Sept. 25, 1956 H. DIETERMAN ET AL 2,763,950

ETCHING PLATE MOVEMENT MECHANISM

Filed Nov. 21, 1955

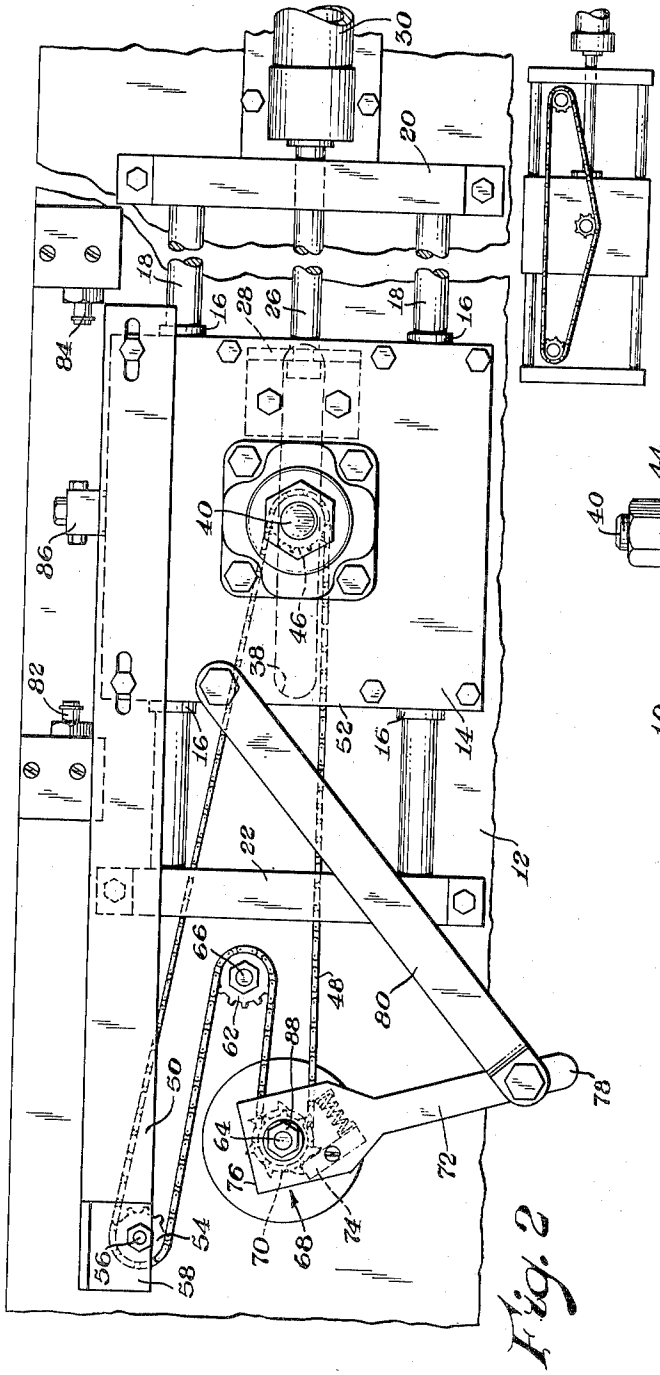


Fig. 2

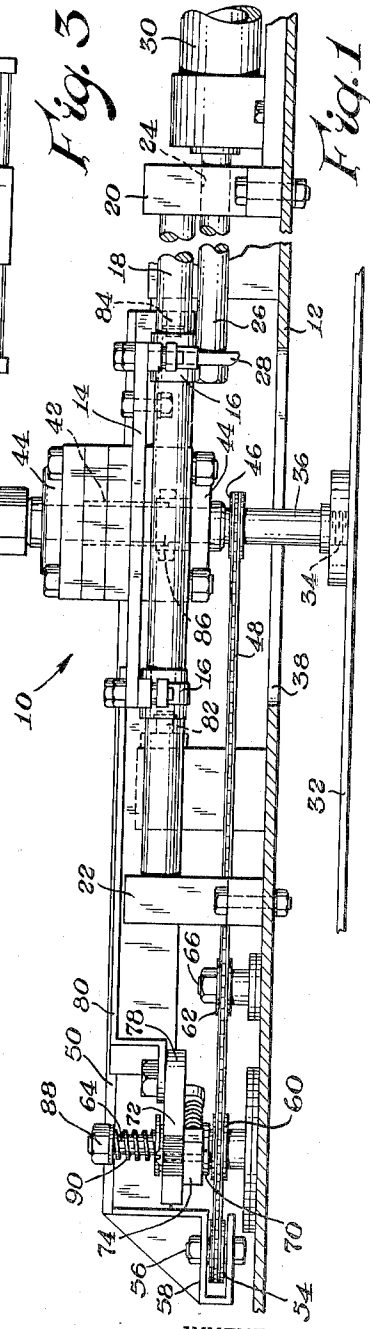


Fig. 1

Fig. 3

INVENTORS.
Henri Dieterman
William J. Bill

BY
Griswold & Burdick
ATTORNEYS

United States Patent Office

2,763,950

Patented Sept. 25, 1956

2,763,950

ETCHING PLATE MOVEMENT MECHANISM

Henri Dieterman, Essexville, and William J. Bill, Bay City, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware

Application November 21, 1955, Serial No. 548,140

5 Claims. (Cl. 41—9)

This invention relates to a plate movement mechanism for use with splash type etching machines, and especially to plate movement mechanisms which impart both a rotary and translatory motion to the plate to be etched.

In etching machines of the type with which this invention is adapted to be used there is the difficulty that the plates are not always uniformly etched. This difficulty, it has been found, is due to the fact that some portions of the plate undergoing etching persistently receive a more vigorous splashing of etching acid than do other parts of the plate. To a large extent the difficulty of uneven etching of plates may be overcome by providing the plate with suitable motion with respect to the etching bath.

A principal object of this invention is to provide improved plate movement apparatus for use with a splash type etching machine.

Another object of this invention is to provide an improved plate movement apparatus which imparts to the plate rotatory and translatory motion at continuously controlled rates.

The above objects are attained in accordance with this invention by utilizing a reciprocating element coupled to a carriage plate to impart the translatory movement to the plate and a chain driven sprocket coupled to a plate holding shaft which is journaled in bearings on the carriage plate for producing rotatory motion of the plate. The chain is so coupled that rotatory motion is produced at all times the reciprocating element is in motion.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevational view, partly broken away and in section, of the plate moving apparatus in accordance with this invention;

Fig. 2 is a plan view, partly broken away and in section, of the apparatus shown in Fig. 1, and

Fig. 3 is a diagrammatical view, on a reduced scale, of an alternative plate moving apparatus in accordance with this invention.

Referring to the drawings, there is shown plate moving apparatus, indicated generally by the numeral 10, mounted on the cover 12 of a splash type etching machine.

The plate moving apparatus 10 includes a rectangularly shaped carriage plate, indicated generally by the numeral 14. The carriage plate 14 is mounted on bearings 16 which are adapted to slide on parallel rod-like ways 18 mounted on top of the cover 12 by means of the end plates 20 and 22. One end plate 20 has an aperture 24 through which passes a drive rod 26. One end of the drive rod 26 is connected to a drive rod coupling plate 28 near one end of the carriage plate 14. The other end of the drive rod 26 is connected to a hydraulic cylinder drive unit 30 which is mounted on the cover 12.

A work holder plate 32 is mounted for rotation in a plane parallel to the cover 12 on the lower end 34 of a shaft 36 which extends through a slot 38 in the cover 12. The other end 40 of the shaft 36 passes through an aperture 42 in the carriage plate 14 and is journalled in bearings 44 which are bolted or otherwise secured to the carriage plate 14. A sprocket 46 adapted to engage the links in a drive chain 48 is fixedly mounted on the shaft 36 between the cover 12 and the lower part of the bearings 44. An extension bracket 50 is secured to one side of the carriage plate 14 and extends from the end 52 of the carriage plate which is opposite to the hydraulic drive shaft unit 30. A sprocket 54 is rotatably mounted on a short shaft 56 at or near to the extended end 58 of the extension bracket 50. The axis of the short shaft 56 is parallel to the axis of the shaft 36 which carries the work holding plate 32.

Two additional rotatable sprockets 60 and 62 are mounted on short shafts 64 and 66, respectively, which extend upwardly from and are secured to the cover 12. The shaft 64, which is farthest from the carriage plate 14, has a ratchet mechanism, indicated generally by the numeral 68, coupled thereto. The ratchet mechanism 68 comprises a ratchet gear 70, a ratchet arm 72, a spring loaded ratchet gear engaging pin 74 secured to the ratchet arm 72 and adapted to bear against the gear 70. One end 76 of the ratchet arm 72 is apertured and fits over the shaft 64 containing the ratchet gear 70. The other end 78 of the ratchet arm 72 is loosely coupled to one end of an arm member 80 which extends to and is loosely coupled to the carriage plate 14 near the end 52 thereof which is adjacent to the shafts 64, 66 and near the extension bracket 50. The other shaft 66 is disposed between the shaft 64 bearing the ratchet gear 70 and the nearest end plate 22 and generally between the ratchet gear bearing shaft 64 and the extension bracket 50. The spatial relationship between the sprocket 54 at the end 58 of the extension bracket 50 and the sprocket 62 on the shaft 66 is such that when the carriage plate 14 is furthest removed from the end plate 22 the sprocket 54 on the end 58 of the extension plate 50 is never any nearer to the end plate 22 than is the sprocket 62.

