Reducing Grain Losses in Threshing

By I. P. Blauzer

The threshing machine is a highly efficient mechanism when carefully operated. Close attention to the manufacturer's instructions and skill in making adjustments will result in considerable saving of grain to the farmers of Illinois.
Suggestions for Efficient Threshing Machine Operation

1. Study carefully the manufacturer's literature and instructions and follow them closely.

2. Provide sufficient power to take care of overloads with slight variation in speed.

3. Set the machine level both sidewise and lengthwise. Test with a spirit level.

4. Run the cylinder at the rated r. p. m. Test with a speed counter.

5. Use just enough concaves to get the grain out of the heads. It is better to have two rows of concaves clear up than four rows part way down.

6. Replace all badly worn cylinder or concave teeth, and straighten all bent teeth.

7. Keep the cylinder and concave teeth centered.

8. Use enough wind in the cleaning shoe to keep the chaff floating.

9. Avoid tailing clean grain.

10. Keep the belts clean and tight.

11. Lubricate the machine properly.

12. Adjust the self-feeder to suit the rate of threshing and the condition of the grain.

13. Insist that the pitchers put the bundles on to the feeder heads first, keeping the feeder well filled at all times.

14. Remember that no machine can be expected to do its best work unless the grain is in good threshing condition.

15. Finish the job by cleaning up around the machine, but turn the blower away from the stack. A good job of threshing may be given a bad appearance by a green straw stack caused by the grain that is sure to go over when cleaning up.
Reducing Grain Losses in Threshing

By I. P. Blauzer, First Assistant in Farm Mechanics

Threshing the small grain crop is an important farm operation in Illinois, as may be realized by the fact that 30 percent of all the improved land in the state is devoted to small grains. This means an annual production of more than 200,000,000 bushels. According to tests made by the Department of Farm Mechanics of this Station, losses in threshing run as high as 4.05 percent for wheat and 10.28 percent for oats. The average efficiency of threshing machines was found to be 98.64 percent in tests made in representative sections of Illinois. On this basis there is an annual loss of more than 2,720,000 bushels of small grain to the farmers of the state and about $100,000 to threshermen.

It is reasonable to believe that losses of grain in threshing will increase rather than decrease, because of the rapid increase in the number of small threshing machines that are being driven by tractors suitable for two-bottom and three-bottom plows. Tests have shown that the small machines operate just as efficiently as the large machine under similar conditions. The operator of the small machine, however, is very often inexperienced. Also, the small machine is crowded more easily.

It is the purpose of this circular to analyze the causes of the common losses that occur in threshing, and to give some general suggestions for reducing these losses that will be applicable to any make of thresher.

Careful Operator Loses Less Than 1 Percent of Grain

A threshing machine has a great many moving parts. There is nothing mysterious about the function and operation of these parts, considered separately, but some study is required if the operator is to keep each of the different units properly adjusted and working in harmony with the other parts of the machine. Threshing machine manufacturers have designed and built their machines to make them as efficient as possible and to give a minimum of trouble. Each make of thresher, however, has characteristics of its own that are explained by specific instructions which the manufacturer sends with each machine. These instructions should be read by the experienced operator as well as the inexperienced operator, and then followed closely.

Altho it is hardly possible to save all the grain, even with most efficient operation and under ideal field conditions, the operator who understands thoroughly the functions of the different parts of the machine and watches them carefully while the machine is in operation can get
99.5 percent of the grain or even more. The careless operator not only will do a poor job of threshing, but will also cause considerable loss of time by having to stop for repairs and adjustments.

The following has been chosen as the standard for threshing machine operation:

- A loss of 0.5 percent or less, very good operation
- A loss of 0.5 to 1 percent, average operation
- A loss of 1 to 2 percent, poor operation
- A loss of 2 percent or more, very poor operation

Three Distinct Operations in Threshing

The threshing machine performs three distinct operations in threshing grain: (1) it removes the kernels of grain from the heads by means of the teeth of the cylinder and concaves; (2) it separates the loose grain from the straw by means of the straw rack and its related parts; and (3) it separates the clean grain from the chaff, dirt, and weed seeds by means of the cleaning shoe. Sometimes two other operations—feeding the grain to the cylinder and delivering the grain and the straw—are included with the three operations mentioned above, but here they are considered as functions of accessory parts.

Requirements for Efficient Threshing

If a threshing machine is to be operated at its highest efficiency, the following points must be given careful consideration:

1. The power unit must have sufficient reserve power to take care of overloads, and at the same time operate with slight speed variation in order to keep the machine running at its rated speed.

