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Grinding Shearing Combs and Cutters

How to achieve the best results

By M. BUTLER, Sheep and Wool Instructor,
and D. A. YOUNG, Shearing Instructor

BEFORE a high standard of workmanship in sheep shearing may be achieved it is imperative that the shearing equipment be maintained at the highest peak of efficiency, but, unfortunately, this is not always the case. Chief among the faults that occur at shearing time is the inefficient grinding of the combs and cutters, the most essential parts of the shearing machinery. If the combs and cutters will not cut, the efficiency of the whole shearing plant is affected. Badly-ground tools increase the work of the shearer, considerably reducing his daily output of sheep, and are the main reason why sheep kick and strain while being shorn, which tends towards poor shearing generally.

Poor grinding is more often the result of a lack of understanding of the principles of grinding, as once a knowledge of the grinding machinery is acquired, the grinding of the tools becomes simplified, better grinding is achieved, and a large amount of the work involved in shearing is eliminated.

MAKING THE DISCS

The first job in connection with grinding is the preparation of the grinding discs. This calls for particular care to see that no foreign matter remains between the disc face and the emery cloth. The discs should be thoroughly cleaned by using a clean stiff brush (which should be kept for this purpose) and hot water to remove the old glue from the disc face, which is then allowed to dry by evaporation. This work is best done with the discs on a raised bench, face upwards, ready to take the emery cloth, the grades of which are, No. 40, or its equivalent for the comb disc and No. 80, or its equivalent for the cutter disc.

When the discs have thoroughly dried out, prepare the disc face by evenly painting on the glue and allow it to dry for five to ten minutes, while the emery cloth is prepared by painting the cloth side with glue.

When everything is in readiness, place the emery cloth face upwards on the disc exercising care that the overlap is distributed evenly around the edges, and carefully pat it onto the disc. When the paper has gripped firmly, tap out the washer cavity with a small ball-pene hammer, avoiding any damage to the spindle hole in the disc. The disc is now ready for clamping, which is done by placing the clamp on the disc, then holding both edges together with both hands. Turn the disc and clamp over and screw down tightly before putting it aside for setting, which takes from five to six hours.

When the glue has dried, and before releasing the clamp, trim the surplus emery from around the edge with a sharp knife.

Before assembling the disc on the grinder, it should be placed for ten minutes in the best drying place, care being taken to see that it is free from water or grease spots.

CLEANING THE COMBS AND CUTTERS

Before grinding, the combs and cutters should be washed, and dried with a cloth to avoid transferring grease or yolk to the disc face, taking care to see that the pin-holes are free of dirt. Any laxity in this regard will soon destroy the emery surface and bad grinding will result, also the emery cloth will need to be changed more frequently.

WHEN TOOLS NEED RE-GRINDING

When a comb has been used for some time, the cutting edges, particularly towards the points, become rounded. This dullness can be seen when the comb is held side-on in a good light, and appears as silveriness on the cutting edge of the teeth. Combs and cutters should be ground until this dullness completely disappears and is replaced by a keen sharp edge, but do not overgrind or overheat the tools.

CLEARANCE AND GRINDING GROOVES

Shearing combs have a groove across the face for the purpose of clearing the steel and emery particles ground from the lower part of the comb during the process of grinding. This is necessary to allow a new starting point for grinding the teeth of the comb and, in effect, the comb is ground in two separate sections in one operation. When the groove disappears as the comb wears, no clearing effect takes place and consequently the comb cannot be ground in a proper manner. The parts that are removed, or gulleted from the bottom of the comb are to reduce the lower grinding surface and balance the grinding areas above and below the "line of balance." If these parts were not gulleted out the comb would quickly grind away to the points.

THE LINE OF BALANCE

The "line of balance" (Fig. 1) is the line where the pendulum magnet exerts pressure on the comb when grinding takes place. This is governed by the position of

