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## 1. TERMINOLOGY

### Diamond Mesh Maker®. Name of Machine.

Description of product: It makes a Mesh fence from rolls of Plain Wire. A mesh is made with loose pieces of formed wire put together to make what is commonly called a fence. All mesh fence is sold in 30 metre rolls. Very tall fence (i.e. 3 metres) is sold in 15 metre rolls because of its weight.

Description of machine: The Diamond Mesh Maker® consists of a Main Frame with two legs and attachments. If you stand at the end of the machine with the red Flywheel, then the leg with the cross piece on the bottom is the Near Leg. The leg at the other end, which does not have a cross piece, is the Far Leg, and that is the Far End of the machine. In the same way, the Drive Shaft Bearing nearest the Flywheel is the Near Bearing and the other one is the Far Bearing.

### Tensioner:

Description: The whole red assembly protruding at an angle off the left side of the machine is called the tensioner (a double wire machine has one protruding from both sides).

Wire enters the machine through the tensioner, which has a slotted plate at one end. The wire passes through the slotted plate and then through a set of rollers.

### Rollers:

Description: wire is rolled through the rollers: The first roller is the one next to the slotted plate. The fourth roller is the one nearest the drive shaft. Two of the rollers can be adjusted up and down in slots. The bolt holding them in position is a 12mm bolt with a 19mm head.

### Spanners:

Two spanners are provided to loosen and tighten the bolts when necessary.

### Flywheel, Handle and Extension:

Description: The round, red flywheel has a handle extension attached to it with one 12mm bolt and one 20mm bolt. The handle is screwed into the handle extension.

The handle also fit into the 20mm hole near the edge of the flywheel if the extension is removed. This second option has the effect of shortening the swing of the handle - desirable if the operator is strong and the wire is thin. The shorter swing means the handle can be turned faster, which increases the production speed.

### Drive shaft:

The flywheel is attached to the drive shaft. The drive shaft passes through two pillow block bearings and is held in position with 4 set screws. The shaft should not be able to slide back and forth in the bearings (use an Allen Key to tighten them if necessary).

### Giraffe, Blade and Clamps:

The red pipe with a spiral slot machined into it is called a giraffe. It is held onto the frame by three clamps - the near clamp is closest to the flywheel, the centre clamp, and the far clamp. Inside the giraffe rotates a blade around which the piece of mesh is

formed. During the machine's operation, each new piece of mesh is formed on the blade and as it does so it is threaded into the previous piece as the handle is turned in a clockwise direction, thus forming the fence.

#### Trough and Pins:

The finished fence hangs off the left side of the machine.. The trough is the long half-round part that looks like a rain-water gutter. The fence is held in position by a set of 6 Pins. Not all the pins are used all the time. They come in different diameters for different fence hole sizes (i.e. 20mm dia. for 75mm fence and 32mm for 50 and 63mm fence). If you are making a short fence (0,9 metres) it will only require 2 or 3 pins. A high fence (2,4 metre) will use all of them. The pins are to be found wrapped together with the spanners.

#### Unwinder:

The three legged frame with a red "horn" on the top is the wire unwinder which is used to hold the roll of wire while in use. It can hold up to 50 Kg of wire at a time.

## 2. SETTING UP A NEW MACHINE

### a. Damage Check

First, check for damage of any kind that may have occurred in transport. Scratched paint work can be touched up with Signal Red Enamel or Black Gloss Enamel.

Damage may include the bending of the handle or the handle extension, or the knocking of the flywheel so hard that it loosens the bolts holding down the main drive shaft bearings. If the bearings are loose, or are ever replaced for some reason, make sure that the drive shaft is exactly in line with the centre of the red giraffe (the pipe with the spiral slot in it).

### b. Putting on the Legs

If the Diamond Mesh Maker has come to you with one or both of the legs removed for transport, they must be re-attached with 4 - 12mm bolts each. The leg in the shape of a `T' goes at the end with the red flywheel. The bolts go through the frame and through the top plate of the leg. The other leg in the shape of the letter `I' is held on with 4 short 12mm bolts. They do not come through the frame. Put the bolts in from below. The 19mm spanner provided fits all these bolts.

If you have lost the short bolts, ordinary bolts are not short enough to work, so do the following: Buy 4 - 12 x 50mm bolts, and 4 nuts. Mild steel bolts come with nuts on them. Screw the nuts down to the bottom of the thread, and screw the bolt with the nut in that position, into the leg and frame. When the bolt gets tight, turn the nut upwards until it holds the leg securely, using the bolt as a stud.

### c. Checking the Blade

The drive shaft has a slot in it into which the blade slips loosely. At that point the end of the shaft should be centred with respect to the giraffe. There should be less than 1mm difference in the measurement between the left side of the shaft and the giraffe and the right side of the shaft and the giraffe.

The blade may be a bit stiff when it is first operated due to paint or dirt on the inside of the giraffe. After a few minutes the paint will wear off so it is not something to worry about. Put some oil onto the blade through the slot in the giraffe so that the inside of the giraffe is lubricated all over the inside. Any oil like old engine oil from a car or bus will do. Treat it like an engine: use 30W or 40W oil. If necessary the blade can be removed by taking out the 8mm bolt holding it onto the drive shaft. This allows you to clean out the inside of the giraffe with a rag.

