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Gott et al.

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[45] **June 4, 1974**

[54] **WIRE MESH WELDING MACHINE**

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Dec. 21, 1970 Great Britain 60644/70

[52] **U.S. Cl.** **140/112,** 140/3, 226/45
[51] **Int. Cl.** **B21f 27/10**
[58] **Field of Search** 140/112, 3; 226/152, 153, 226/134, 136, 135, 120; 145, 37, 38, 45, 122, 199, 137, 144, 156; 83/365, 367, 369

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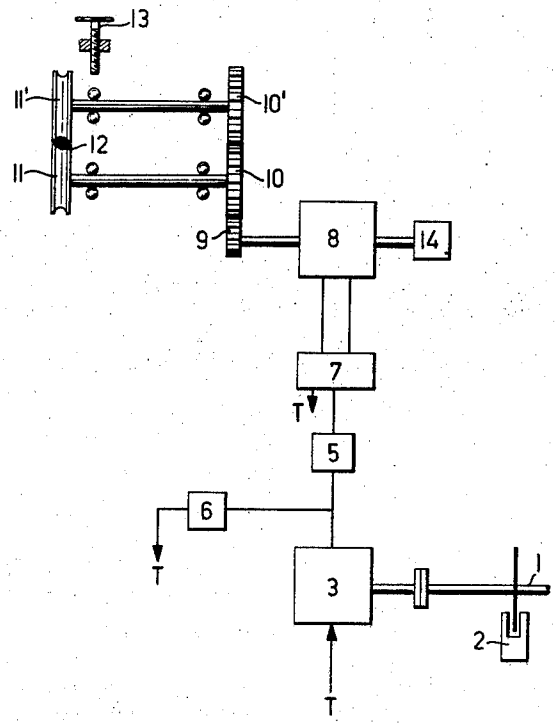
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Assistant Examiner—E. M. Combs
Attorney, Agent, or Firm—Ernest F. Marmorek

[57] **ABSTRACT**

A wire mesh welding machine in which a plurality of line-wires arranged side by side in parallel relation are fed through the machine intermittently and cross-wires are fed to the machine at right angles to the line-wires and are welded to the line-wires at their respective points of contact, the cross-wires being drawn off a storage reel and cut to length by means of feed rollers and a cutter which are both driven by the main shaft of the machine. The lengths of the individual cross-wires severed from the wire drawn off the storage reels are controlled by an electronic control system which governs the action of the feed rollers in direct dependence on the length of wire unreeled in each cycle of operation of the machine. The electronic control system includes a cycle controller driven by the main shaft of the machine, the cycle controller delivering, in each working cycle of the machine, a start signal which causes a drive between the main shaft and the feed rollers to be engaged, a measured value transducer, controlled by the rotation of the feed rollers, or by the advance of the cross-wire, which produces a signal which, through an adjustable counter-controller, acting as a reference transducer, causes the drive to be disengaged again and the feed rollers to be stopped after feeding of a predetermined length of wire. A reset signal from the first impulse transmitter subsequently causes the counter-controller to be reset to zero after a time interval corresponding to the feeding of a maximum length of cross-wire.