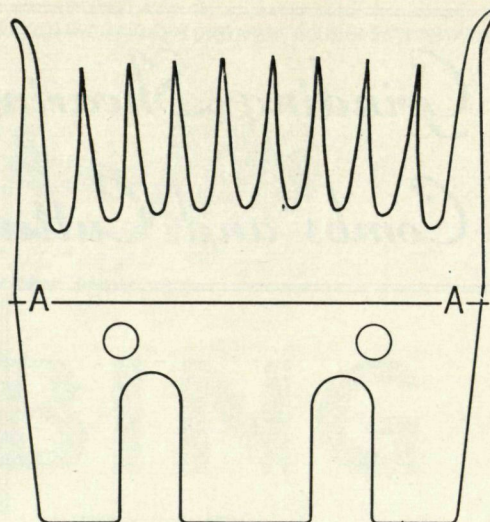


Fig 1.—The line of balance

the holding pins attached to the lower magnetic pole. These pins are so placed to allow the comb to grind slightly to the heel, which assists in protecting the points of the comb. With each successive grind, the comb will become more heel ground until the gullets in the comb start to grind out. As this occurs, the lower area will gradually increase, altering the balance of the comb, which will then grind more to the points and gradually revert to level. When the grind reaches the points the comb will have reached the limit of its usefulness and should be discarded.

THE GRINDING DISCS

The discs of the grinding machinery are slightly convex, and will grind a lengthwise concave, or hollow in the face of the comb. This hollow grind compensates for the pressure exerted on the comb, by the application of tension. When both comb and cutter are attached to the shearing handpiece and tension is applied to the cutter, the resultant pressure straightens the comb and allows the cutting surfaces of both comb and cutter to meet accurately along the full length of teeth.

GRINDER SPEED

The ideal speed at which the grinding discs should revolve is 2,500 r.p.m. This should, if possible, be checked with a revolution counter. Slower grinding speeds require heavier pressure when grinding,

which tend to overheat and burn the points of the tools, and could cause feathering of the cutting edges. When ordinary pressure is used with slow grinding speeds the tools will not be properly ground but only polished, and will not cut satisfactorily.

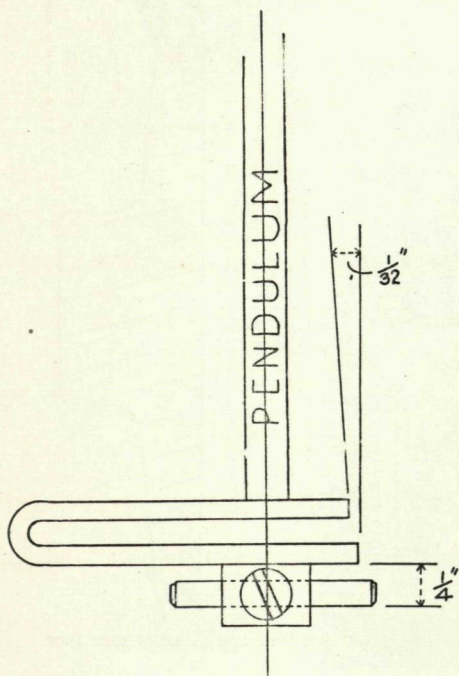


Fig. 2.—Magnetic holder

THE MAGNETIC HOLDER

Examination of the magnetic poles on the pendulum will reveal that the lower pole is slightly in advance of the top pole (see Fig. 2). The difference in the pole positions is to ensure that when a comb or cutter is placed on the magnetic holder for grinding, it will be drawn backward at the top, and the bottom of the comb, or cutter will strike the disc first, the comb leaving the top pole entirely as grinding commences. In this manner the points of the comb or cutter are protected from damage.

Further reference to Fig. 2 will show that the distance between the bottom of the lower pole of the magnet, to the bottom of the holding pins is $\frac{1}{4}$ in.

This enables the lower pole, the one through which the pressure is applied, to take over the comb, or cutter at the "line of balance," which allows them to be

ground correctly. It is most essential that the holding pins be accurately spaced from the lower magnetic pole, as any variation in the measurement, up or down, will seriously interfere with the grinding. Pins insufficiently spaced will exert the grinding pressure below the "line of balance" and difficulty will be experienced in making the grind reach the teeth of comb, while pins spaced over $\frac{1}{4}$ in. will have the opposite effect and grind the combs and cutters excessively at the teeth.

Magnets and holding pins are set by the manufacturers and should not be altered. If alteration has occurred, by filing one or other of the magnets, or bending the pendulum rod, etc., correct adjustment should be made before grinding takes place. It is also advisable to check the holding pins to make sure that the comb will move freely when placed on them for grinding. If the pins are found to fit too tightly in the pinholes the diameter of the pins should be reduced.