2. The threshing machine must be adjusted properly. Some of the more important adjustments are: setting the machine, regulating the cylinder speed; using the correct number and setting of concaves; adjusting the sieves both as to size of opening and position in the shoe; regulating the direction and intensity of the cleaning blast; and adjusting the tailings board.

3. The grain must be in good threshing condition.

4. The self-feeder must be kept well filled at all times but not beyond the capacity of the machine, and it is important that the bundles be pitched on to the feeder heads first.

Testing for Losses

Usual Method.—The operator's usual method of checking up on the loss of threshing machines is to catch some of the chaff from the cleaning shoe with the hand and estimate from the number of grains found in the chaff the amount of grain being blown over. To determine whether all the grain is being threshed out of the heads, straw is caught at the rear end of the straw rack and examined for unthreshed
heads. This method gives some idea of the amount of grain being lost, but a blanket test is necessary for an accurate determination.

Standard Blanket Test.—This test can easily be made by the thresher operator or the farmer. Straw is collected from the blower on a canvas, and a count kept of the number of dumps the weigher makes while the straw is being caught. After the straw is examined for unthreshed heads, it is pitched off, and the fine material run over a fanning mill to separate the grain from the chaff and fine straw.

Blanket Tests Show Some High Losses

The standard blanket test was made by this Department on 73 machines during 1924 and 1925. For these tests a canvas measuring 14 feet square, with 4-foot sidewalls, was used. Four iron stakes held the canvas in place. Fig. 1 shows the canvas set up, ready to receive the straw and chaff from the blower.

In 1924 the lost grain was recovered by using a fork to separate the straw from the grain and chaff, a small fanning mill being used to make the final separation. The grain left in the heads was not recovered by the above method.

For the tests made in 1925 a 16-by-20-inch double-cylinder thresher, shown in Fig. 2, was used to recover both the grain left in the heads and the loose grain. A 4-horsepower engine mounted on a light Ford truck furnished the power to drive the small thresher. The straw caught from the blower is being rethreshed in the small machine. The coarse straw was run thru the rethresher first, and the unthreshed grain recovered. Then the chaff was run thru and the loose grain recovered. The two determinations indicated whether the loss was due to unthreshed heads or to grain being carried over. However, consideration must be given to the fact that the blower fan threshes out some of the grain left in the heads.
The purpose of these tests was to determine not only the loss, but also the cause of the loss. When a machine was losing more than 1 percent for the first test, an adjustment was made and another test run to determine whether the loss had been reduced by the adjustment. If the adjustment did not reduce the loss, the operation was repeated until the cause of the loss was determined.

FIG. 2.—TESTING OUTFIT IN OPERATION

The coarse straw was separated with a fork and run thru first. This gave the amount of grain lost because of heads. The loose grain was then separated from the chaff and fine straw by running thru the tester the material that was left on the canvas after the coarse straw was removed. These two separate determinations aided in locating the cause of the loss.

On the 20 threshing machines tested in 1924 the average loss was found to be 0.95 percent. Eight of the machines were losing more than 1 percent. The loss was reduced on five of the eight machines; the loss of the other three was not reduced because of very damp grain in two cases and because of rain in the third case. Two other machines that were losing slightly less than 1 percent on the first test were adjusted and the losses reduced about one-half. The average loss for the 20 machines after adjustments were made was 0.68 percent.

In 1925, 23 of the 53 machines tested were losing more than 1 percent of the grain, and were therefore classified as poor in operation. The loss averaged 1.36 percent for the first test. After making adjustments on these 23 machines, the average loss was reduced to 0.7 percent, or approximately one-half that of the first test. Machines losing less than 1 percent were not adjusted. The average loss, no doubt, would have been lowered still further if all machines losing over 0.5 percent had been adjusted.

The losses for wheat in 1925 varied from 0.11 percent to 4.05 percent; the losses for oats from 0.05 percent to 10.28 percent; and for barley from 0.34 percent to 2.09 percent. The higher losses in 1925
Use Spirit Level to Set Machine

Threshing machines are built to operate efficiently when set level. This is a place where the operator should not guess but should use a spirit level for every setting. To do its best work, the machine must be level from side to side, and it is desirable to have it level lengthwise also, altho it may be a little out of level lengthwise without causing a great deal of trouble. If the machine is not level sidewise, the shafting will crowd to the low side, and the low side of the sieve will be overloaded with grain.

It is always well to take advantage of the wind when possible, setting the machine so that the wind blows diagonally from front to rear, taking the chaff and dust away from the men.