**THE BLADE SHOULD NOT BE TIGHT IN ITS SLOT IN THE SHAFT!**

When you rotate the handle, the blade should be able to be moved very slightly in any direction at any position. The blade is guided by the giraffe, not the shaft. If the drive shaft bearings are accidentally tightened down with the shaft off-centre, the handle will be very difficult to turn in some positions and easy in others. Correct this immediately by centring the shaft in the manner mentioned above.

There is an 8mm bolt holding the blade onto the drive shaft. Even though this bolt should be tight, it is not intended that the blade be held tightly by the slotted end of the shaft.

The section of the drive shaft holding the blade is very thick so that you do not accidentally clamp it onto the blade, and the bolt is deliberately small so that if over-tightened, it might break off rather than allow the shaft to grip the blade. The blade must "float" in the giraffe and the blade merely rotates it.

d. Checking the Handle

The handle should be pointing away from the main part of the machine, not towards it. When shipped to you, it is reversed so that it does not get damaged. Loosen the large nut (if there is one) and unscrew the handle shaft. Screw it in again from the other side and tighten the nut again. When not using a handle extension, there is no large lock nut as the handle screws directly into the flywheel. The Diamond Mesh Maker is normally run without a handle extension.

The Handle Grip, the part that is held by your hand, that rotates around the Handle Shaft, should rotate freely. It has two sealed ball bearings in it that do not require oiling.

If the handle does not rotate at all or only with difficulty, it may be paint making it stick, or it may need adjustment. The adjusting nut inside the end can be screwed back a little if was too tight. The Nylock nut should not be tightened until it stops as this will crush the bearing. The nut should be tight enough to prevent almost all movement of the handle back and forth on the handle shaft.

### 3. WIRE SELECTION

a. Wire Sizes

The Diamond Mesh Maker uses wire from 1,6mm up to 4,0mm. The possible sizes are, in this region, limited to 1,6mm 1,8mm 2,0mm 2,32mm 2,5mm 2,9mm 3,15mm (sometimes called 3,2mm) and 4,0mm. The sizes underlined are those normally available. The others are "export sizes". The local size 2,24mm (often called steel wire) is not annealed (softened) and is very springy. Do not buy it for use in this machine. It can only be used with a very specialized blade.

b. Wire Descriptions

Wire is made from steel and is usually galvanized (zinc coated). Wire available in shops and from wholesalers is usually Lightly Galvanized Wire (LGW). Also available is Heavy Galvanized Wire. This is sometimes used in coastal areas where corrosion from salt water is a problem. It is significantly more expensive.

Wire is made from iron bars that are pulled, with enormous force, through a small hole. This has the effect of "work hardening" the wire. After this they are heated to several hundred degrees and cooled slowly. This softens the wire so that it can be bend several times without breaking. In factories this process is sometimes done erroneously resulting in wire that is harder than normal or with a varying stiffness within a single roll.

Such wire is usually rejected and sold off at a lower price ("reject wire"), or to retailers who assume that it will not be used in production machinery. For this reason, you should be careful that you are not being sold rejected wire. Rejected wire is fine for use as long strainer wires but not for diamond mesh making. Some problems encountered with fence making are related to errors or variations in the wire manufacturing procedures.

The wire stiffness of two different rolls can vary a lot, especially between manufacturers. This requires adjusting the machine each time a new roll of wire is consumed. For this reason many people prefer to buy their wire in "jumbo" coils of 1/2 a ton or more. Once the machine is set for that wire, it does not have to be adjusted again for as long as a week.

#### 4. WIRE SUPPLIERS

There are large number of suppliers of wire, only a few of which are mentioned here as starting points.

African Gate Tel:From RSA (011) 908-4064	Cape Gate Tel:From RSA (011) 452-1574
All Cashbuild Wholesale Branches (Check each and every roll for stiff and reject wire)	All Farmer's Co-op Branches
Consolidated Wire Industries (CWI) Tel:From RSA (011) 825-8380	Haggie Rand Tel:From RSA (011) 629-1111 (Haggie Rand has a branch in Zimbabwe that deals in galvanized wire)
Lancashire Steel Kwekwe, Zimbabwe Tel:International (263) (55) 3701/2/3	New Dawn Engineering P.O. Box 3223 Manzini, Swaziland Tel:From Swaziland 518-5016 / 518-4194
Steel and Wire International P.O. Box 1426 Matsapha, Swaziland Tel:From Swaziland 518-4127 /518-4235 / 518-4381	Swazi Wire Industries P.O. Box 9 Matsapha, Swaziland Tel: From RSA (09268)518-5213 / 518-4010
All Stewarts and Lloyds Branches Tel:Johannesburg (011) 493-3000 East London (0431) 31-300	Wirecor (owned by CWI) Pietersburg, Transvaal, R.S.A. Tel:From RSA (01521) 931-851

## 5. OPERATION AND ADJUSTMENT (MODEL 2)

### a. Getting the Wire Ready

Take the wire unwinder (the three legged frame) and place it 4 metres or more behind and to the left of the operator. Point the red horn towards the tensioner. As the operator turns the handle, the wire should be behind him/her, and to their left. The adjustable horn on the unwinder holds back the wire slightly. The longer the horn, the more it holds onto the wire before releasing it. Set it as you prefer it.