ADJUSTING THE PENDULUM

The pendulum is hung on that side of the disc that rotates upwards, with the magnet suspended midway between the

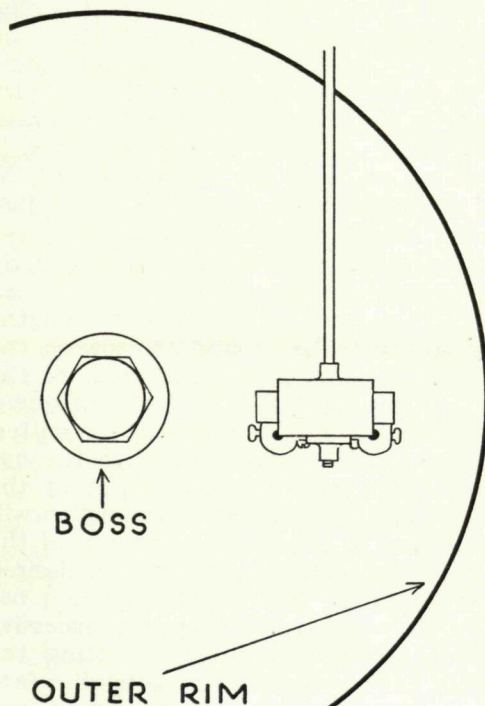


Fig. 3.—Correct pendulum adjustment

centre boss and the outer edge (see Fig. 3). When this position is found, adjust the magnet up or down by means of the thread

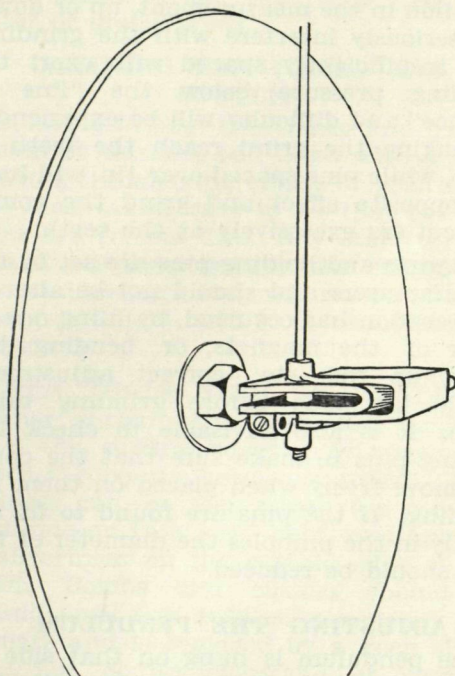


Fig. 4.—Correct height adjustment

on the pendulum rod, for height. The correct height will be indicated when the division between the magnetic poles coincides with the centre of the grinder spindle when the magnet is taken across. (see Fig. 4.) All that is now necessary, is to place a comb on the magnet and adjust the pendulum until the comb hangs just clear of the disc face. (Fig. 5.)

To explain the importance of correctly setting the pendulum, a magnet set too high will cause the depth of the lengthwise hollow to be ground too low in the comb face. This allows the teeth of the comb to spring too far with consequent loss of tension at the points of the cutter. A magnet set too low, will have the opposite effect, grinding the depth of the hollow too high, and excessive tension will be required to straighten the teeth of the comb sufficiently to achieve the desired effect, resulting in increased friction between the comb and cutter, and excessive heating of the handpiece. Setting the magnet to hang too far from the disc face will cause the lower edge only of the