13 Claims, 12 Drawing Figures



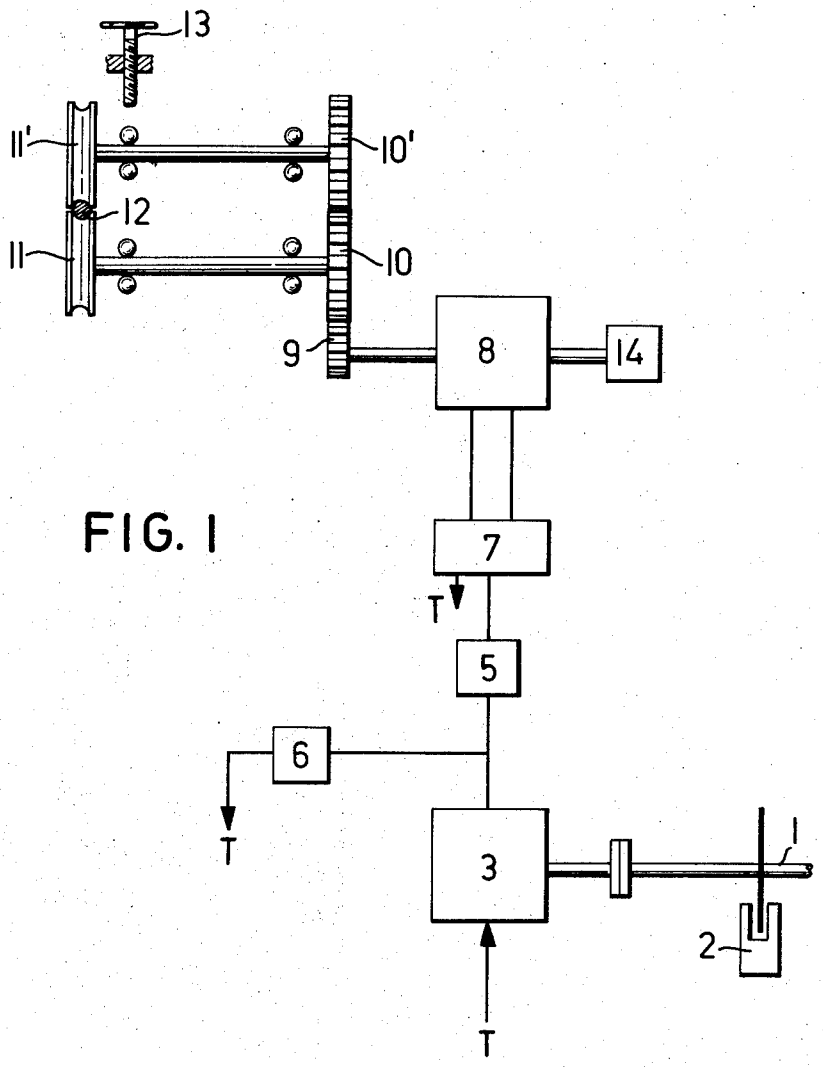


FIG. 1

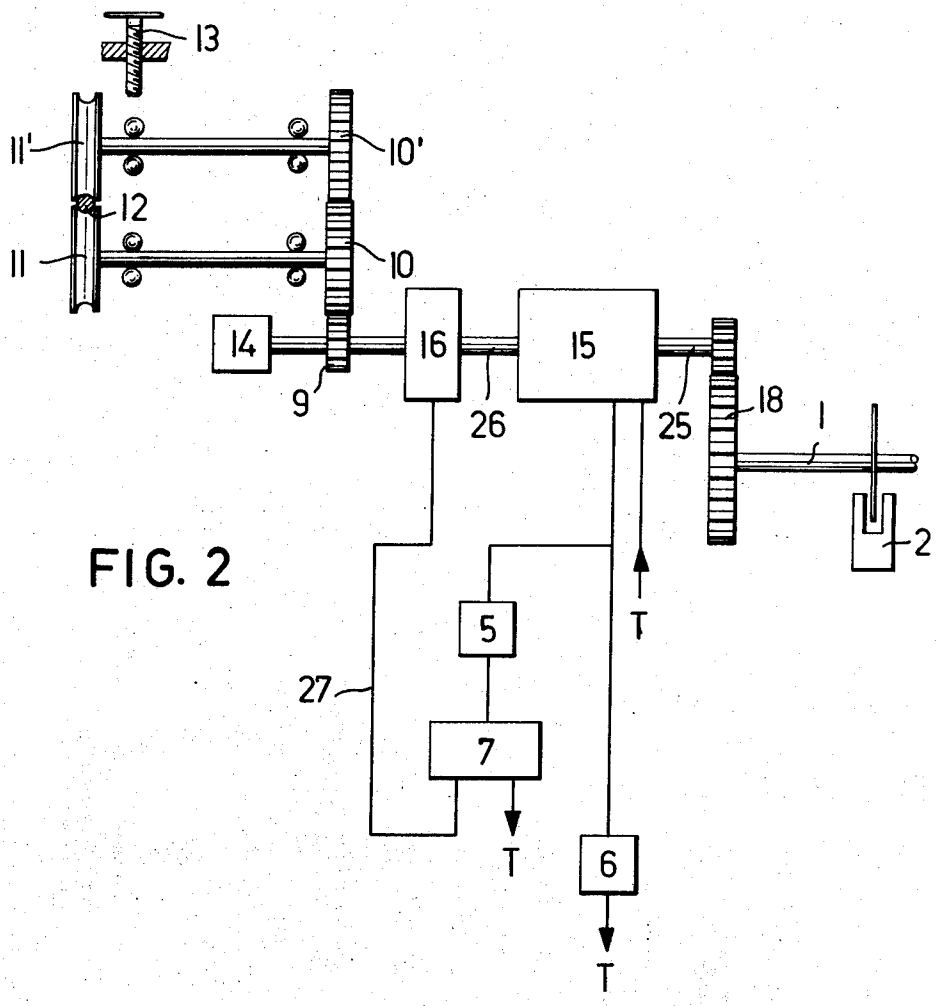


FIG. 2

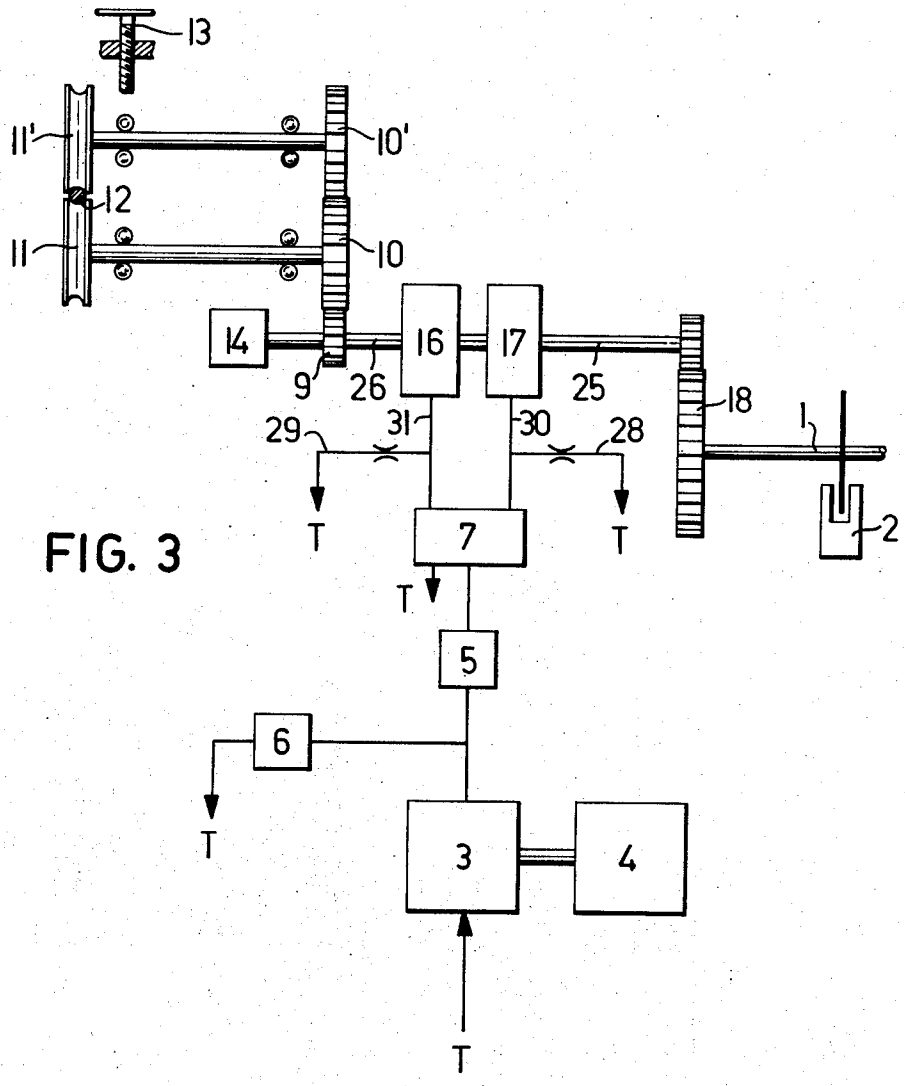


FIG. 3

FIG. 4