Place a roll of wire on the wire unwinder by lifting it over the red horn. Cut off the wires binding the roll together. Make sure that the loose wire at the beginning of the roll is not allowed to move around once it is released. This is an important consideration. If the wire gets loose into the roll, it may create a knot and later it will be impossible to feed the wire off the roll. Controlling the end of the wire as the roll is opened is the first major lesson in working with any wire product.

### b. Starting a New Roll of Wire

Make a hook on the end of the wire about 30mm long by bending the wire's end down and back under itself. The gap in the hook should not be more than the thickness of a pencil.

**DON'T INSERT THE WIRE INTO THE TENSIONER.  
YOU ARE NOT READY YET.**

Lift the handle, which hangs in the 6 o'clock position, up to the 10 o'clock position. Hook the end of the wire over the edge of the blade where it is visible through the slot in the giraffe next to the near clamp. This is at the near end of the giraffe where the slot first becomes visible (the flywheel end). Hook the wire over the edge of the blade and hold the wire pretty much in line with the slot in the giraffe.

Hold the wire firmly with your left hand and rotate the handle slowly clockwise with your right hand until it is back down to the 6 o'clock position. The hooked end of the wire will disappear under the giraffe and wire will be drawn through your hand. Make 3 more full circles with the handle, continuing to let the wire slide slowly through your left hand. When you hold the wire you are creating tension on it so that it wraps around the blade nicely.

When you have finished these 3 turns the hook on the end of the wire will have emerged from the far end of the giraffe. Bring the wire in your left hand down to the number 4 roller of the tensioner and press it into the groove ON THE TOP of the roller. Next, bend the wire down and press it under the number 3 roller. Bend it up on the other side of number 3 and press it over the top of the number 2 roller. Again bend it down and press it under the number 1 roller. Bend it up for the last time and move it over to the slot in the slotted plate. Bend it down again until it is horizontal. The machine is now ready to begin making fence.

c. Preparing for the First Piece

Now as you rotate the handle, the wire feeds into the tensioner through the slotted plate, passes under roller 1, over roller 2, under roller 3 and over roller 4, then proceeds through the slot in the giraffe, where it is wound around the blade. Turn the handle 4 times, finishing at the 6 o'clock position.

Cut off the piece of fence sticking out of the giraffe. Cut it off a bit past the end of the blade. This short piece you are removing was not correctly formed because the tensioner was your hand not the rollers. Normally, this off-cut is the only wasted wire.

Don't put the wire into the rollers first (a common mistake). If you tried to put the wire into the rollers first and then hook the end of the wire over the blade, there is a high probability that the hook will be cut off before it emerges from the giraffe as the tension is too high in that situation.

d. Holding Pins

There are sets of holes drilled into the bed of the machine in lines parallel to the trough. Each set of holes gets one pin. Put one pin into any hole in the set nearest to the giraffe. Rotate the handle a couple of times until the leading end of the "piece" is next to the pin. Rotate the handle until it is in the 6 o'clock position.

**NEVER ROTATE THE HANDLE BACKWARDS**  
(counter-clockwise) more than half a turn.

The new piece of fence is a zig-zag shaped wire. When the handle is in the 6 o'clock position it is lying flat, horizontal. The curved points of the zig-zag shaped wire piece alternate back and forth from left to right and back again. The first pin should be placed in the hole that is BETWEEN two of the points lying against the left side of the trough. It must not be next to a point, but exactly centred between two of them (as close as possible to centre).

e. Starting a New Roll of Fence

If you are starting a fence of a particular height, rotate the handle until the length of the "piece" is long enough to equal the fence's height. Measure it with a tape measure when you first start. Later you can count the number of diamonds in the piece. Hold the end of the tape between the end of the blade and Pin 1 and measure along the frame to get the height you want. Turn the handle until the end of the wire reaches the desired mark. The handle must finish in either the 6 or 12 o'clock position.

To make a short demonstration piece of fence, rotate the handle 11 turns (clockwise, of course). Now the new piece of fence passes more sets of holes for pins. Put a pin in each set, centred between a pair of the rounded points on the zig-zag.

f. Cutting the Piece

Now it is time to cut off the piece with wire cutting pliers. Locate a position on the piece of fence about 100mm to the near side of the first pin, that is, between the first pin and the end of the blade. If making fence to a particular height, measure from the end of the piece to the point where you want to cut to be sure it is the correct length.

Cut the wire between two of the rounded points, right in the centre of the trough. Try to

make the cut exactly in the centre so that the short ends on each side of the cut are the same length. This saves problems later

g. Bending the Loop

Leave the offcut piece lying in the trough for a moment. You are now going to squeeze the short piece at the leading end of the wire back into a flattened loop. Take hold of the end of the wire sticking out from the end of the blade, but do not lift it up. Squeeze the short end back onto the wire to make a closed, a flat hook with the rounded point becoming the new leading end of the wire. If, when you cut the first piece of fence off, the pliers were off-centre, this bending might be difficult as the little bit you have to bend is too short and you will have to use the pliers.