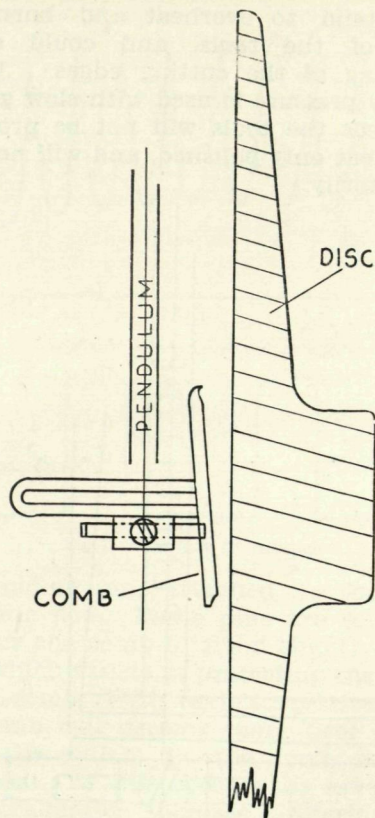


Fig. 5.—Comb hanging clear of disc face

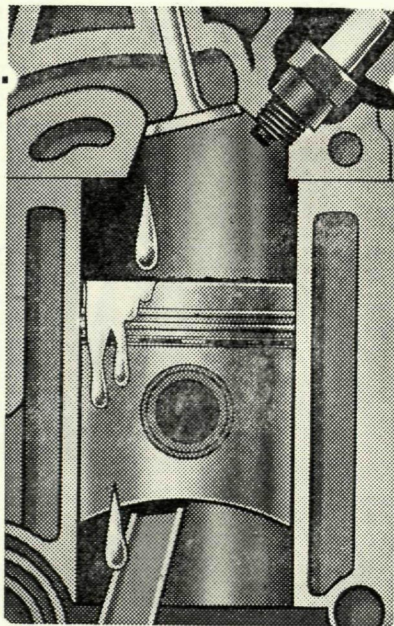
bottom magnetic pole to exert pressure on the combs and cutters, grinding them excessively towards the heel.

GRINDING THE COMBS

Grinding shearing combs requires a little practice to gain that confidence necessary for success, and is carried out in the following manner. Stand facing the disc, at a position which allows free use of the elbows, and placing a comb on the magnetic holder take it to about one inch distant from the disc. Then, using both hands, with a quick movement apply the comb squarely on the disc face, moving it from side to side, pendulum fashion across the emery for about six seconds, **NOT LONGER**. This movement across the disc grinds the old face off the comb, but does not sharpen it. Repeat this process until all of the old face of the comb has been ground off, and the "silveriness" disappears from the cutting edges of the teeth. When the comb has been sufficiently ground, which may be determined by



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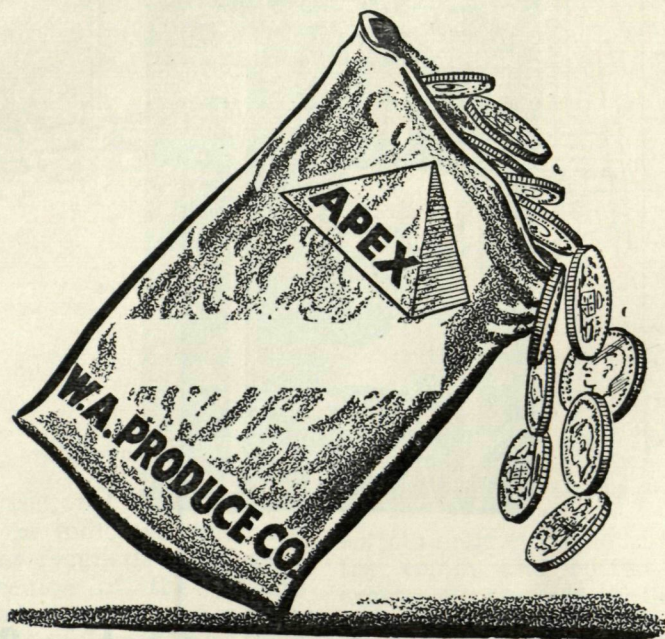
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holding it side-on in a good light, bring it to a position midway on the disc where the sparks leave straight up the teeth, and momentarily apply a slight extra pressure, observing that the sparks curl in towards the centre teeth of the comb. This movement will produce a good cutting edge and, at the same time, grind a hollow cross-wise in the centre of the comb, which minimises friction between the comb and cutter when in use.

The correct pressure to use can be determined by observing the height to which the sparks travel as they leave the disc. They should be made to reach just above the level of the top of the disc. The outer radius of the disc travels much faster than the inner radius, therefore, a compensating heavier pressure must be applied to the inner side of the magnet to ensure that the comb, or cutter grinds level. This pressure may be gauged by making the sparks from the inner side reach to the same height as they do on the outer side of the comb.

The free use of the arms is recommended when grinding, not the restricted use of the wrists only.

GRINDING CUTTERS

The cutters are ground on the fine emery (No. 80), and require much lighter pressure than the combs owing to the smaller area of steel presented to the face of the disc. Move the cutter across the disc the same as for the combs, but only for a few seconds, then momentarily hold the cutter stationary on the disc, where the sparks run straight up the teeth, then withdraw it. DO NOT exert a heavier pressure at the completion of the grind, as this practice will cause the cutting edges to become feathered, and possible danger of burning the points. Feathered edges will not cut cleanly but merely break the wool, while burning at the points will ruin the temper of the steel. The action of grinding the cutters should be the same for each cutter, so that even thickness is maintained for all the cutters during their useful life.