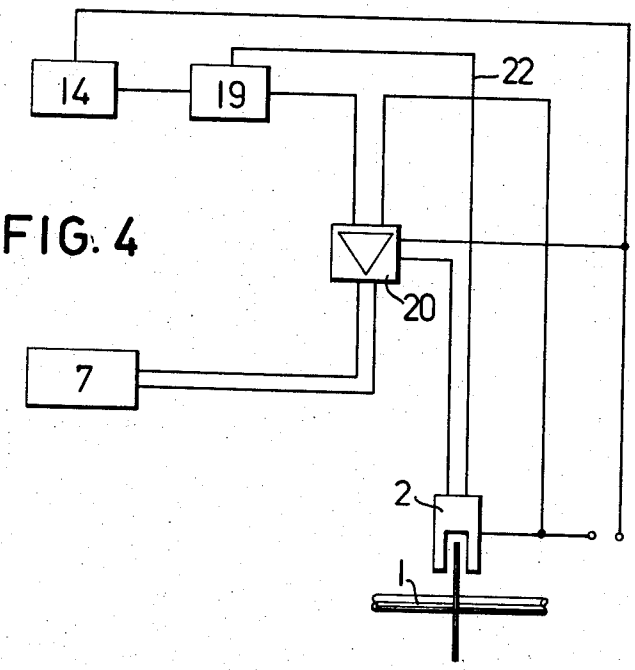


FIG. 5

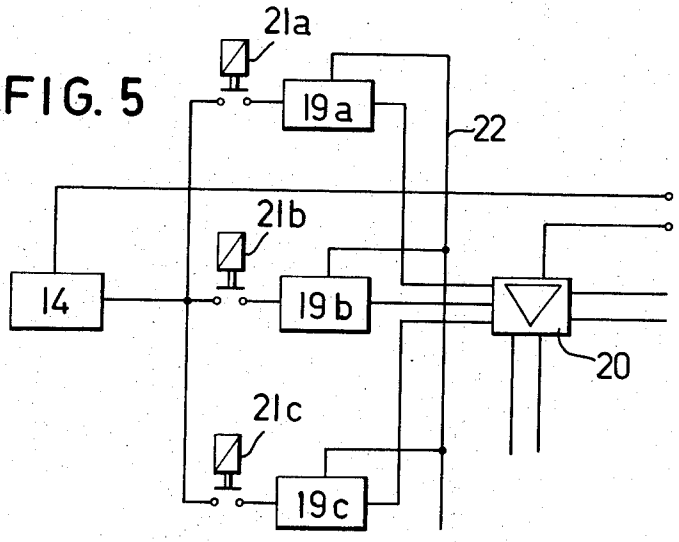


FIG. 6a

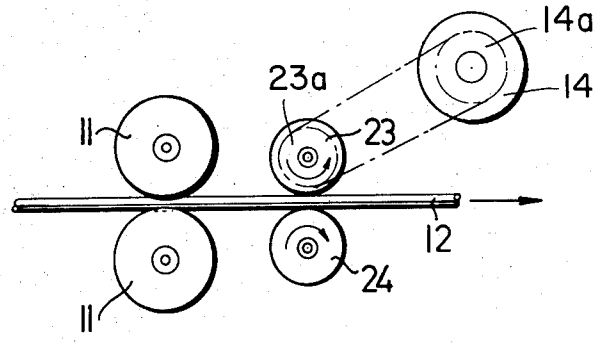
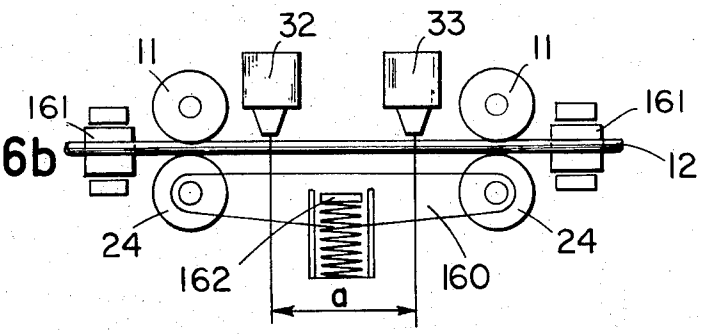