The reason for not lifting the end of the wire up and performing this bending task is that the wire will be deformed and will not go back down again.

h. Squeezing the First Diamond

The first zig and zag of the wire (which makes half a diamond) needs to be shortened slightly (about 10mm) in a lengthwise direction. Squeeze the first and third points towards each other slightly so that the distance between them is reduced by about 10mm. Don't over-do it!

i. Joining the First Two Pieces

This next step is for the operator's helper, Operator number 2. With the end of the wire coming out of the giraffe now having a closed hook on it, pick up the first piece and hold it against the pins in the following manner:

In order to proceed with the next piece, the first piece must hang into the left side of the trough with its rounded points held by one finger against the side of the pin. As a person only has two hands, it is only possible to hold the piece against two of the pins at a time. Start with pin 1 and pin 3, one finger on each. The piece must not be hooked over the pins and resting down into the trough. It must be on the trough-side of the pin hanging into the trough. If viewed from the operator 1's position, it will be on the left side of the trough.

Turn the handle slowly to see the magic. As the handle turns, the new piece threads itself into the last piece, barely touching it as it advances. If the pins are in the correct position, the leading end of the second piece threads through the space created under the first piece by the curvature of the trough. Rotate the handle until the new, second piece reaches the far end of the first piece. The handle will finish in either the 6 or 12 o'clock position. (It will never finish anywhere else.)

If the first piece finished with the leading end pointing left, the new piece will finish with its leading end pointing right. If the first piece finished pointing right, the new piece will finish pointing left. One after another, the pieces will always finish pointing in the direction opposite to the last one. This is how the two hooked loops on top of a diamond mesh fence are created.

Now it is time to cut off the new piece. Locate the near end of the first piece. If it is on the left side of the trough, look directly across the trough and locate the rounded point of the new piece that is opposite it. Put your finger on that point. Move your finger along

the wire towards the giraffe until it is half way to the next point. That is the place to cut the wire.

Now take the first piece and slide it sideways out of the trough and toward the pins. It will have to be moved sideways exactly 1/2 a diamond so that the first piece hooks against the pins and the second piece hangs into the trough, held against the pins by the first piece. At this early time it will still be necessary for operator 2 to hold the pieces in this position as the third piece is made.

j. Making the Third Piece

To make the third piece, you must first prepare the leading end as you did before: bend over the end to make a flat hook. Try to do it without lifting the wire up. Try to bend the wire back until it touches itself.

Rotate the handle again carefully making sure that the new hook threads into the last piece properly. The handle should be turned until the new piece reaches the end of the second piece. As mentioned before, the end of the new piece will always point in the opposite direction of the last piece made when it comes to the correct length.

OIL THE BLADE AND GIRAFFE with 1 to 2 cc's of oil. Do this every few pieces. Any excess oil will collect in the oil guides on the side of the frame and can be collected in a shallow pan placed on the floor. If the piece you are about to cut feels warm, it is very likely that you need to put some oil into the giraffe.

From now on, you will be cutting the new piece off, and advancing the fence TO THE SIDE and AWAY from the trough. The fence does not advance directly away from the trough, but zig-zags back and forth. In all cases it is held properly when the piece just made is hanging down into the trough while being held against the pins by the weight of the rest of the fence pulling away from the pins.

k. Re-Adjusting the Pins

This can be done at any time: Put the handle into the 6 o'clock position. Observe the position of any of the left hand points of the zig-zag piece presently being made. Is it exactly in between two of the points of the previous piece? If you move all the pins in one direction or the other, the completed fence will move closer to or away from the giraffe. The newest piece will have trouble threading into the fence if its position is wrong.

On a BRAND NEW MACHINE the pins will have to be adjusted after about 30 to 60 minutes of use, as the new parts will "wear in" very slightly.

## 6. BLADE CLEARANCE

The blade - giraffe clearance should be about 0,3 to 0,7mm. To do this, tighten the Centre Clamp while turning the blade. Tighten both bolts one after the other so that the clamp top does not go down more on one side than the other. Keep tightening until the blade stops at some point in its rotation. Then loosen the bolts until it turns quite freely again. This will be about 1/2 a turn of the bolt or less. Repeat this procedure with the other two clamps. When you are finished the blade will be turning freely and the clearance between the blade and giraffe will be very small. As the blade wears over the years the clearance

can be adjusted again.

When using thin wire this clearance must be kept small.

## 7. THE TENSIONER

### a. How It Works

As you are making any piece, you can check to see if the tensioner is doing its job properly. The 4 rollers are there to pull on the wire as it winds around the blade. The amount of pull is important, which is why rollers 1 and 3 are adjustable. If either of the two rollers are adjusted downwards, they force the wire to bend more as it passes through. This has the effect of requiring a harder pull to bring the wire past the rollers. To move the rollers down, means to make them tighter. To move the rollers up, means to make them looser.

### b. Aiming the Tensioner

When the wire passes over roller 4 and goes into the slot machined into the giraffe, it can enter the slot in various positions because the slot is quite a bit wider than the wire. The giraffe can be rotated if the 3 clamps are loosened so as to have the slot be in a useful position.