WORN EMERY CLOTH

It is useless to persist with grinding on worn emery cloth. When the emery becomes worn to such an extent that it will

not grind the tools satisfactorily, it should be changed, as the resultant grind will not last for any length of time. Frequent changing of the emery cloth is essential for good grinding, as without good grinding, good shearing cannot be accomplished.

GOOD LIGHTING IMPORTANT

It is most important that grinding be carried out in a good light, so that the newly-ground edges may be thoroughly examined. When the grinding takes place in poor light, any dullness that remains cannot be seen and the tools may be underground, which will shorten their cutting life on the handpiece, and necessitate frequent changes.

The bulk of the sheep in the agricultural areas are shorn when the days are short and often cloudy. For this reason, the grinding of the tools should be carried out at midday when the light is at its best, rather than at the end of the day when the light is poor.

POINTS WORTH REMEMBERING

- (1) Be sure to thoroughly clean the tools before grinding.
- (2) See that the grinding discs revolve at the correct speed.
- (3) Examine the magnetic holder before grinding commences.
- (4) Make sure the magnetic holder is hung in the right position for correct grinding.
- (5) Observe that the sparks leave the teeth of the combs and cutters to fly straight upward at the completion of the grind.
- (6) Do not persist with worn emery cloth, change the paper frequently.
- (7) Continue to grind the tools until the dullness disappears from the cutting edges.
- (8) Always grind in a good light, and preferably at midday when grinding takes place only once a day.

COMB AND CUTTER COMBINATIONS

No matter how accurately the tools are ground, their cutting efficiency is impaired unless the correct combination of comb and cutter is used on the shearing

handpiece. Combs and cutters of different makes are available, the teeth spacing varying with most types. When the teeth spacing of the cutter does not correspond with the teeth spacing of the comb, the wrong combination is used and the resultant cut will be most unsatisfactory.

Correct combinations are those in which the teeth of the cutter accurately match the teeth of the comb, as illustrated in the centre diagram in (Fig. 6). The accompanying diagrams show the wrong combinations, left, a cutter that does not complete the cut, and right, a cutter with the teeth spacing too wide for the comb. Either of these combinations is wrong, and should not be used.

CUTTERS OF EVEN THICKNESS

To ensure that the cutting ability of the handpiece is maintained, it is most important that the cutters be of the same thickness, whatever the degree of wear. Cutters of different degrees of thickness will cause alteration to the post setting of the handpiece with every change of cutter. A useful method of keeping the cutters all the same size, is to bend a piece of wire to form the letter S. Thread the cutters on one end as they are reground, and use them from the other end when placing them on the handpiece. In this manner they will all receive the same

amount of grinding, and will all remain even. When this is done, the centre post of the handpiece can be set to any one cutter and will be set for each of the cutters.

The importance of maintaining the cutters at a universal thickness cannot be over-emphasised.

THE SHEARING HANDPIECE

To obtain maximum efficiency, the speed of the handpiece should be maintained at not less than 3,200 revolutions. This may be checked by placing the revolution counter on the back cogs of the handpiece. Any reduction in speed will not only affect the cutting ability of the tools, but will have a tendency to make the handpiece feel lifeless in the shearer's hand, and will have a retarding effect on his ability to shear in a proper manner.

Fig. 7 is a diagram of the internal working parts of a shearing handpiece, alphabetically named. Some of these parts are subject to a good deal of pressure while the handpiece is in operation and should be inspected at frequent intervals for excessive wear, and replaced if necessary.

The main wearing parts are (H) Centre post (I) Fulcrum (C) Tension pin (D) Crown plate (B) Tension sleeve, and also (F) Fork yokes.