Correct Cylinder Speed Essential

Every machine has a definite speed at which it was designed to operate. This usually is stamped on the machine in terms of “r.p.m.” (revolutions per minute) of the cylinder. It is important that the cylinder be driven at the rated speed, for a small variation either way is likely to decrease greatly the efficiency of the entire machine.

The peripheral speed of cylinders is about 6,000 feet a minute regardless of their size; that is, the teeth are traveling at the rate of over a mile a minute. In order to have the same peripheral speed, the small cylinder will have to rotate faster than the large cylinder. The operator should not guess at the speed and call it good enough, but should use a speed counter, which is an inexpensive piece of equipment and the only accurate method of determining the r.p.m. of a rotating shaft. The ear may be trained to be fairly reliable in determining the speed, but that is the exception rather than the rule.

The unreliability of the ear test is illustrated by the following instance. A machine was found on test to be losing 2.26 percent of the grain. The speed of the cylinder was taken and found to be 150 r.p.m. below the rated speed. The operator was then asked if the cylinder was running at the rated speed. He replied that he didn’t care what the speed indicator showed, for he had been running a threshing machine for forty years and he could tell by his ear when his machine was operating at the proper speed for good threshing. Turkey Red wheat, which is very difficult to get out of the head, was being threshed at the time. Eight-tenths of one percent of the grain was being left in the heads, even after it had gone thru the blower.

Altho the operator was very much opposed to increasing the speed of the machine, he finally consented, and the speed was increased from 950 r.p.m. to 1,075 r.p.m., which was within 25 r.p.m. of the rated
speed. Another test was then made which gave a loss of 0.02 percent for grain left in the heads, and a total loss of 1 percent as compared with 2.26 percent for the first test at the lower speed. This meant a reduction of 1.26 percent in the loss of grain (or 1.26 bushels per hundred) resulting from increasing the speed 125 r. p. m. Had the operator consented to increase the speed further, making it 25 or 50 r. p. m. above the rated speed, the loss would have been reduced still more.

In another case in threshing oats the loss for the first test was 10.28 percent. The cylinder speed was 185 r. p. m. below the rated speed and the machine was being fed heavily. The oats that were recovered gave a higher test weight per bushel than those from the machine. The speed was increased 160 r. p. m., which brought it to 25 r. p. m. below the rate speed, and the feeding was lighter. Under these conditions the loss was reduced to 1.46 percent.

**Power Unit Should Be Large Enough for Overloads**

A power unit should be provided with sufficient capacity to take care of overloads for short periods, if the machine is to be kept running at the rated speed. Even tho the power unit has sufficient capacity, the cylinder must have the proper-sized pulley, and the engine must be running at its rated speed. To determine the proper-sized pulley, multiply the r. p. m. of the engine belt pulley by its diameter in inches, and divide by the rated r. p. m. of the cylinder. The result will be the diameter of the cylinder pulley in inches.

The drive belt should be wide enough to transmit the power from the power unit to the cylinder, for it is only the power delivered to the cylinder that is useful. The other parts of the machine receive their power from the cylinder, and will be driven at the correct speed if the cylinder is driven at rated speed and the belts are not slipping. Keep the pulleys in line so that the full width of the belt is in contact with them. Also keep the belt in good condition and tight enough to prevent slippage, but not so tight as to cause excessive friction and wear on the bearings.

**Belts Need Care**

*Leather Belts Work Best Fleshy Side Out.*—The outside of a leather belt stretches a little as it goes over a pulley; since the flesh side of the leather is more elastic than the grain side, or hair side, it should be placed out. This will bring the hair side next to the pulley, which is an advantage, since it is smoother and will cling closer to the pulley and transmit more power. When leather belts become dry and hard, they sometimes can be made soft and pliable again by a thorough cleaning and the application of neat’s foot oil or castor oil.

Mineral lubricating oil is injurious to all kinds of belting. Oil can be removed from a leather belt by scraping the belt as clean as pos-
sible and then packing it in dry sawdust for three or four days. Oil may be removed quickly by sponging the belt with gasoline or by dipping it in gasoline. If the belt seems too dry after the gasoline has evaporated, neat’s foot oil or castor oil may be applied sparingly. Water and soap may be used to remove oil from rubber belts without injury to them.

In case of rain, shut down and cover the whole machine with a canvas if possible; if not, at least remove the belts and put them in a dry place. It is a good plan to remove the belts every night, even tho rain is not expected. If leather belts are allowed to get wet, the glue will be dissolved and the joints will come apart.