If you remove the giraffe for any reason, it is likely that you will have to adjust the position of the tensioner. When putting in the giraffe, do not tighten the clamps too much or else the blade will not be able to turn. The blade should be able to move around a little bit in any position. Tightening the clamps too much will wear out the blade and wear out the operator because he is working for nothing.

The correct position of the tensioner places the wire at the near edge of the slot, that is, on the side of the slot nearest the flywheel. The wire will go up and down as the handle is turned, but it should never get far away from the near side of the slot for more than a split second. It does move back and forth slightly as the blade rotates, but generally it should be against the side. The wire should not ride heavily against the slot as it will wear a groove into it after a time. Galvanized wire is actually quite abrasive and can wear a fully hardened giraffe..

If the wire is entering the slot on the far side (away from the flywheel) there will be all sorts of problems - especially a very deformed corner on the pieces coming out of the giraffe or a triangular to the pieces.

The position of the tensioner can be adjusted back and forth along a slot, as well as being able to rotate. To move it, loosen the nut under the tensioner using the 24mm ring spanner. The whole tensioner becomes loose and the position can be changed. The position is correctly set at the factory but sometimes the tensioner is knocked out of position during transport and it has to be reset before you can do anything else.

The tensioner can rotate so that you can set it in such a way that the wire draws off roller 4 in a straight line. This means that the wire does not wear the roller any more than it has to. If the wire comes off pulling hard to one side it will wear the side of the roller and it won't last as long as it otherwise might. The rollers are made from hardened steel, but galvanized wire is quite abrasive and can cause a lot of wear.

c. Checking the Tension

Turn the handle to the 3 o'clock position and stop. The piece of fence being made at the moment will be on its edge because the blade is vertical with the handle in the 3 o'clock position (remember that it was horizontal in the 6 and 12 o'clock positions).

Look at the piece currently being formed. The farther it goes away from the blade, does it twist to the left, to the right, or does it remain on edge?

- If it remains perfectly straight and does not twist to either side, everything is OK.
- If it twists to the left as it goes away from the giraffe, the rollers are too loose.

LEFT MEANS LOOSE.

- If it twists to the right as it goes away from the giraffe, the rollers are too tight.

RIGHT MEANS TIGHT.

In a properly made fence, all the pieces will stand on edge for their entire length, without any signs of twisting over their length.

d. Changing the Tension

First, do not change the tension until you have oiled the giraffe. As the mechanism runs out of oil, the friction increases on the blade and the wire "tightens up" resulting in a hot piece of fence with a right hand twist. When you are just learning to use the machine, you will forget to oil it from time to time. This leads to premature wear of the parts and gives what appear to be tension related problems.

If you find the tension is not correct, it will explain problems you may have had getting the pieces to engage properly, or problems you have had getting the pieces to lie down properly in the trough.

The roller next to the slotted plate on the tensioner is roller 1. It can be regarded as a Fine Adjustment. Roller 3 can be viewed as a Coarse Adjustment. Normally it is not necessary to use the fine adjustment and it can be put near the top of its up-down range. Changes to the position of roller 3 should be about 1mm to 2mm at a time.

Use a 19mm spanner to loosen the bolt and nut holding the roller in place. Do not loosen it very much. Stop turning as soon as the nut is free. Press the roller with your right thumb if you want to move in downwards or lift it gently if you want it to go up. Leave the spanner on the nut all the time so you can quickly re-tighten the bolt without losing your position.

After making an adjustment, you will have to make another piece of fence, or at least half a piece, to see what effect the change in tension has made.

The setting of the tensioner does not have to be perfect, however it is better have a slight right hand twist than a left. The piece should either be straight or twist slightly (30 degrees maximum) to the right over its whole length.

Remember that when the machine is brand new, the tensioner will require some adjustment after 30 to 60 minutes of use due to the parts "wearing in" as the paint and so on wears off.

## 8. WIRE FEED AND CONTROL

### a. Controlling the Twist

One of the first problems you will experience, even if everything else goes perfectly, is that the wire coming off the unwinder gets twisted up. Controlling this twisting is the job of operator 1, the person who turns the handle. It is done with the left hand.

About once for each piece made, the operator must force one twist of the wire coming off the roll to go into the tensioner. Usually a novice tries to stop the twists in the wire from going into the tensioner by holding onto the incoming wire and forcing the twists to stay away from the machine. They end up between the tensioner and the roll of wire, and after a few minutes twist down so small that they jump around and make a figure 8 shaped mess.

The first solution to this is not to let it happen. As a twist in the wire approaches, the experienced operator grabs the wire with their left hand of the FAR SIDE of the twist. The puts the twist, or half-twist between the operator's hand and the slotted plate on the tensioner. By carefully turning their wrist and moving their arm, the twist can be made to go into the tensioner as the handle is turned. The motion necessary has the effect of making the next incoming twist BIGGER in diameter. If your motion makes the next twist smaller and tighter, reverse your motions. Watch to see that the next loop is getting bigger and the one near your hand is going into the tensioner. Remember to do this about once per piece, and keep an eye on it until you get used to the amount or work required. If you do it too many time in a row you will generate a twist in the opposite direction.