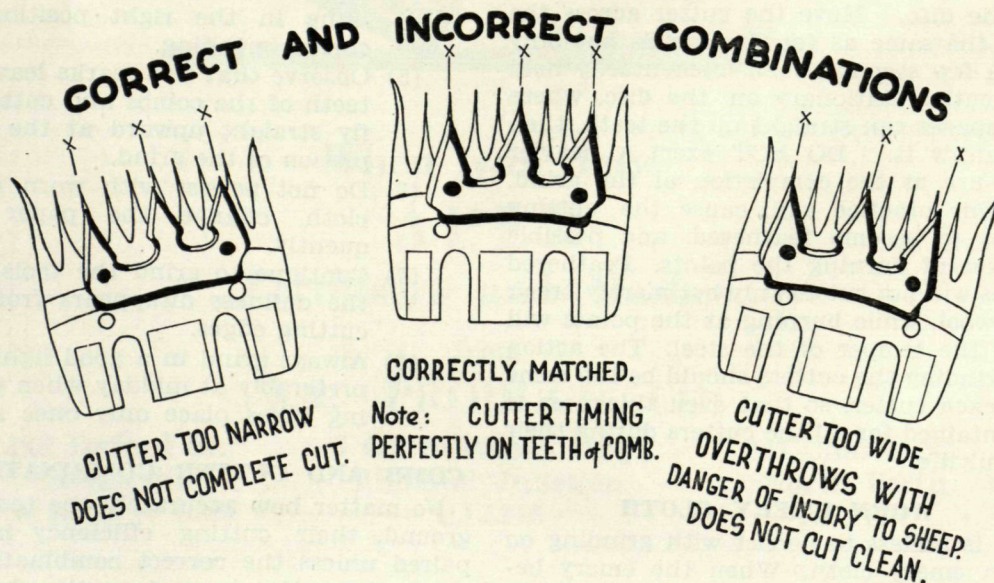


Fig. 6.—It is essential to have properly-matched combs and cutters

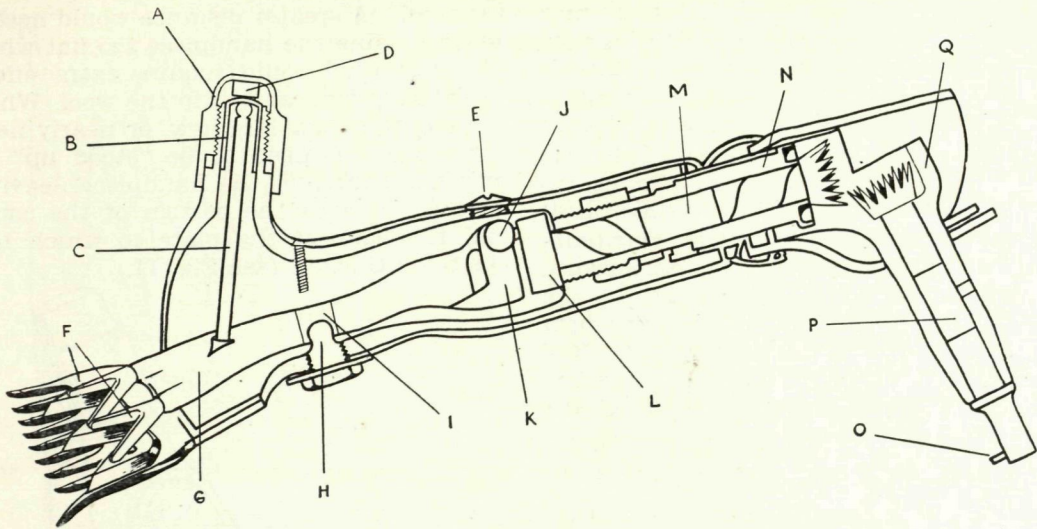


Fig. 7.—Shearing Handpiece—(A) Tension nut; (B) Tension sleeve; (C) Tension pin; (D) Crown plate; (E) Inspection screw; (F) Fork yokes; (G) Fork; (H) Post; (I) Fulcrum; (J) Ball; (K) Ball race; (L) Crank head; (M) Main spindle; (N) Bush; (O) Spindle pin; (P) Back spindle; (Q) Back joint

Excessive wear on the centre post (H) will be exhibited when the ball on which the fulcrum (I) seats, becomes "out of round," or egg-shaped. At this stage it has reached the limit of its efficiency and should be renewed. It is advisable, at the same time, to renew the fulcrum.

The tension pin (C) will, after much usage, become worn at both ends. This will shorten the pin and difficulty will be experienced in applying the correct degree of tension. As this becomes apparent, the tension pin, crown plate (D) and tension sleeve (B) should be renewed.