Rubber Belts Should Be Run with Seam Side Out.—The seam side of a rubber belt should be away from the pulley. These belts will give better service and last longer if kept clean and free from all belt dressings. Oils, especially mineral oils, injure rubber and reduce the wearing qualities.

Canvas Belts Require Frequent Oiling.—To transmit their maximum power, canvas belts must be kept clean and pliable. This requires frequent application of a vegetable oil (castor oil or linseed oil) or a prepared belt dressing. Dressing that contains enough rosin to leave a sticky surface should not be used, for even tho the belt will stop slipping for a short time, the surface will soon become glazed and will be in a worse condition than before the dressing was applied.

Grain Threshed from Heads by Cylinder and Concaves

The function of the cylinder and concaves is to thresh the grain from the heads. This is accomplished by two processes, beating and rubbing. The beating process is performed by the cylinder teeth playing on the grain as it is fed into the cylinder, and just as it is ready to go between the cylinder and concave teeth. The beating process is controlled by the speed of the cylinder alone. Oats, when very dry, require little more than the beating process to thresh them.

The rubbing process, which is accomplished by the cylinder and concave teeth, is of great importance and is required for threshing most grains. There are a number of things that lower the effectiveness of the rubbing process: namely, number and position of concaves, end play of the cylinder, bent teeth, and loose teeth.

Use Just Enough Concaves to Thresh Clean

It is a good plan always to use just enough teeth in the concaves to thresh the grain clean from the heads, and to keep the concaves up close. If the straw is being cut up too much when four rows of concaves set close up are being used, it is better to take out one or two rows and keep the remaining rows close up than to lower the four rows. When the concaves are lowered, the clearance (Fig. 3C) between
the cylinder teeth and concave teeth is increased, and there is also a large space left at the end of the teeth thru which heads may pass untouched, while part of the straw is cut fine. When some of these un-threshed heads are threshed out by the blower, the loss of grain appears to be due to poor separation, but the real cause is improper concave adjustments. Also, part of the straw being chopped up fine overloads the chaffer and shoe and causes poor cleaning and waste.

The number of concaves to be used depends upon the kind and variety of grain, the condition of the grain, type of concave teeth, and the speed of the cylinder. That some varieties of wheat are more difficult to thresh than others is shown by a comparison of the following losses which occurred in two different varieties of wheat. The same machine with the same adjustments was used for both tests.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Number of concaves</th>
<th>Weight of grain threshed</th>
<th>Weight of grain recovered</th>
<th>Percent- age lost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>lbs.</td>
<td>oz.</td>
<td></td>
</tr>
<tr>
<td>Red Chaff</td>
<td>6 up</td>
<td>93</td>
<td>2.5</td>
<td>1.65</td>
</tr>
<tr>
<td>Turkey Red</td>
<td>6 up</td>
<td>93</td>
<td>13.5</td>
<td>2.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>22.5</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>27.5</td>
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<td></td>
<td></td>
<td></td>
<td>41.0</td>
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These figures show a difference of 1.02 percent in favor of the Red Chaff wheat, and they bring out the point that there is a difference in varieties of the same kind of grain.

When grain is damp, it is harder to thresh and will require more concaves or higher cylinder speed. Increasing the cylinder speed will have somewhat the same effect as using more concaves. However, the cylinder speed must not be raised very much above the rated speed or the other parts of the machine will be operated too fast.

Sometimes special corrugated concave teeth are used when the grain is especially difficult to get out of the heads. They increase the rubbing effect of the concave and cylinder teeth.

Most companies do not recommend putting a grate between two concaves, because the pieces of heads that are not threshed by the first two rows will go thru the grate into the grain pan, and then into the tailings auger. The rubbing action can be prolonged by placing a blank, or a concave from which the teeth have been removed, between the two concaves. Then the heads that are not threshed by the first concave will have a chance to be threshed by the next.

**Badly Worn, Bent, or Loose Teeth Cause Poor Work**

If the teeth become worn they should be replaced, as the rubbing action is greatly decreased by worn teeth. In replacing cylinder teeth, care should be taken to keep the cylinder in balance. This can
be done by replacing all the teeth at once or by replacing the same number on opposite sides of the cylinder. Running a cylinder out of balance tends to heat the bearing and flatten the shaft, and loosen the entire framework of the machine.

The teeth must be kept tight at all times. A loose tooth is easily detected by striking it with a hammer. If the teeth are permitted to run loose for any length of time, the holes will become worn and it will be impossible to keep the teeth tight after that.