This process becomes so automatic that an experienced operator does not even have to look at the roll any more. They feel the loop approaching as it hits their left hand and it gets passed on into the machine.

As for the figure 8 mess, the best way to handle it is to first tighten the next few coils of wire on the unwinder. Take them down to the size of a dinner plate. This has the effect of untwisting the knot that lies between the unwinder and the tensioner, and may open it entirely, leaving you with a series of tight loops. These must be forced into the tensioner one at a time over the next couple of pieces of fence. Perhaps when you are first starting you would like to assign one extra person to handling this job until it is clear how the twists are to be handled.

A Giant Wire Unwinder is available from the manufacturer that can hold any sized roll and which feeds wire up into a cone-like device and over a top roller. You might make one of these yourself. It eliminates the problem. Simply placing the three legged wire unwinder further away from the machine and raising the horn will also help control the problem.

## 9. EDGE FINISHING

### a. Edge Types

There are three types of edges possible on a diamond mesh fence:

- plain edge
- hooked edge
- twisted edge

#### i) Plain Edge

The plain edge means that it is left as a cut wire edge and nothing is done to it. The edge of the fence at Pin 1 is plain. The piece is cut and the fence is rolled up as is. This gives a little extra height but is rather easily undone and may not be acceptable to customers. Fence made on the "cheap" frequently is made with 1/2 fewer diamonds in the height and one plain edge to give the impression that it is a full height product.

#### ii) Hooked Edge

The hooked edge is the type found at the far end of the fence where the ends with a flat hook stop at the end of each cycle. One loop is inserted into its neighbour and pulled back in such a way that the hook clips over its mate. This is quick and easy. It can be done by the Third Operator who is usually stationed at the far end of the machine. Their task is call out incorrect piece lengths, to help advance the fence and to ensure that the pieces are correctly aligned as the fence is rolled up. They are responsible for hooking the pieces together AFTER they have advanced away from the pins by about 200mm. A hooked edge has a neat appearance and is quick and easy to make. It shortens the total height of the fence by 1/2 a diamond if there is a hooked edge on both the top and bottom of the fence.

#### iii) Twisted Edge

The twisted edge involved using a tool (usually pliers or a gloved hand) to twist the two wires around each other at least 2 times. This will most easily be done to the edge at Pin 1 because they are not already bent into hooks. There are two advantages to this edge. First, it increases the legitimate height of the fence as the twisted ends stand straight up and down. Second, it goes a long way toward preventing the pieces from getting messed up if the fence is dropped loosely on the ground. That may save a lot of effort later. Its disadvantage is that it requires more labour. The price may have to be increased slightly to pay for the twisting. In a typical roll of 30 metres of 75mm mesh, there are about 1166 twists which need to be made, each having 2 or 3 turns. This can slow production, and it can also increase income. The decision should rest with the customer. A fence with two twisted edges is a bit more than 1/2 a diamond high than one with two hooked edges. That half can be omitted and the wire saved.

## 10. ROLLING

### a. Standard Length of a Roll

Mesh fences are defined as those fences made up from a number of pieces linked together in such a way that they create a long mat which can be erected on a framework of poles and strainer wires. Examples of mesh fencing are Square Mesh and Diamond Mesh.

Mesh Fencing is normally sold in Southern Africa in 30 metre rolls. All the fencing you see in shops is packaged in 30 metre rolls.

In countries further north other standards apply. Sometimes the length is dependant on the wire size. The constant factor is the mass. In these countries a 50 Kg roll of wire is processed into diamond mesh and sold as a unit. In such places the roll will always weigh 50 Kg but the length will vary.

In some countries the mass of a roll made from 2,5mm wire is taken as the standard length, frequently 18.3 metres (60 feet). Whatever the case in your area, you should stick as closely to it as possible, and where practical, offer as an additional service a per-metre rate so that people can buy an exact length fence. This is a much appreciated service and will boost sales.

### b. Controlling Length

There are two basic methods of getting the right length for a roll: calculation and direct measurement. If you and your staff are good at mathematics and will keep accurate records of the number of pieces made so far, you can quite accurately make rolls of fence without measuring them. As machines and wire vary slightly it is strongly recommended that you make a roll of fence, measure it to be 30 metres, and then count the number of pieces in it. For 75mm hole fence it will be something like 580 to 590 pieces. This number can be counter as they are made with a mechanical device that Operator 2 presses each time they cut the wire, or it can be done on a piece of paper.

One way of doing it on a piece of paper is to not finish the edge at Pin 1 for some time. When some fence has accumulated, everyone takes a break for a few minutes. The fence is rolled out and the edges closed in pairs with the left and right thumbs pressing the open ends back onto themselves and count 2 - 4 - 6 - 8 - 10 and so on. As you get near the frame, working your way up the fence, stop when the number is even, like 60 or 140 or whatever. Write that number on a piece of paper and carry on. This counting can be done at intervals, initially infrequently and as the total gets closer to 585 or so, the pieces are counted individually. This method can be used in relatively confined spaces.

