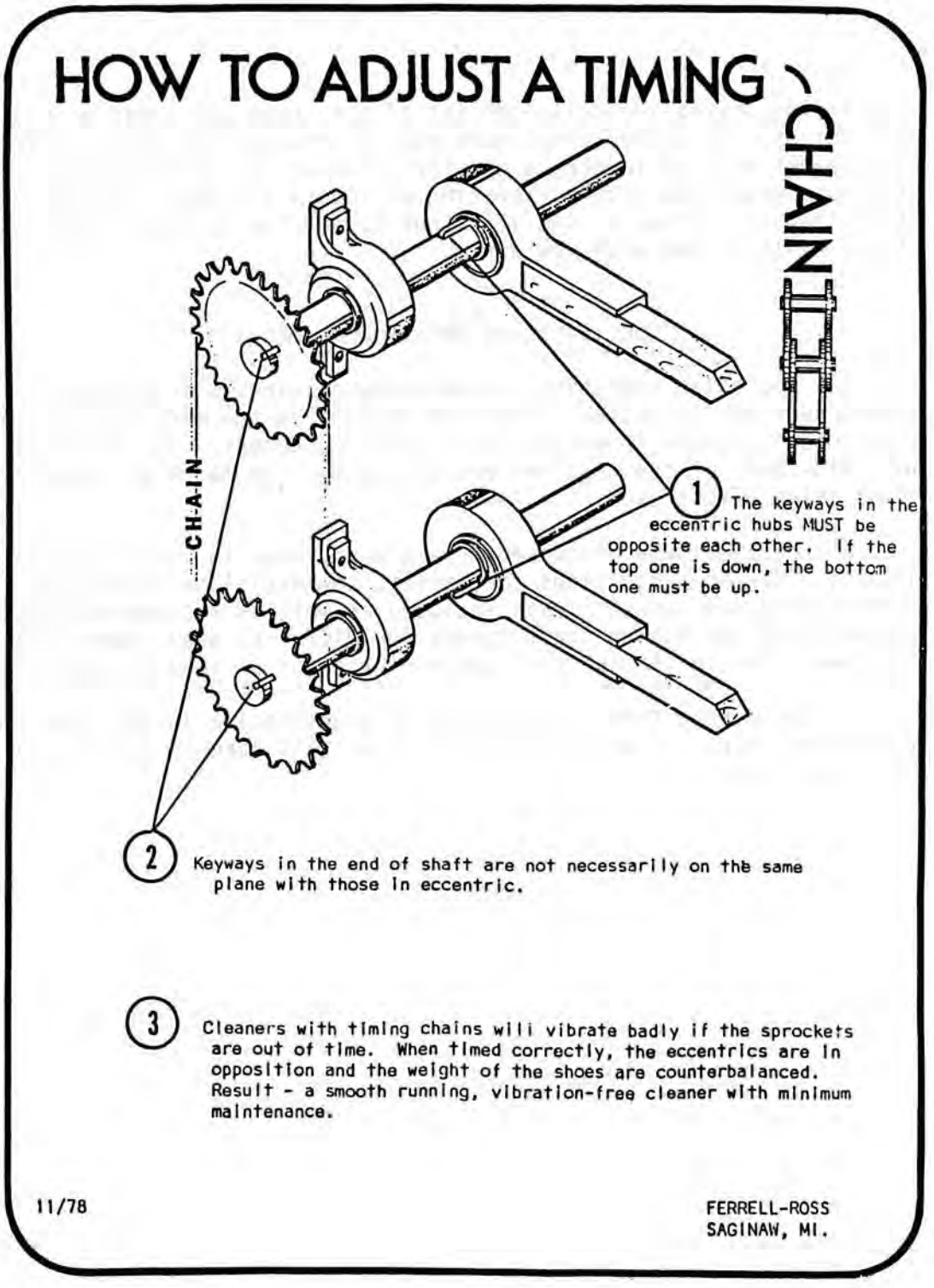

Figure 8. Adjustment of timing-chain on air/screen cleaner.

Timing drives generally consist of sprockets and chain or timing belt drives. If either slips more than a notch or two during operation, the cleaner will no longer be counter-balanced for smooth operation and will not impart the proper vibrating action to the seed mass for effective cleaning. Check to see if either type drive has excessive wear and if so, replace them with new parts.

Operation and Maintenance Manuals

All too often operation and maintenance manuals are thrown into a desk drawer and forgotten. They are printed by the manufacturers of air/screen cleaners to assist you - their customers - in the proper care and adjustment of the machines you purchase. The manuals, however, are of no value unless used.

All of the items discussed here are included in most operation manuals. Screen suggestions for market, commercial and precision seed conditioning are almost always included as well as recommendations on screen pitch and shaker shaft speeds for different seed commodities. Use them. They will make your job easier and your seed cleaner!

If you cannot find the solution to your problem in the operation or maintenance manuals, ask questions. We are all here to assist you. That's our job!