**Concave and Cylinder Teeth Must Be Kept Centered**

Every machine has some means of centering the concave and cylinder teeth, so that there is the same amount of clearance on each side of the concave teeth (Fig. 3A). This adjustment is made by shifting the concave or cylinder to the right or left as the case demands. Fig. 3B shows unequal clearance, the result when the teeth are not centered.

Ordinarily the clearance between the cylinder and the concave teeth is \( \frac{1}{8} \) to \( \frac{3}{32} \) of an inch when the concaves are clear up. The clearance is increased between the cylinder and the concave teeth when the concaves are lowered, and the effective rubbing decreased. It is necessary for the cylinder to have a small amount of end play to prevent the bearings from heating. For plain Babbitt bearings \( \frac{1}{64} \) inch clearance is recommended, but less for roller or ball bearing.

Bent cylinder or concave teeth will have too little clearance on one side and too much clearance on the other side. The results will be unthreshed heads and cracked grain.
Of the 23 machines tested in 1925 that were losing over 1 percent of the grain, 9 had their losses reduced by concave adjustments. In some cases the concaves were raised, and in others more were put in.

**Bundles Should Be Fed Heads First**

By far the larger percentage of the threshing machines in Illinois are equipped with self-feeders. Many people have the mistaken idea that all that is necessary with this equipment is to get the bundles on the feeder, and that it will do the rest. While the self-feeder does remarkable work, it cannot turn the bundles end for end, nor take care of irregular feeding. It is important, therefore, that as many as possible of the bundles be so pitched on to the feeder that the heads will go into the cylinder first.

The bundles go into the cylinder at a relatively slow rate when compared to the rate at which the cylinder teeth travel, which is over a mile a minute. When the bundles are fed heads first, the cylinder teeth play upon the heads while they are increasing the speed of the bundle to somewhere near their own speed, and a considerable amount of the grain is threshed by the beating process of the cylinder. On the other hand, when the butts are fed first, the cylinder teeth play upon the butts, and by the time the heads reach the cylinder the heads have nearly the same speed as the cylinder teeth. This eliminates practically all of the beating action and reduces the rubbing action, thus lowering the efficiency of the cylinder and concaves.

The following two tests will show the difference in results when nearly all the bundles are pitched on to the feeder heads first, as in average feeding, and when all the bundles are fed with the butts first. The rate of feeding, as well as all adjustments, was exactly the same for both tests, which were made on the same machine.

| Variety of wheat | Manner of feeding | Grain threshed | Grain recovered | Percent-
<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>lbs.</td>
<td>oz.</td>
<td>oz.</td>
<td>oz.</td>
</tr>
<tr>
<td>Turkey Red</td>
<td>Heads first</td>
<td>93</td>
<td>1.5</td>
<td>8.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Turkey Red</td>
<td>Butts first</td>
<td>93</td>
<td>13.5</td>
<td>88.0</td>
<td>101.5</td>
</tr>
</tbody>
</table>

These figures show a very heavy loss due to feeding the bundles butts first. The large amount of loose grain recovered when feeding butts first is explained by the fact that it was loosened by the cylinder but was not threshed out until it reached the blower.

A bundle going into the cylinder crosswise not only makes it harder for the cylinder to thresh out the grain but also slugs the cylinder, which often causes an almost instantaneous drop in the speed.
of the cylinder of over 100 r. p. m., and has the same effect as very irregular feeding. When the feeder is fed from both sides, a divide board is effective in preventing the careless pitcher from putting the bundles in crosswise.

**Keep Self-Feeder Well Filled**

Best results are secured when the self-feeder is kept well filled at all times, but care must be taken to see that the machine is not fed beyond its capacity. The ideal way to feed a machine is to keep a steady, even stream of grain going into the cylinder by pitching the bundles heads first, with little or no space between bundles. In the larger machines, which are fed from both sides, it is desirable to have the two rows of bundles zig-zagged, so that the heads of both rows of bundles will not go in at the same time. This will not only even up the power consumption of the cylinder but will also keep an even blanket of straw on the straw racks.

**Uneven Feeding Lowers Efficiency of Machine**

Having the cylinder alternately overloaded and running empty, not only causes grain to be left in the heads, but also causes poor separation, poor cleaning and waste of grain. Poor separation of the grain from the straw, one of the evils of uneven feeding, is caused by the straw being delivered to the straw rack in bunches which do not have a chance to spread out sufficiently for good separation. At the same time the speed of the whole machine is decreased and the straw racks, besides being overloaded, are also under speed.