FIG. 6b



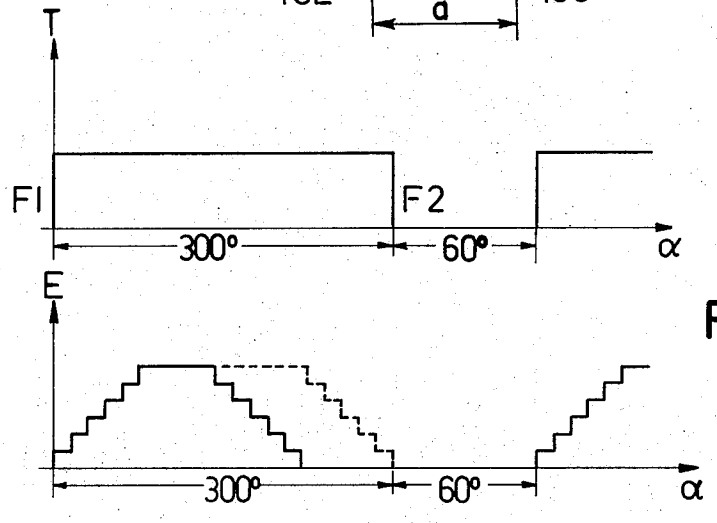


FIG. 7

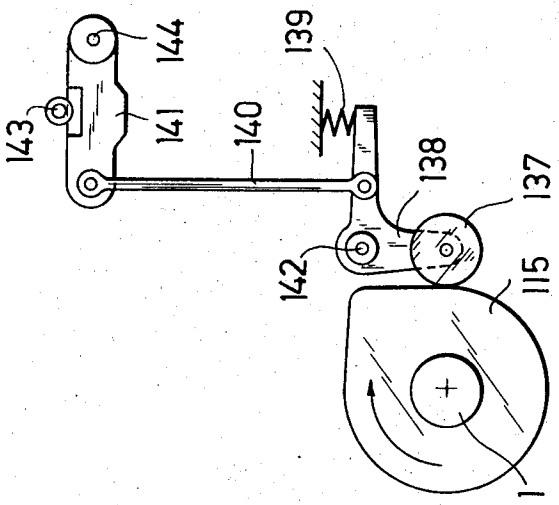


FIG. 11

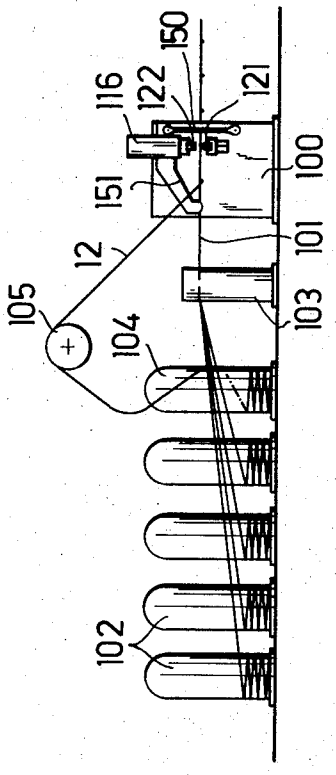


FIG. 8

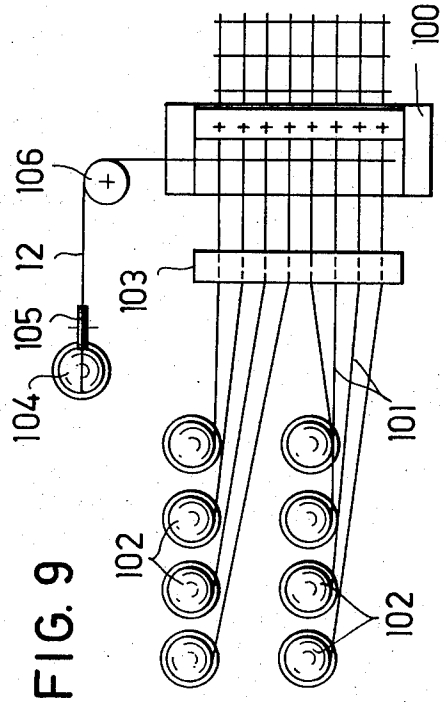


FIG. 9

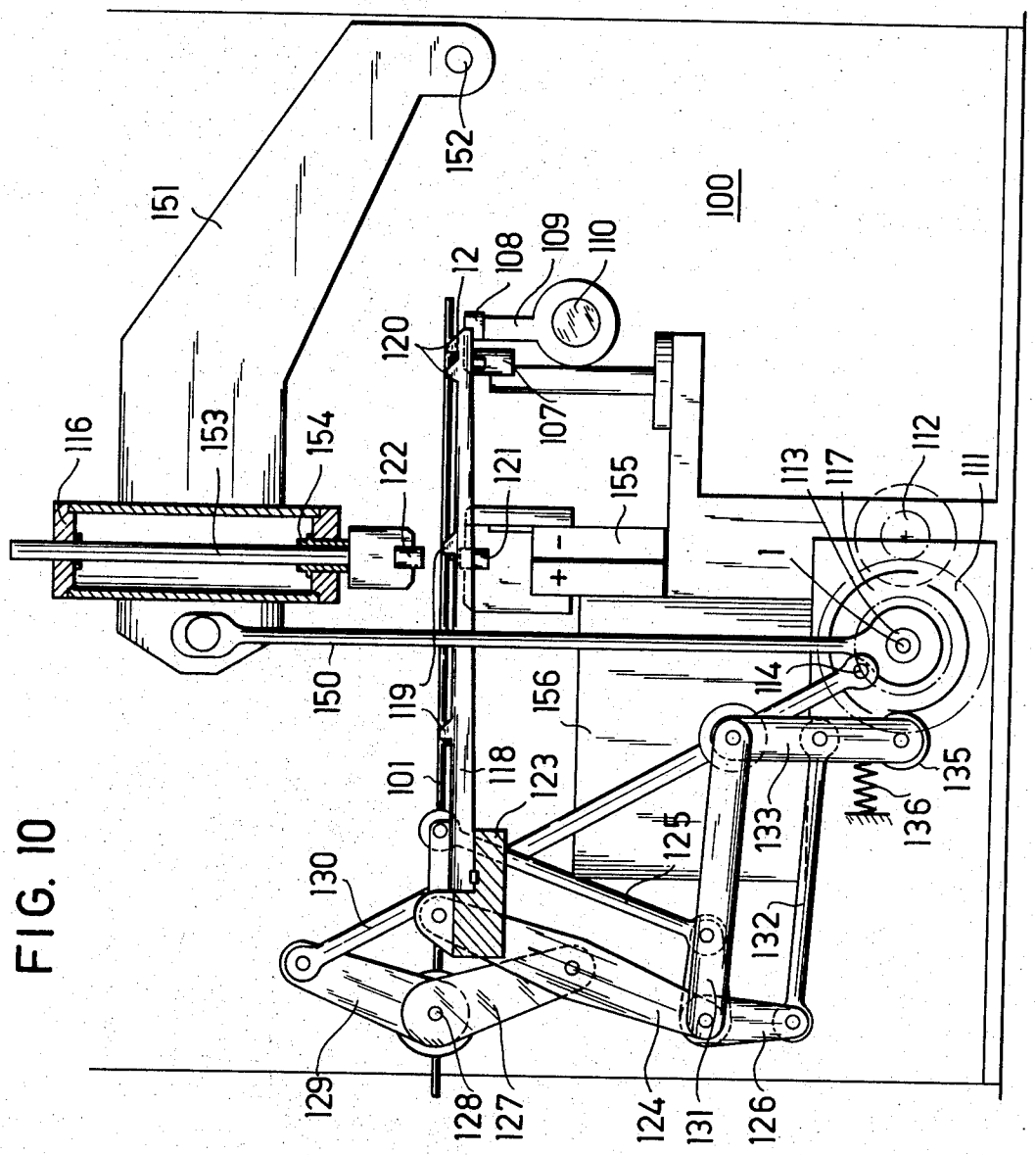

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FIG. 10

WIRE MESH WELDING MACHINE

In wire mesh welding machines for the manufacture of welded mesh by spot welding the line- and cross-wires of the mesh at their respective points of contact the line-wires are usually unreeled from storage reels and fed to the machine in parallel relation and spaced apart from one another. The line-wires are advanced between two rows of welding electrodes extending across the full width of the machine. The cross-wires, on the other hand, are fed to the machine from the side and at right angles to the line-wires at a distance ahead of the rows of welding electrodes, so that each cross-wire extends across the array of line-wires. The mesh having been welded between the rows of electrodes is intermittently advanced together with the attached array of line-wires and a newly fed cross-wire, the movement continuing until the new cross-wire reaches in its turn the welding station between the electrodes, where it is welded to the line-wires.

The intermittent movement of the mesh together with the array of line-wires and the newly fed cross-wire and the correspondingly intermittent action of the welding electrodes at the end of each step of advance of the mesh are usually controlled by a power-driven main shaft of the machine. This shaft accomplishes one revolution in each work cycle and usually also drives the cutting and feeding device for cutting and feeding of the cross-wires.

In a known feeding device the cross-wire is advanced across the machine by two feed rollers, clamping the wire between them and advancing it by friction.

The main shaft of the machine drives the feed rollers by means of a crank which imparts a reciprocating movement to a rack which in turn drives the feed rollers through a uni-directional drive, so that the rollers rotate intermittently and in one direction only. A switching device in the uni-directional drive ensures that the feed rollers rotate always in the desired direction even though the rack passes a dead-center position at the end of each stroke. In order to render cutting and feeding of cross-wires of different lengths possible a driving crank of adjustable length is provided.

In another known device two pairs of feed rollers are provided. The rollers of each pair rotate in opposite directions in timed relation with the movements of the driving crank. The two pairs of spring-loaded feed rollers alternatively engage the cross-wire feeding it to the machine.

In the operation of such feeding devices a difficulty arises if different lengths of cross-wires are to be fed selectively to the welding machine in order to produce wire-mesh of different widths. In such cases the operator has to adjust the machine accordingly by adjusting the length of the driving crank. To this end the operator has to stop the machine after which the length of the crank can be adjusted by sliding the crank-pin in a guide by means of a threaded spindle or the like. A graduated scale may be attached to the crank-pin guide and the crank-pin may be provided with an indicator mark indicating the selected length of cross-wire. However, the accuracy obtainable by this method is limited by a variety of factors. First the accuracy with which the cross-wire is fed and cut to length is limited by the nature of the uni-directional drive. Such a drive usually comprises a ratchet and pawl device, the accuracy of which depends on the size of the ratchet-teeth. The smaller the teeth the greater the accuracy.

Moreover, all these movements require a certain length of time. The cross-wire has to be fed to the machine, cut off and advanced towards the welding station before the next cross-wire can be fed. In a fast running machine the time available for all these operations may not be sufficient. The problem, therefore, is to satisfy the two conflicting requirements of accuracy, on the one hand, and speed on the other hand.

It is the object of the present invention to provide a new feeding and cutting device for feeding cross-wires to mesh-welding-machines and cutting the cross-wires to lengths, such a feeding and cutting device comprising a pair of feed-rollers for intermittently unreeling wire from a storage reel and feeding the unreeled lengths of wire at right angles across an array of line wires and cutting means for finally severing the lengths of wire fed to the machine from the wire drawn off the reel.

It is a further object of the invention to provide a feeding and cutting device of considerably improved accuracy of operation as compared with devices hitherto known.

It is still a further object of the invention to provide a feeding and cutting device rapidly adjustable to different cross-wire lengths without requiring the interruption of the machine's operation.

With these aims in view, according to this invention, in a mesh welding machine in which cross-wires are fed to the machine from the side and at right angles to an array of line-wires and in which the cross-wires are welded to the line-wires at their respective crossing points, a length of wire being unreeled from a storage reel in each working cycle of the machine by feed rollers which are driven by the main shaft of the machine, after which a length of wire is cut off from the unreeled wire so as to form an individual cross wire, a cycle controller is provided being driven by the main shaft of the machine, the cycle controller delivering, in each working cycle of the machine, a starting signal which causes a drive between the main shaft and the feed rollers to be engaged and wherein a measured value transducer controlled by the rotation of the feed rollers or by the advance of the cross-wire, produces a signal which, through an adjustable counter-controller, taking the place of a reference transducer, causes the drive to be disengaged and the feed rollers to be stopped after feeding of a predetermined length of wire, a second signal from the cycle controller subsequently resetting the counter-controller to zero after a time interval corresponding to the feeding of a maximum length of wire.

Up to now the length of the cross wire fed to the machine and severed from the unreeled portion of the wire was determined by the mechanically operating feeding device which was subject to wear. According to the present invention the length of the cross wire is determined, much more accurately, by direct measurement by means of the measured value transducer cooperating with an adjustable counter-controller. The setting of the adjustable counter-controller may easily be changed by the operator from one cross-wire length to another without interrupting the operation of the machine.