The measuring of each roll does not require the use of a tape measure. Assuming that there is a 30 metre long space available nearby, the roll which is known to be over 30 is taken outside. At one end of the space place two short poles into the ground (about 150mm high) and hook the end piece of the fence over the two to hold it securely. Unroll the fence towards the other end of the space where you have placed another pair of short poles (or spikes) exactly 30 metres from the first set. Tension the fence nicely ensuring that there are no snags or jumbles in it and hook it over the second set of poles. Remove the very next piece by opening the hook and "unscrewing" the piece. Now you have a roll of exactly 30 metres.

If you do not have such a long space, you can make a plan of the same type with a 15 metre space, going from pole set 2 to pole set 2 and then back again.  $15 + 15 = 30$  metres.

Fencing should always be rolled up very neatly and as tightly as is practical. The end of the roll should be a flat surface rather like the end of a can or drum. The appearance of the roll will affect the customer's impression much more than the actual quality of the fence. When you have 1 layer left to go in the roll, put your company or group's advertising sheet onto the roll and wind the last bit of the fence over it. This will hold the sheet in place.

c. Advertising Sheet

The professional appearance of a roll is important to its market acceptance. You should make up an advertising sheet, either A4 or A3 in size. Put bold lettering on it with the name and contact information of your company or group on it. Put some lined squares or rectangles in which to write (with a permanent marker) the size of the fence: height, hole size, wire size, length of roll. If you have some rolls of a non-standard length you can put that information on the sheet. If you have standard prices, this is the place for it.

You do not have to go to the expense of having these printed. Make a good looking original and have them photo-copied. Add the cost to the roll of fence. It will enhance the appearance of your roll and this adds to its saleability.

d. Joining Part Rolls Together

Pieces of Diamond Mesh can be joined together at any time with a completely invisible joint that does not look different from the rest of the fence. Place the two ends of the pieces on the ground facing each other, about 20mm apart, as if the part rolls were part of a single roll with a piece missing. It is important that end loops on the end piece of both fences should be facing in the same direction, not opposite as you are used to seeing in the trough as the fence is made. The reason for this is that you are going to thread in an additional piece to join the two together and in order to avoid having a "step" down in the fence, the two edges pieces must have their end loops facing in the same direction. If the end loops are facing in opposite directions, remove one piece from one of the part rolls.

Take a single piece of fence that is long enough to close the gap. You can use a piece removed from the other end of the part roll or make a new one on the machine. Close the loop on one end and thread it into the two edge pieces simultaneously. It is difficult to describe this in words, but it is the exact reverse of taking out a single piece in order to shorten a roll. The idea is to keep the two roll ends fairly close together so that the joining piece can turn easily. When the joint is completed, the fence should be exactly as if it had been made that way in the first place. If there is a 1/2 diamond shift to the side at the joint, then the two end pieces were not facing in the same direction to begin with. Remove two adjacent pieces and replace one of them to re-join the ends.

Using this method, very long pieces of fence can be put together "seamlessly". It is also possible to assemble waste or extra pieces into a fence in this manner, greatly reducing waste from mis-feeds and incorrect cutting.

## 11. ECONOMIC CALCULATIONS

### a. Production Costs

Fence production costs are:

- Wire
- Labour
- Consumables
- Depreciation

The value of the wire is discussed below. The cost of labour is directly related to productivity. If the operators are taking 1 minute to complete one piece, production will be about 30 metres per day. Normally an experienced team can make a piece in 20 seconds on a long term basis. This gives a production speed of 90 metres or 3 rolls per day. As the team will normally be three people this means that the cost of labour is equal to the wage of 1 person for 1 day.

It is strongly recommended that labourers be paid on a production basis so that they are paid on a per metre produced basis. It is suggested that the day's production target should be achievable in 6 hours of work. If this is reached on a daily basis you will have a labour efficiency of 75% which is good in the long term.

Fence making uses oil. You should allow for the cost of a 500 ml can of oil each day. If you have access to used engine oil it can you save this cost.

The blade is subject to a lot of friction and will wear out after 1 or 2 years. It should certainly last for 100 rolls. In order to save up money for a new one, you should budget an amount similar to the value of the oil consumed.

The capital cost of the machine (buying, delivery and setting up costs) should be depreciated over 5 years. Most users make some assessment of their production and work it out as so much per roll. You can also take the capital cost and divide it by 1250 to get a cost per day for replacing the whole machine.

Generally speaking, the sum of the oil, blade and depreciation costs is equal to about 2% of the cost of labour and wire put together. When you get the sum of the wire and labour costs you can add 2% to arrive at your true production cost.

Such expenses as salaried staff, rent and telephone and so on are obviously expenses that must be met, if you have them. Work out the true cost of operating your business making sure that each and every expense is going to be covered by your income. Banks usually have simple forms they will give you free to help you assess the costs and viability of a proposed business. Get one and be a well informed business owner.

### b. Cost of Wire

Wire is sold in rolls, and you will pay a price per roll or a price per kilogramme. You need to know the price per kilogramme. If it is £185 for 50 Kg then it is  $185/50 = £3.70$  per Kg or £3700 per ton.