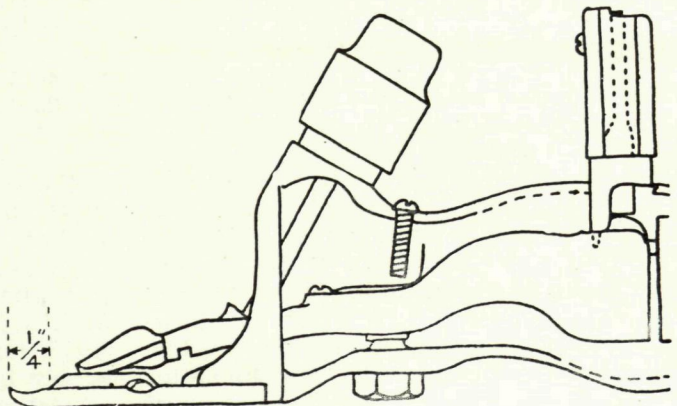
The fork yokes (F) should at all times fit snugly in their sockets, as any degree of slackness at these points will affect the accurate setting of the centre post and

make it difficult to achieve maximum efficiency in the handpiece. Also at this stage the points that fit the cutter pin-holes will be sufficiently worn to effect their proper seating in the pinholes and replacement of the fork yokes will become necessary.

SETTING THE CENTRE POST

Before a handpiece is put into use, the centre post may need adjusting to the thickness of the cutters to be used. This is done by placing a comb and cutter on the handpiece, and then by releasing the lock-nut, the centre post can be raised or lowered, by means of the screw thread on the post, as required. The centre post will be correctly set when the ball (J)

Fig. 8.—Testing the centre post



protrudes one-third from the ball race (K) both top and bottom. This can be tested by removing the inspection cap on top of the handpiece, and inserting a centre post gauge (Fig. 8.)

An important point to remember, is that when altering the height of the centre post, use a **HALF TURN** at a time, until the correct adjustment is made. One half-turn will bring the reverse, or unworn, side of the post into the seating in the fulcrum cup. Two half-turns will return the post to its original seating. **DO NOT** use quarter, or three-quarter turns, as this will give an uneven seating of the centre post in the fulcrum cup.

"LOADING THE HANDPIECE"

The term "loading the handpiece" means attaching a comb and cutter to handpiece. To do this correctly requires a little care to see that the cutter does not throw over on one side of the comb (see Fig. 9), or it will not complete the cut on the opposite side. There is a slight

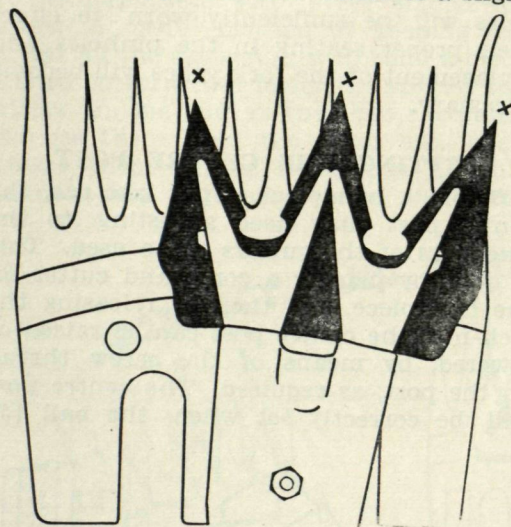


Fig. 9.—Cutter "throwing over" the bottom tooth

variable movement sideways to correct any tendency for the cutter to overthrow the comb, before the comb screws are tightened. At the same time, adjustment for "lead" is made. "Lead" is the distance the points of the comb are in advance of the points of the cutter, which should be not less than a quarter of an inch (Fig. 10). A lesser distance will allow the cutter points to override the combing bevels of

the comb. A greater distance would necessitate holding the handpiece too flat when shearing, and would require extra effort in entering the comb into the wool. When using cutters that are new, or nearly new, the comb will need to be "stood up" or moved forward on the handpiece, leaving a space between the bottom of the comb and the back of the plate to which the comb is attached (see Fig. 11.)

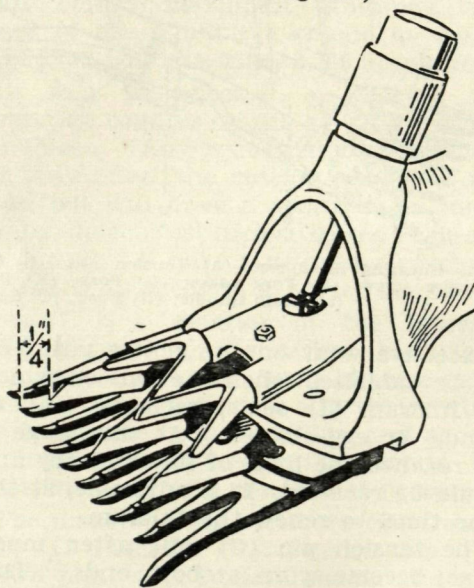


Fig. 10.—Correct comb lead

PRECAUTIONARY MEASURE

Prior to placing the handpiece on the downtube, it is advisable to check it for freedom of movement. This is carried out by applying a light tension on the cutter, then placing the right thumb on the driving cogs at the rear of the handpiece, rotate the spindle to make certain the cutter moves freely across the face of the comb. Failure to check the cutter for freedom of movement, can result in an accident if the handpiece should lock.