Preferably, the drive between the main shaft and the feed rollers includes a power transmission system con-

trolled by an electro-hydraulic servo-valve responsive to the signals from both the cycle controller and the adjustable counter-controller.

The drive between the main shaft and the feed rollers may be composed of an hydraulic pump and an hydraulic motor, the pump being uninterruptedly driven by the main shaft and delivering oil through the electro-hydraulic servo-valve to an hydraulic motor which in turn drives the feed rollers.

Alternatively two aligned shafts may be provided interposed between the main shaft and the feed rollers, one of the aligned shafts being geared to the main shaft of the machine by means of a suitable mechanical transmission whereas its other end drives the rotor of an hydrostatic coupling or the driving disc of an hydrostatically operated disengaging coupling whereas the second of the two aligned shafts, one end of which is connected to the housing of the hydrostatic coupling or to the driven disc of the disengaging coupling, and the other end drives the feed rollers. This second shaft is positively connected to a likewise hydraulically operated brake. In an oil-duct connecting the actuating means of the brake and the coupling, an electro-hydraulic servo-valve is provided controlling oil-pressure in such a way that the coupling is engaged when the brake is disengaged and vice versa.

Some examples of mesh welding machines according to the invention will now be described with reference to the accompanying drawings, in which:

FIGS. 1 to 3 are diagrammatic representations of three different examples of cross-wire feeding devices forming part of the machine;

FIG. 4 is a circuit diagram of an electronic control-circuit forming part of each of the devices shown in FIGS. 1 to 3;

FIG. 5 shows a detail of part of an alternative form of an electronic control-circuit;

FIGS. 6*a* and 6*b* show examples of a measured value transducer forming part of the control-circuits;

FIG. 7 is a diagram representing a cycle of operations of the devices shown in FIGS. 1 to 3.

FIG. 8 is a side view of the line and cross wires being fed into the welding machine;

FIG. 9 is a plan view of FIG. 8;

FIG. 10 is a cross-sectional view through the welding machine; and

FIG. 11 is a detailed view of the wire shearing means and its actuation.

In the feeding device or means for feeding an array of line wires intermittently side by side in parallel relation as shown in FIG. 1, the main shaft 1 of a mesh welding machine drives an hydraulic pump 3, which draws oil from a tank (not shown) and discharges it into a delivery line in which the oil pressure is kept constant by means of an adjustable pressure control valve 6. The intake of the pump and the exhaust from the pressure control valve 6, which leads back to the tank, are indicated by the symbol T (tank).

The delivery line connects the pump 3 by way of an oil filter 5 and an electro-hydraulic servo-valve 7 to an hydraulic motor 8. The motor 8 drives the feed rollers 11, 11′ through gear wheels 9, 10 and 10′. The cross wire gripped between the feed rollers is advanced to the machine by friction. The pressure applied to the wire by the feed rollers may be adjusted by means of an adjustment screw 13 shown diagrammatically in the drawing.

Mounted on the main shaft 1 is a cycle controller 2, e.g. in the form of an impulse transmitter, which operates for example on a photo-electric or an inductive basis. Mounted on the shaft of the motor 8 is a measured value transducer which is connected to a counter-controller, or reference transducer, for selection and control of the lengths of wire to be fed and cut.

The cycle controller 2 together with a measured value transducer 14 controls the electro-hydraulic servo-valve 7. This control system will be described in greater detail later with reference to FIGS. 4 and 5 of the drawings. The transducer 14 is mechanically connected to the feed-rollers 11 as can be seen from FIGS. 1 to 3 wherein the transducer 14 is attached to the shaft which carries gear wheel 9 which drives feed-rollers 11. Other means mechanically connecting the transducer 14 to the feed-rollers 11 can be used.

In the feeding device shown in FIG. 2 the main shaft 1 of the mesh welding machine drives, through a gear 18, a first shaft 25 which is mounted in aligned relation to a second shaft 26. The two shafts 25 and 26 may be positively connected by an hydrostatic coupling 15. An hydraulically actuated mechanical brake 16 is mounted on the second shaft 26 the brake being connected by an oil-duct 27 provided with an electro-hydraulic servo-valve 7 and an oil-filter 5 to the hydrostatic coupling.

This device operates as follows: When the electro-hydraulic servo-valve 7 hydraulically connects the brake 16 to the hydrostatic coupling 15 — by means which will be described later — the rotor of the coupling 15, driven by the shaft 25 builds up pressure in all parts connected by the duct 27, until, upon the pressure's reaching a predetermined value, the control valve 6 opens. The pressure in the oil-duct 27 releases the brake 16, usually held in engagement by a spring, by acting on a piston and, at the same time, causes the housing of the hydrostatic coupling 15 to rotate, thus positively connecting shafts 25 and 26 so that now the main shaft 1 of the machine drives the feed rollers 11, 11′ by way of the gear 18, the aligned shafts 25, 26 and the gear 9, 10, 10′.

If, on the other hand, the electro-hydraulic valve 7 connects the coupling 15 to the exhaust line to the oil tank (T) pressure in line 27 drops to zero with the result that the brake 16 is applied by its spring and the coupling 15 disengaged, the rotor of the hydrostatic coupling idling within the housing.

Feeding of the cross wire is interrupted and the length of wire fed is cut off by a cutting device which is not shown in the drawing. Otherwise like parts shown in FIGS. 1 and 2 are designated by like reference numerals and do not, therefore, require further explanation. It should, however, be mentioned that units combining the functions of the coupling 15 and the brake 16 are commercially available. Merely for the sake of clarity the two parts were represented separately in the drawings.

In the example shown in FIG. 3 the driving transmission between the main shaft 1 of the mesh welding machine and the feed rollers 11, 11′ is engaged and disengaged essentially in the same way as in example FIG. 2. However, in the embodiment of the invention shown in FIG. 3, both the coupling 17 and the brake 16 are engaged by springs and disengaged by hydraulic pressure applied to pistons, the hydraulic pressure, in this case, being provided by a pump 3 driven by a motor 4, pref-

erably an electric motor. An electro-hydraulic servo-valve controls the flow of oil in such a way that hydraulic pressure is applied alternatively to the coupling **17**, through a duct **30**, or to the brake **16**, through a duct **31**.

Preferably the action of the servo-valve **7** should be controlled in such a way that both the brake and the coupling are engaged gradually, that is to say gently, in proportion to the current energizing the valve **7**, that current itself being gradually increased, by means which will be described later. In order to obtain gradual action of the coupling **17** and the brake **16** two branch-lines **28** and **29**, each one provided with a throttle valve and branching off from the ducts **30** and **31** resp. permit oil fed into the ducts **30** and **31** to drain back to the tank.

By this arrangement oil constantly circulates through the electro-hydraulic valve **7** since the ducts **30** and **31** connect that valve to the pump and the coupling.

FIG. **4** shows by way of example an electronic control-circuit by the help of which the length of wire to be fed is determined. The cycle controller **2** driven by the main shaft **1** of the machine is connected through an amplifying AND gate **20** to the coil of an electro-hydraulic servo-valve **7**. The photo-electric or inductive cycle controller **2** emits a sustained signal while the main shaft **1** accomplishes a specified fraction of a full turn, say 300°. While the main shaft **1** rotates through the remaining 60° the cycle controller emits no signal. The duration of the sustained signal is chosen in accordance with the greatest length of cross wire which might be required and allowing for the gear ratio between the main shaft **1** and the feed rollers **11, 11'**. The leading flank of the sustained signal opens the valve **7** starting the rotation of the feed rollers and the trailing flank of the signal resets the counter controller **19**, to which the measured value transducer **14** is connected, to zero.