The price of wire has to include the cost of getting to your place of work, so add in the

transport costs. If you buy 10 rolls of 50 Kg each at E185 per roll and pay E25 to have it delivered to your workshop, then your wire is costing you

$$\frac{10 \text{ rolls} \times (\text{E}185 \text{ each} + \text{E}25 \text{ For transport})}{10 \text{ rolls} \times 50 \text{ Kg each}} = \text{E} \frac{2100}{500 \text{ Kg}} = \text{E}4.20 \text{ per Kg}$$

c. Wire Consumption in a Roll

You buy wire by the kilogramme and you sell fence by the metre. This is a basic problem that you will have to learn how to handle. The most important thing to know is how much your roll of fence weighs. There are number of reasons why the weight of a roll varies and you cannot be really sure how much the roll weighs from theory alone. The following considerations affect the weight of a roll of fence:

- the actual height of the roll (don't make it too high or too short)
- the actual length of the roll (it should be 30 metres)
- the size of the wire used
- the thickness of the blade (the thicker it is, the more wire used)
- the type of edge (a twisted edge uses less wire and makes it taller)
- the weight of galvanizing on the wire (heavy or light)
- or plastic coating (which also requires a thicker blade)

The easiest way to find out how much wire you have consumed in a roll is to take to someone with a large scale and weigh it. Frequently this is not possible and scales are very expensive. Once you have a good idea of the weight of your rolls you will not normally have to weigh them again so owning a scale is not necessary.

As mentioned before, the number of pieces in a roll of fence tends to be pretty much the same from roll to roll if you have not changed wire size. The length of wire in each piece is also very much the same. If you know how much wire is consumed in one piece then you can calculate the length of wire used in the whole roll. Dividing by the number of metres in a kilogramme (see Table) you will know the mass.

d. Measuring the Wire in 1 Piece

Make part of a roll and satisfy yourself that everything is operating properly. Take a couple of turns of wire off the roll and pull it out straight, directly away from the tensioner. Clamp a pair of pliers onto the wire about 4 metres from the tensioner. Measure the distance from the pliers to the slotted plate on the tensioner to the nearest millimetre. Holding the pliers tightly on the wire, rotate the handle making exactly one piece. Again, measure the distance from the pliers to the slotted plate. The difference between the two measurements is the amount of wire used to make one piece.

You should take several measurements in a row, and the number taken should be EVEN (i.e. 2, 4, 6, or 8). If you take 4 measurements in a row, add up the total amount of wire consumed and divide by 4. This gives a more accurate measurement.

Reading 1	2.701
Reading 2	2.706
Reading 3	2.710
<u>Reading 4</u>	<u>2.702</u>
TOTAL	10.819

Divide by 4 = 2.705 metres

Count the number of pieces in 30 metres of fence. Suppose you find that it is 580 pieces:  
580 pieces x 2.705 metres each = 1568.9 metres

1569 metres of 2.5mm wire = 60.35 Kg of wire

26 metres per Kg ← (from Table 1)

60.35 Kg x E3.95 per Kg = A wire cost of E238.37 per roll

Table 1 - Wire Data

Size	Wire Size	Kg	Metres	Kg per Metre	Metres Per Ton
Size	1.6	1	62	0.01613	62 000
	Roll	50	3100		
Size	1.8	1	50	0.02000	50 000
	Roll	50	500		
Size	2.0	1	40.6	0.02463	40 600
	Roll	50	2030		
Size	2.24	1	33	0.03030	33 000
	Roll	50	1650		
Size	2.5	1	26	0.03846	26 000
	Roll	50	1300		
Size	2.9	1	19.3	0.05181	19 300
	Roll	50	966		
Size	3.15	1	16	0.06250	16 000
	Roll	50	800		
Size	4.0	1	10	0.10000	10 000
	Roll	50	500		

Table 2 - Fence Data

Approximate mass of standard sizes of Diamond Mesh Fencing  
Please confirm your own product's mass

All rolls are 30 metres long. Format is:

Height x Hole Size x Wire Size, Kg

Size	Kg
900 x 75 x 2.5	31
1200 x 75 x 2.5	41
1800 x 75 x 2.5	61
900 x 75 x 2.0	21
1200 x 75 x 2.0	27
1800 x 75 x 2.0	41
900 x 63 x 2.5	31
1200 x 63 x 2.5	40
1800 x 63 x 2.5	60
900 x 63 x 2.0	20
1200 x 63 x 2.0	26
1800 x 63 x 2.0	39
900 x 50 x 2.5	43
1200 x 50 x 2.5	63
1800 x 50 x 2.5	95
900 x 50 x 2.0	31
1200 x 50 x 2.0	41
1800 x 50 x 2.0	61

## 12. TECHNICAL SUPPORT

### a. Training

While it is intended that someone can learn to make fence using this booklet, there is no substitute for on-hands training. If you have persistent problems with your machine, it is advisable to contact your dealer for advice and or training as the case may be.

### b. Technical Advice and Spares

Technical advice and spares are available from your dealer and if need be, from the Manufacturer.

Your Dealer is  
New Dawn Engineering  
[crispin@newdawn.sz](mailto:crispin@newdawn.sz)