CORRECT TENSION

When the handpiece is set up for use, the right degree of tension can only be applied while the machine is running. It requires some experience to gauge, by feel, just what is the right degree of tension. Usually, when the handpiece exhibits a slight tendency to turn over when held loosely in the hand, the tension is near-correct and may require only slight ad-

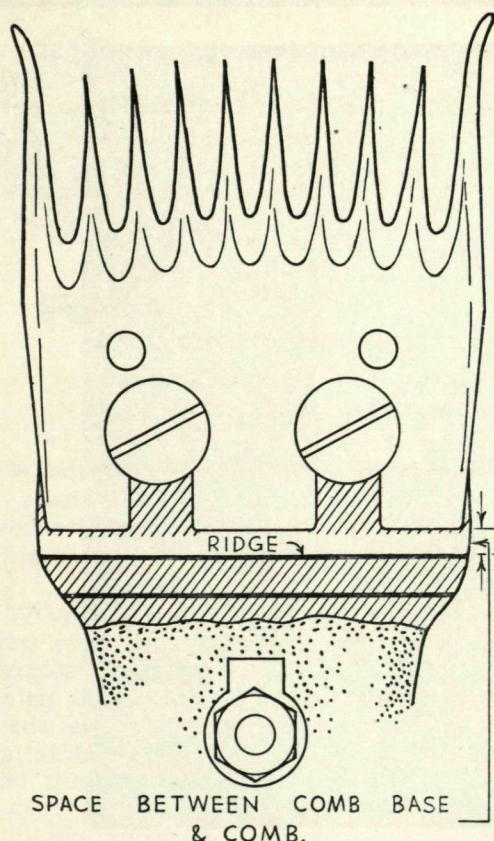


Fig. 11.—The comb "stood up"

justment either way. The correct tension, should be the lightest tension possible that will make the machine cut freely, and at the same time feel alive in the hand. Too much tension will cause overheating, with consequent expansion of the comb and cutter. This will cause smoke to rise, and will quickly ruin the cutting edges making frequent changes of the tools necessary.

EXCESSIVE USE OF TOOLS

It is unwise to persevere with combs and cutters that do not cut freely. The cutting edges have a limit to their usefulness before reaching the stage where they need to be replaced. It is advisable to use at least two, and sometimes three cutters to each comb. The amount of tools used will vary with the type of sheep, and the condition of the wool being shorn. In hard sandy sheep the tools will need to be changed more frequently, while in light free-cutting wool such frequent changes may not be necessary.

However, no matter which type of sheep is being shorn the cutting ability of the machinery must be at its best to avoid plucking, instead of cutting, the wool fibres. Plucking causes pain to the animal which makes it kick and strain.

LUBRICATION OF WEARING PARTS

Shearing machine oil is cheaper than replacements, and proper lubrication of all the working parts is essential. Without proper lubrication no machine can function perfectly. Always see that the barrel of the handpiece is filled with lubricant. Occasionally withdraw the chicken feet by turning them over with a pair of pliers and insert some grease in their holders before replacing them. Remove the coupling spring and fill the joint caps with grease from time to time, to save wear in the back joint. All other oiling points can be reached with the oil can. A good system is to first release the tension and oil the centre post and fulcrum cup making sure that the oil penetrates to these points. After re-applying the tension, drop a little oil on the comb and cutter, and with the handpiece turned over squirt some oil into the tension sleeve. Oil the ball and ball-race through the hole in the inspection plate, completing the job by oiling the back cogs and driving spindle.

IT DEFINITELY PAYS

- To use the right combination of comb and cutter.
- To keep the cutters all of the same thickness.
- To see that the centre post is set correctly, using a post gauge.
- To see that the cutter does not throw over the comb.
- To have sufficient "lead" on the comb.
- To check the handpiece for freedom of movement before attaching it to the downtube.
- To refrain from using excessive tension.
- To change the tools when the cutting edges have become dulled.
- To occasionally insert some grease in the fork yoke seatings, and the thrust caps on the back joints of the handpiece.
- To keep the machine well oiled.



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