FIG. **7** is a representation of how the speed of revolution of the feed rollers **11, 11'** is controlled by the combined signals of the cycle controller **2**, the measured value transducer **14** and the counter controller **19**.

On the abscisses of both diagrams a full revolution of the main shaft through 360° is plotted. The ordinate of the upper diagram represents the voltage of a sustained signal emitted by the first impulse transmitter **2**, the signal having a leading flank **F1** and a trailing flank **F2** and being of constant voltage over an angle of rotation of 300° accomplished by the main shaft **1**. The voltage of that signal is applied to one input terminal of an AND gate **20**. The counter-controller **19** may now open the hydro-electric valve **7** by applying a voltage to the other input terminal of the AND gate **20**. In the embodiment of the invention according to FIG. **1** the oil motor is switched in by the valve **7**. In the embodiments of the invention according to FIGS. **2** and **3** the main shaft **1** of the machine is connected to the feed rollers **11, 11'** by way of the hydrostatic coupling **15** or the hydraulically operated coupling **17** respectively.

The feed rollers start to rotate, advancing the cross wire and at the same time the measured value transducer begins to emit a sequence of impulses the frequency of which is proportional to the speed of advance of the cross wire.

The impulses emitted by the measured value transducer **14** are counted by the counter-controller **19**. The counter-controller **19** in its turn applies — each time after counting a specified number of impulses — control voltages to the input terminal of the AND gate. By these control voltages the current energizing the coil of the electro-hydraulic servo-valve is first increased till it reaches its maximal value and then reduced to zero again.

The arrangement might be such that the current energizing the coil of the electro-hydraulic servo-valve increases by increments, each increment being added to the already applied voltage after a certain number of pulses.

Upon reaching, after a number of incremental increases, the maximum voltage the electro-magnetic servo-valve **7** is completely open and oil may pass through the valve suffering minimum resistance. In a like manner the tension applied to the electro-hydraulic servo-valve is decreased again. So the rate of rotation of the feed rollers **11, 11'** gradually increases and decreases as has been shown in the diagrams in FIG. **7**

Now the length of wire fed to the machine may be severed from the wire drawn off the reel and transported to the welding station. The feeding device is ready for commencement of a new feeding cycle. After closing the servo-valve **7** completely, the main shaft **1** of the machine continues to rotate and actuates the cutting device but the feed rollers **11, 11'** remain stationary, the pump **3** — in the example of FIG. **1** — being disconnected from the motor **8** or — in the examples of FIGS. **2** and **3** — the main shaft being disengaged from the feed rollers **11, 11'**. After sufficient rotation of the main shaft **1** the trailing flank of the sustained signal emitted by the cycle controller **2** will reset, through a lead **22**, the counter-controller **19** to zero. At the same time also the second input of the AND gate **20** will be deenergized.

The counter-controller **19** is adjustable for selection of the desired fraction of the sustained signal during which the energizing current is supposed to flow. If the longest possible cross wire length is required, the current continues over the entire length of the sustained signal. In all other cases the current passing through the coil of the electro-hydraulic valve **7** flows during a fraction of that length only. It should be observed that if the measured value transducer **14** or the counter-controller **19** failed to close the valve **7** after a sufficient advance of the cross wire, the cross wire will nevertheless be stopped since at the end of the sustained signal from the cycle controller **2** the trailing flank of the sustained signal will put one of the two input terminals of the AND gate **20** at zero voltage, closing the servo-valve **7** and stopping the feeding mechanism.

In the above shown examples of the invention digital controllers were supposed to be used. But if so desired analogous controllers might be used instead.

In the embodiment of the invention shown in FIGS. **1** to **3** the measured value transducer **14** is driven directly by the feed rollers **11, 11'**. Another arrangement is shown in FIG. **6***a*. In that case the wire advanced by the feed rollers **11, 11'** passes between a pick-up wheel **23** and a supporting wheel **24**. These wheels **23, 24** are in their turn rotated by the advancing wire. The measured value transducer **14** is positively connected to the pick-up wheel **23** by sprocket wheels **23***a* and **14***a* and a sprocket-chain there between and the transducer **14** emits pulses in proportion to the angle of rotation of the pick-up wheel.

FIG. 6*b* shows a further alternative arrangement for measuring the distance covered by the wire **12.** In this case the distance travelled by the wire **12** is measured by means of a magnetic recording head **32** and a magnetic pick-up head **33.** These two conjugate devices are spaced apart by a given distance *a* as shown in FIG. 6*b*. A magnetic mark is applied to the cross-wire by the recording head **32.** When that mark passes the pick-up head **33** the latter delivers a counting pulse to the counter-controller **19** and at the same time actuates the recording head **32** which in its turn applies another mark to the cross wire **12.** Therefore, the pick-up head **33** delivers a counting pulse each time after the cross wire's covering the distance *a*. Means guiding the cross-wire fed by the feed-rollers **11** past the recording head and subsequently past the pick-up head **33** include, for the horizontal direction, rollers **161** on either side of cross-wire **12,** for the vertical direction, wheels **24** rotatably fastened to the ends of beam **160** which is biased into contact with cross-wire **12** by spring **162.**

The last two examples have the advantage that signal pulses can only be emitted if the cross wire actually has covered the distance *a*.

As shown in FIG. **5** a plurality of counter-controllers **19***a*, **19***b*, **19***c* may be provided instead of a single one. Each one of the plurality of counter-controllers may selectively and individually be connected to the measured value transducer **14** by means of relay switches **21***a*, **21***b*, **21***c*. Connections of the counter-controllers to the measured value transducer may be established by hand, by means of push-buttons or automatically by an appropriate control device or similar program controlling means. The advantage of this arrangement is that a desired length of wire to be fed to the machine may be preselected on each counter-controller **19,** permitting the operator to switch the feeding device to the desired length by merely actuating the apropriate push button or by programming a control-device accordingly.

Reference is had to FIGS. **8** to **11** for further clarification.

Line-wires **101** are fed in parallel relation and spaced apart to a welding machine **100.** The line-wires are drawn off supply-reels **102** positioned some distance ahead of the welding machine **100.** Before entering the welding machine **100,** the line-wires pass through a straightening device **103.**

A feeding-device such as shown in FIGS. **1** to **3** feeds a cross-wire **12** from the side of and at right angles to the array of line-wires **101** into the welding machine **100.**

The cross-wire **12** is drawn off a supply-reel **104.** In order to reduce resistance to a minimum, the cross-wire is pulled off the reel **104** in a vertical direction so that the reel **104** need not rotate during the pulling off of the wire. Guide-rollers **105, 106** guide the wire on its way into the welding machine **100.**

The cross-wires are fed into grooved blocks **107.** The blocks **107** are aligned in spaced relation in a direction transversely of the welding machine **100.** The grooves of the blocks **107** which receive the cross-wires **12** are covered by lids **108** which are fastened to arms **109** fixed to a rotatable shaft **110.** By rotating the shaft **110** the lids are retracted so as to allow a cross-wire resting in the groove of a block **107** to be lifted out of that groove for feeding of the cross-wire to the welding station. The shaft **110** is actuated by a lever-system which, not being essential for the invention, is not shown in the drawing and which is actuated by the main shaft of the welding machine **100.**

A gear **111** is fastened to the main shaft **1** of the welding machine. The gear meshes with a pinion **112** which is rotated at constant speed by an electro-motor not shown. Fastened to the main shaft is an eccentric **113** for operation of the means for welding the cross-wires one after the other to the line-wires such as electrode beam **116,** a crank-pin **114** for operation of the mechanism advancing the welded mesh together with the line-wires and for feeding a new cross-wire to the welding station, a cam **115** which operates the shear **141** which cuts the cross-wire just fed to the welding machine, the cycle controller as shown in FIG. **1** to **3** and, finally, a second cam **117** which likewise serves to operate the mesh-advance mechanism.