Uneven feeding probably causes the most trouble in the cleaning shoe. This is due to the fact that the wind blast of the cleaning fan is adjusted to take care of a certain quantity of chaff and grain. If the machine runs partly empty, the speed of the whole machine increases, causing a stronger blast. Under these conditions some good grain goes into the tailings and some into the windstacker. A further loss is incurred by some of the cleaned grain that is tailed being cracked when it is returned to the cylinder. On the other hand, when the machine is fed too heavy, the wind blast is cut down by the reduced speed, and also by the large quantity of grain and chaff, and poor cleaning results. It is almost impossible to adjust the wind blast of the cleaning shoe so that it will do good work when the machine is fed unevenly.

**Adjusting the Governors on a Self-Feeder**

All of the self-feeders used on recent models of threshing machines have at least one governor, and a large number of them have two, a speed governor and a straw or volume governor. The speed governor controls the starting and stopping of the entire feeder, its purpose being to prevent the self-feeder from operating until the cylinder speed
has reached good threshing speed. It should be adjusted to stop the feeder when the cylinder falls below good threshing speed, which is between 50 and 75 r. p. m. below rated speed. The speed governor does not control the speed of the feeder or even the feeder carrier, as the name indicates.

The straw, or volume, governor which is found on many self-feeders stops the feeder carrier when too much straw is going into the cylinder. The other parts of the machine keep on doing their work, and as soon as the volume of straw is reduced to normal by the cylinder, the carrier check is disengaged and the carrier starts moving again. The straw governor should be adjusted to suit the rate of threshing and the requirements of the grain.

Retarders of some kind or other are found in most machines just in front of the cylinder. Their function is to hold back the bottom part of the bundle, so that the top of the bundle will be fed into the cylinder first, in this way helping to even up the feeding. The retarder should be raised for damp grain and lowered for dry grain.

Straw Racks Should Be Driven at Rated Speed

The separation of the loose grain from the straw is the second function of the threshing machine. The chief parts involved are grate, beater, and straw rack. The separating part of the machine is always much wider than the cylinder, in order to make the blanket of straw on the straw racks thin enough for good separation, and at the same time handle the capacity of the cylinder.

About 90 percent of the grain is separated just back of the cylinder by the grate, and it is the function of the straw racks to separate the other 10 percent. The function of the beater, which is just back of the cylinder, is to check the speed of the straw and spread it over the full width of the straw racks.

The crank shaft driving the straw racks has a definite speed at which it should be driven. This speed should not vary more than a few revolutions either way.

It is a mistake to think that the faster the straw racks are run the better will be the separation, for the violent agitation resulting from the greater speed will keep the kernels thrown up on top of the blanket of straw and they will be carried over the straw racks into the blower and be lost. On the other hand, if the speed of the straw racks is too slow, the straw will not be agitated sufficiently to shake out the kernels, and loss will result. If the cylinder is running at the rated speed, the straw racks will be running at the rated speed also, provided the belt driving crank shaft of the straw rack is not slipping.

Quite frequently poor separation is caused by the use of too many concave teeth, which cut the straw up so fine that the straw racks cannot separate the fine straw from the grain.
Cleaning Shoe Makes Final Separation

The third function of the threshing machine is to separate the clean grain from the dirt, chaff, and weed seeds. This function is performed by the cleaning shoe, which is composed of sieves and a fan, and constitutes another important part of a threshing machine.

The cleaning shoe has a number of adjustments. Those controlling the direction and intensity of the wind blast from the cleaning fan, the size of openings in the sieve, and the position of the sieves in the shoe are the more important. The making of these adjustments probably requires more skill on the part of the operator, than is required for any other adjustment on the machine.

No set rules can be given that will apply to every case, because of the many different makes of machines and the ever-varying grain conditions. If, however, the operator knows the function of each part of the shoe, and how to make adjustments so that each individual part functions properly, he should have no trouble in cleaning the grain thoroughly, and saving practically all the grain at the same time.

The character and amount of the tailings returned to the cylinder are good indications of the quality of work being done by the cleaning shoe. There should be a very small amount of tailings, with very little plump grain or light chaff. It is a good plan to follow the manufacturer's instructions as closely as possible in regulating the air blast and arranging the sieves. Of course good judgment is required also, since the instructions are for average conditions.

Grain Pan Must Be Level Crosswise

The grain pan as well as the shoe must be level from side to side so that the grain will be evenly distributed the full width of the shoe. If the machine is properly set at the start, the grain pan and shoe will usually be level unless the machine settles unevenly, or the grain pan or shoe is out of level with the rest of the machine.

If the grain pan and shoe are not level, the low side of the shoe will be overloaded and the high side will be underloaded, causing grain to be both carried over and blown over.