The main parts of the mesh-advance mechanism are feeding rails **118.** A plurality of such rails are distributed at intervals and in parallel relation over the width of the welding machine. The feeding rails **118** and the grooved blocks **107** are arranged in such a way that each feeding rail rests in an interval between two adjacent aligned blocks **107.**

On their upper surfaces, the feeding rails carry hooks **119** capable of engaging cross-wires of the already welded mesh and at their ends the feeding rails carry two closely spaced protrusions **120** between which a cross-wire can be received in order to lift it out of the grooves of the blocks **107** and to transport it to the welding station between the electrodes **121, 122.**

At their other ends, the feeding rails **118** are fastened to a beam **123** extending across the entire width of the welding machine. At each of its ends the beam **123** is hinged to two parallel struts **124, 125,** the lower ends of which likewise are hingedly fastened to one arm of a bell-crank-lever **126,** the arm of the bell-crank-lever to which the struts are fastened being parallel to the beam **123.**

The middle of the strut **124** is rotatably fastened to a lever **127** which in its turn is fastened to a shaft **128** pivotably mounted to the frame of the welding machine **100** at both its ends. By means of a lever **129** rigidly fastened to the shaft **128** and a connection rod **130** rotatably fastened to the lever **129** at one end and to the crank pin **114** at the other end, an oscillating rotative motion can be imparted to the shaft **128** and to the lever **127.**

The two parallel struts **124** and **125,** together with the beam **123** and the arm of the bell-crank-lever **126** which is parallel to the beam **123,** form a parallel motion drive. A second parallel motion drive is composed of the other arm of the bell-crank-lever **126** which is parallel to a lever **133** and by two parallel struts **131** and **132.**

The strut **131** and the lever **133** are journalled to a pivot-pin **134** fastened to the machine frame. The strut **132** is pivotably mounted to the lever **133** half-way between the pivot **134** and the bearing of a cam-follower roller **135** mounted to the end of the lever **133.** A compression-spring always urges the cam follower-roller **135** against the surface of the cam **117.**

Rotation of the main shaft **1** of the welding machine results in a rocking motion of the lever **129,** linked by means of the connecting rod **130** to the crank-pin **114,** as well as of the lever **127** since both these levers are rigidly fastened to the shaft **128.** The lever **127** being

rotatably connected to the strut **124** imparts by means of the parallel motion drive **123, 124, 125, 126** a reciprocating movement to the feeding rails **118.**

The cam **117** has a cam-lobe extending over half of its circumference. During the first half of a full clockwise turn of the main shaft the cam follower roller **135** contacts the sunken part of the cam's surface and the feeding rails **118** remain in a position parallel to the line-wires **101** of the welded mesh and move from the position shown in FIG. **10** to the left. During that movement the hooks **119** engage cross-wires which already have been welded to the line-wires and pull the welded mesh and the line-wires along with the feeding rails. The protrusions **120** advance a new cross-wire which rests in the recess between the two protrusions to the welding station between the electrodes **121, 122.**

When the main shaft has rotated through 180 degrees the feeding rails **118** have reached their extreme left-hand position. Now the lobe of the cam **117** strikes the cam-follower-roller **135** rotating the lever **133** a few degrees in clockwise direction about its pivot **134.** The struts **131** and **132** force the bell-crank-lever **126** to rotate in the same direction and, finally, the same angle of rotation is also imparted to the beam **123** by way of the struts **124, 125.**

Rotation of the beam **123** tilts the feeding rails **118** to the right, lowering their free ends, and, at the same time, disengaging the hooks **119** from the cross-wires and depositing the new cross-wire held between the protrusions **120** on the lower welding electrode **121.**

While the main shaft **1** of the welding machine continues to rotate the feeding rails move back to the right towards their starting position. During the second half of the rotation of the main shaft **1** the cam-follower-roller **135** rides over the raised part of the cam's surface thus keeping the feeding rails **118** inclined with respect to the line-wires **101** of the mesh. The hooks **119** are kept out of engagement with the cross-wires and the free ends of the feeding rails **118** are lowered to such an extent that they can pass underneath the cross-wires which have been fed into the grooves of the grooved blocks **107** by means of the cross-wire-feeding device.

Shortly before the feeding rails again reach their starting position, a cam-operated lever system, not shown in the drawings, rotates the shaft **110** a few degrees in clockwise direction removing the lids **108** from the grooves of the grooved blocks **107.** The moment when the feeding rails have returned to their extreme right-hand position the cam-follower-roller **135** leaves the lobe of the cam and returns to the sunken part of the cam-disk's circumference swinging the feeding rails **118** back to the horizontal. This counterclockwise rotation of the feeding rails brings the hooks **119** back into engagement with the cross-wires of the already welded mesh. At the same time the recess between the two protrusions **120** lifts a newly fed cross-wire out of the grooves of the grooved blocks **107.**

Then, the shaft **110** is rotated back to the position shown in FIG. **10,** the lids **108** covering again the grooves of the grooved blocks **107.** The time interval between the closing of the lids **108,** after removal of a cross-wire **12** from the grooves of the blocks **107** up to the opening of the lids **108,** which immediately precedes the removal of a newly fed cross-wire **12,** is free for feeding of a new cross-wire **12** by means of the feeding mechanism which is an object of this invention. This is the "time required for feeding a maximum length of cross-wire."

The lobe of a cam **115** strikes a cam-follower **137** at the moment when the shaft **110** starts to rotate in clockwise direction in order to retract the lids **108** from the grooves of the blocks **107.** The cam-follower **137** is pivotably mounted to one arm of a bell-crank-lever **138** the other arm of which is loaded by a spring **139** and connected by means of a rod **140** to one end of a shear-blade **141.** The bell-crank-lever **138** is journalled to a pivot-pin **142** which is fastened to the frame of the machine. Due to the action of the spring **139,** the cam-follower **137** is always forced against the cam's surface.

When the lobe of the cam strikes the cam-follower, the bell-crank-lever is rotated counterclockwise imparting a limited rotative movement in clockwise direction to the shear-blade **141** about its pivot **144.** Means for cutting such as shear-blade **141** is situated right in front of a nozzle **143** through which the cross-wire **12,** advanced by the feeding system shown in FIGS. **1** to **3,** issues into the grooves of the blocks **107.** By rotation of the shear-blade **141** the cross-wire is severed from the strand of wire which is pushed off the reel **104** by means of the cross-wire-feeding system.