Openings in Adjustable Sieves Easily Changed

Some machines have adjustable sieves and also adjustable chaffers. These are generally to be preferred because the size of the openings can be regulated without removing the sieves from the machine and can be adjusted while the machine is running.

As has been mentioned before, trouble experienced in cleaning the grain may be caused by using too many concaves, which cut the straw up so fine that it goes thru the straw racks and chaffer with the grain. When the grain goes over the sieve into the tailings, it is an indication that either the chaffer is open too far, permitting enough chaff to go
thru to clog the sieve, or the sieve openings are so small that not all the good grain can go thru the sieve.

A weed screen is often used in the bottom of the shoe to remove weed seeds. If the weed screen is to function properly, it must be watched carefully and kept clean.

**Cleaning Blast Needs Careful Watching**

The intensity and direction of the cleaning blast is controlled very easily by the wind boards and blinds. The blast must be strong enough to force its way thru the grain and chaff into all parts of the cleaning shoe, but not so strong as to blow the good grain over the tailings board or even into the tailings auger.

In adjusting the blinds at the ends of the cleaning fan, it is important to remember that the blinds on the left side control the blast on the right side of the shoe, and that the blind on the right side controls the blast on the left side, that is, there is a crossing over of the wind blast. Ordinarily the blinds should have the same setting on both sides, but sometimes with a strong cross wind blowing it will be necessary to change their setting to get best results. Since the heaviest load on the chaffer and shoe sieves occurs at the front end, where the grain and chaff are delivered from the grain pan, the blast should be so directed that as much of the chaff as possible is floated at that point. If the wind cannot break thru the material at that point, the blast will be that much stronger at the rear of the sieves, and much of the good grain still in the unbroken mass of chaff will be blown over the tailings board into the wind stacker. The amount of chaff going to the cleaning shoe has quite an effect on the blast: the greater the volume of chaff the greater is the retarding effect on the blast. This means that a stronger blast is required in the cleaning shoe for heavy feeding and a lighter blast for light feeding.

**Special Adjustment of the Sieves Sometimes Necessary**

Ordinarily the sieves are run level, but sometimes conditions make it desirable to set them a little off level in order to get better results. If the grain has been cut a little green, the hulls sometimes cling very tightly to the kernels, and finer sieve adjustment is necessary. But if the sieve opening is merely made smaller, the good grain will travel farther back on the sieve, and be tailed or blown over.

To get the finer sieve adjustment which will remove the white caps and not tail or blow over good grain, it is necessary to make the grain travel slightly up hill. This can be done by either raising the rear end or lowering the front end. It is better to lower the front end than to raise the rear end, which would obstruct the opening between the chaffer and the sieve.
GRAIN SEPARATOR TROUBLE CHART

I. THRESHING PROPER

1. Cylinder does not thresh grain from heads:
   a. Concaves too low.
      Raise concaves.
   b. Speed of cylinder too low.
      Run cylinder at rated speed.
   c. Old worn teeth in cylinder or concaves.
      Replace with new.
   d. Concave teeth not central with cylinder teeth.
      Adjust concave to center teeth.

2. Grain is cracked:
   a. Too much end play in cylinder.
      Adjust bearings to take up end play.
   b. Concaves set too high.
      Lower concaves.
   c. Too many rows of concaves.
      Remove one row and add blanks.
   d. Too much grain coming back thru tailings elevator.
      Adjust sieve and wind.
   e. Cylinder and concave teeth not central.
      Adjust concaves so that all cylinder teeth run centrally
      with concave teeth.
   f. Bent cylinder or concave teeth.
      Straighten or replace with new.
   g. Cylinder running at too high speed.
      Operate cylinder at rated speed.

II. SEPARATING GRAIN

1. Chaffer overloads:
   a. Too much straw going thru straw racks.
      (1) Take out one row of concave teeth.
      (2) Put two concaves together and run with blanks in
          the rear.
      (3) If straw is dry, drop concaves slightly.
      (4) Run cylinder at little lower speed.
   b. Grain pan is not running up to speed.
      Tighten belt. See that the whole machine is running up
      to speed.
   c. Not enough wind.
      (1) Open stop boards at the ends of the fan.
      (2) Tighten belt driving fan.
d. Wind blast not properly directed.
   (1) Set upper board so that the blast will strike the front end of the chaffer.
   (2) Set the lower board straight or level.

2. Grain pan clogs:
   a. Dirt or wet grain sticking on the grain pan.
      (1) Clean the pan thoroughly and smooth all rough spots.
      (2) Never let water stand in the grain pan.
   b. Too much straw going thru straw racks into grain pan.
      Take out one row of concave teeth.
   c. Machine too high behind.
      Dig rear wheels in until machine is level. Always run with the machine level.

3. Straw rack chokes:
   a. Straw rack not running up to speed.
      Tighten belts.
   b. Blower not taking the straw away fast enough.
      (1) Tighten blower belt.
      (2) See that the machine is level.
   c. Beater belt may be slipping.
      Tighten belt.
   d. Rear end of machine may be too high.
      See that machine is level.

III. CLEANING

1. Grain goes over adjustable sieve into tailings:
   a. Sieve set too close.
      Open until grain stops going over.
   b. Too much wind.
      Close stop boards at the end of the fan until grain stops going over.
   c. Rear end of adjustable sieve is too low.
      Raise one notch.

2. Grain goes over one side and does not clean:
   b. Blast of air uneven because stop boards are opened unevenly.
      Open stop boards so that the air flows freely and evenly into the fan housing from both ends.

3. Sieve lets straw thru:
   a. Sieve is open too wide.
      Close until straw ceases to come thru, but do not close enough to cause grain to go over.
   b. Back end of sieve too high. Lower rear end one notch.
IV. MISCELLANEOUS

1. Separator speed is irregular when engine is running steadily:
   a. Bundles not properly pitched into feeder.
      Pitch bundles with heads towards the cylinder, so that there are no spaces in between bundles. Do not pile bundles in the feeder.
   b. Drive belts slipping.
      Tighten.

2. Feeder fails to stop when cylinder falls below rated r. p. m.:
   a. Governor sticks.
      (1) Lubricate carefully.
      (2) See that belt wheel is free on shaft.
   b. Governor set for too low a speed.
      Set governor so that when the separator is not running at rated speed, feeder stops.

3. Feeder stops:
   a. Feeder clutch adjustments too loose.
      Tighten to proper adjustments.
   b. Separator below speed.
      Set to proper speed.
   c. Governor set for too high speed.
      Loosen to proper adjustment.

4. Cylinder wraps with straw:
   a. Tough damp straw.
      Lower grate and speed up the machine slightly.
   b. Straw rack running below speed.
      Tighten straw rack belts.
   c. Grate back of cylinder too high or rake running too slow.
      Lower grate slightly; tighten belt on rake drive.
   d. Too many concaves when threshing tough rye.
      Do not use more than two rows of concave teeth. Leave them low and speed cylinder to prevent wrapping.
   e. Worn teeth. Replace with new teeth.

5. Hot bearings:
   a. Lack of lubrication.
      (1) Fill all oilers and grease cups.
      (2) Use a good heavy oil such as heavy gas-engine oil, good grade of machine oil, or a light hard oil if compression cups are used.
      (3) Keep oil and grease free from dirt and grit.
   b. Lubrication does not flow to the bearings properly.
      (1) Remove bearing caps and clean oil grooves.
(2) If oil groove walls are square, scrape so that the oil can work around the shaft.

c. Lubricant may be too light, wasting from bearings.
   Use good grade of oil.

d. Bearings too tight.
   Loosen bearings; put in shims so that the bearing bolts may be tight on the shims and not bind the shaft. Do not loosen too much.

e. Belt too tight.
   Loosen belts, but be careful not to loosen too much.

6. **Knock in straw rack**:
   a. Crank bearings loose.
      Tighten and check often.
   b. Bolts loose on pitman and straw rack connection.
      Tighten bolts. Never operate machine with loose bolts.
   c. Slats may be loose, causing racks to shake to pieces.
      Tighten slats.

7. **Knock in grain pan**:
   a. Bolts loose in hanger brackets or in connecting rod blocks.
      Tighten all loose bolts and keep them tight.

8. **Belts run off the pulleys**:
   a. Belts too loose.
      Tighten with tightener or by cutting and relacing.
   b. Pulleys out of line.
      Loosen pulley and line centers.
   c. Machine not level.
      Check with a spirit level.
   d. Wind blowing across the main belt.
      Set the engine so that belt will have a tendency to run off on the opposite side of the pulleys, but will be kept centered by the action of the wind. As soon as the wind ceases, reset in line.
   e. Water on belts.
      (1) Stop for even a small shower.
      (2) Keep belts dry.
      (3) When wet, belts will slip and come off, and often-times tear to pieces. Time and money will be saved by caring for belts.

9. **Belts slipping but tight**:
   a. Belt too narrow. Use wider belt.
   b. Belt hard.
      Oil leather belts with castor oil or neat's foot oil. Never use a mineral oil on leather belts.