Now the new cross-wire **12** is ready to be lifted out of the grooves of the blocks **107** by means of the feeding rails **118,** as has been previously described. The eccentric **113** is connected by means of a connecting rod **150** to the electrode beam carrier **151** which is pivotably mounted to the frame of the welding machine at **152.** Usually, there are two eccentrics **113,** two connecting rods **150** and two electrode beam carriers **151,** one at each end of the electrode beam **116.**

The electrode beam **116** is rigidly mounted to the electrode beam carriers **151.** The upper electrodes **122** are resiliently guided within the electrode beam by means of guide rods **153** and compression springs **154.**

The lower electrodes are mounted to the bus-bars, and alternatively connected to either the bus-bar of positive polarity or to the bus-bar of negative polarity. The bus-bars are in conductive connection with the secondaries of a number of transformers mounted in a housing **156.** Upper and lower electrodes are distributed over the width of the welding machine in exactly the same spaced relation as are the longitudinal wires **101,** so that each longitudinal wire rests between an upper and lower electrode.

The upper electrodes are not connected to the source of electric power but are conductively connected with each other in pairs. The welding current passes from a lower electrode of negative polarity through the crossing-point formed by a longitudinal wire with the cross-wire into the upper electrode opposite the lower electrode of negative polarity, through the lead connecting that electrode with its neighbour and finally through another crossing-point of the neighbouring longitudinal wire with the same cross-wire to a lower electrode of positive polarity.

As the main shaft **1** rotates a reciprocating movement is imparted to the electrode beam by means of the eccentrics **113** and the connecting rods **150,** resiliently pressing the crossing-points of the longitudinal wires and a cross-wire between the upper and lower electrodes, each time when the eccentrics pass through

their lower dead centers. During that time, the welding current is switched on.

We claim:

1. In a wire mesh welding machine comprising a main driving shaft, first means operatively connected to said main driving shaft for feeding an array of line wires intermittently side by side in parallel relation through said machine, second means for feeding cross wires successively to said machine from the side of and at right angles to said array of line wires and welding means operatively connected to said main driving shaft for welding said cross wires one after the other to said line wires at their respective crossing points, said means for feeding said cross wires comprising a storage reel for storing a supply of wire, a pair of feed rollers for unreeling wire from said storage reel, means operatively connecting said feed rollers to said main driving shaft whereby said feed rollers are operated to unreel a length of wire from said storage reel in each working cycle of said machine and means operatively connected to said main driving shaft for cutting said unreeled length of wire to form individual cross wires, the improvement comprising a cycle controller, connected in such a way to said main drive shaft of the machine that it emits a start signal in each working cycle of the machine, said start signal serving to engage said means connecting said feed rollers to said main drive shaft in order to impact rotary motion to said feed rollers for unreeling wire from said storage reel and feeding the unreeled wire to said machine, a measured value transducer emitting a signal representing the length of wire unreeled from the storage reel and fed to the machine, a preadjustable counter-controller acting as a reference transducer, means for transmitting said signal emitted by said measured value transducer to said counter-controller, said counter-controller disconnecting said first and second feeding means and causing said feed rollers to stop when a predetermined length of wire has been unreeled and fed to the machine by said feed rollers, said cycle controller emitting after a time interval corresponding to the unreeling of a maximum length of cross wire a reset signal resetting the counter-controller.

2. A wire mesh welding machine as claimed in claim 1 wherein said means operatively connecting said feed rollers to said main drive shaft comprise a power transmission system, an electro-hydraulic servo-valve, means operatively connecting said electro-hydraulic servo-valve to said power transmission system and means rendering said electro-hydraulic servo-valve responsive to the signals from both said cycle controller and said counter-controller.

3. A wire mesh welding machine as claimed in claim 2, wherein said means operatively connecting said feed rollers to said main drive shaft comprise an hydraulic pump being continuously driven by said main drive shaft, an hydraulic motor, means operatively connecting said hydraulic motor to said feed rollers and means connecting said hydraulic pump to said hydraulic motor, an hydraulic servo-valve being interposed between said hydraulic pump and said hydraulic motor for control of the operation of said motor.

4. A wire mesh welding machine as claimed in claim 2, wherein said means operatively connecting said feed rollers to said main drive shaft comprise first and second shafts mounted in aligned relation, hydraulic coupling means disengageably coupling said shafts for rotary motion, an hydraulically operated brake acting on said second shaft, means operatively connecting said second shaft to said feed-rollers, means operatively connecting said first shaft to said main drive shaft and means connecting said electro-hydraulic servo-valve to said brake and said coupling means, said valve selectively engaging or disengaging said coupling means and releasing said brake when the coupling is engaged.

5. A wire mesh welding machine as claimed in claim 4, further comprising an hydraulic pump, means driving said pump independently of that main drive shaft, and hydraulic ducts connecting said pump to said brake and said hydraulic coupling means, said electro-hydraulic servo-valve being interposed in said ducts between said brake and said coupling means.

6. A wire mesh welding machine as claimed in claim 2, wherein said measured value transducer is a pulse transmitter which emits pulses at a frequency proportional to the speed at which the cross wire is advanced by said feed rollers and further comprising means operatively connecting said counter-controller to said electro-hydraulic servo-valve said counter-controller including a counting device which, after a predetermined number of pulses emitted by the pulse-transmitter have been counted by said counting device, causes said means operatively connecting said feed rollers to said main drive shaft to be disengaged by closing that electro-hydraulic servo-valve.

7. A wire-mesh welding machine as claimed in claim 6, further comprising an energizing circuit for said electro-hydraulic servo-valve, said energizing circuit comprising an AND gate and means connecting said AND gate to both said counter-controller and said cycle controller, whereby when said AND gate receives a sustained signal from said cycle controller in part of each working cycle of the machine, the leading flank of said sustained signal causing said electro-hydraulic servo-valve to be opened in order to engage said means operatively connecting said feed rollers to said main drive shaft and the trailing flank of said sustained signal causing said electro-hydraulic servo-valve to be closed and said counter-controller to be reset to zero.

8. A wire mesh welding machine as claimed in claim 7, wherein said counter-controller comprises means producing a control signal which, in each feeding cycle gradually increases the tension applied at the input terminal of said AND gate to a maximum and susequently gradually reduces that tension to zero.

9. A wire mesh welding machine as claimed in claim 6, comprising a plurality of counter-controllers, each one adjustable for a different length of wire to be fed to said machine and means for selectively connecting said measured value transducer to each one of said plurality of counter-controllers for feeding of wires of different predetermined length.

10. A wire mesh welding machine as claimed in claim 9, wherein said means selectively connecting said measured value transducer to anyone of said plurality of counter-controllers comprise program controlling means.

11. A wire mesh welding machine as claimed in claim 1, further comprising means mechanically connecting said measured value transducer to said feed rollers.

12. A wire mesh welding machine as claimed in claim 1, further comprising a pick-up wheel, a supporting wheel conjugate to said pick-up wheel, means guiding said cross-wire from said feed rollers to said pick-up

wheel whereby said pick-up wheel is rotated through an angle depending on the length of said cross wire unreeled by said feed rollers and means mechanically connecting said measured value transducer to said pick-up wheel.

13. A wire mesh welding machine as claimed in claim **1**, wherein said measured value transducer comprises a magnetic recording head, a magnetic pick-up head, means mounting said magnetic pick-up head at a specified distance from said recording head, means guiding said cross wire fed by said feed rollers past said recording head and subsequently past that pick-up head, means in said recording head to provide magnetic signal marks on said cross-wire and means interconnecting said recording head and said pick-up head so that a further magnetic signal mark is provided on said cross-wire when a preceeding mark is picked up by said pick-up head and means connecting said pick-up head to said counter-controller for counting the signals emitted by said pick-up head in order to control the length of wire fed to the machine.

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