A loop of chain 48 is threaded tightly around the various sprockets 46, 54, 60, 62. The chain loop path is from the sprocket 46 on the plate holder shaft 36 to the sprocket 60 on the ratchet shaft 64, to the sprocket 62 and around the sprocket 54 on the extension bracket 50 and back to the sprocket 46 on the plate holder shaft 36. With such an arrangement the peripheral path around the various sprockets remains constant in length through the sprockets 46 and 54 carried by the shaft 36 on the carriage plate 14 and on the extension bracket 50, respectively, move with respect to the other sprockets 60, 62.

Limit switches 82, 84 are provided at each side of the carriage plate 14. A contactor 86 comprising a plate extending from one side of the carriage plate 14 actuates one of the limit switches 82, 84 each time the carriage plate 14 approaches an end plate (20 or 22). The limit switches 82, 84 are used to control the direction of movement of the piston (not shown) of the hydraulic drive unit 30 which may be driven by any suitable fluid source.

During operation the plate moving apparatus 10 moves the plate to be etched (the plate being secured to the plate holder 32) over a splashing etch bath with a movement which includes both translational and rotational motion of positive progression. (See U. S. Patent No. 2,699,048 to Easley et al. for a description of an etching machine with which this plate moving apparatus is adapted to be used in place of the plate moving mechanism shown. The above described type of motion is required in order to insure maximum uniformity of contact between the upwardly moving drops of etching bath and the plate being etched.)

The translatory motion of the plate holder 32 is accomplished by means of the reciprocating motion of the hy-

draulic drive unit **30** which is transmitted to the carriage plate **14** through the drive rod **26**. The rotary motion is achieved by means of the chain **48**. The chain **48** is held stationary by the ratcheted sprocket position (at sprocket **60**) except during the ratchet advance stroke due to friction between a stop member **88** on the shaft **64**, the ratchet arm **72** and the ratchet gear **70**. The friction is the result of tension on those parts **88, 72, 70** (applied by the spring **90** on the shaft **64**). Since the chain **48** is normally held motionless, the sprockets **46** and **54** on the carriage plate and extension bracket move along the chain **48** as the translatory motion takes place. Because the carriage plate sprocket **46** is coupled to the shaft **36**, causing the shaft **36** to rotate, the plate or work holder **32** is also rotated as it undergoes translatory motion. The direction of rotation of the work holder **32** changes as the direction of translatory motion changes. The length of the ratchet arm **72** and the length of the coupling arm **80** is such that the engaging pin **74** moves the ratchet gear **70** and advances the chain **48** by a distance represented by one notch of the ratchet gear **70** each time the carriage plate **14** completes one cycle of motion towards the end plate **22**.

A hydraulic drive unit has been illustrated as the means for driving the carriage plate at a substantially constant velocity on each cycle of motion. Other drive means, such as an electric motor on the carriage plate and geared to a rack-type gear on the ways could be used to produce the translatory motion of the carriage plate. Combination limit and reversal switches would thus replace the limit switches shown in Fig. 2.

Another embodiment of the invention is shown diagrammatically in Fig. 3. In the embodiment of Fig. 3 the chain (or belt) means for use in providing the work holder with reciprocatory motion is threaded around three rather than four sprockets. Although for the sake of simplicity no ratchet arrangement is shown in Fig. 3, a ratchet gear and holding arrangement of the type shown in Figs. 1 and 2 (gear **70**, spring **90**, and stop member **88**) could be applied at either of the end sprockets. The ratchet gear **70** conveniently would be advanced by a drive pin (not shown) coupled to the appropriate end of the carriage plate.

An advantage of the embodiment of Fig. 3 is its compactness and that the moving parts (except for the drive rod **28** coupled to the hydraulic drive unit **30**) can be easily enclosed by a cover plate (not shown).

We claim:

1. Work plate moving apparatus for use with a splash type etching machine in which a work plate is moved in a plane above a bath of etchant fluid in both a translatory and a rotatory manner while the bath liquid is splashed against the work plate, comprising a mounting plate having an elongated slot extending therethrough, a carriage plate mounted above said slot on ways and adapted to be moved in a translatory manner along an axis which is aligned with said slot, a rotatable shaft including upper and lower end parts, the upper end part being secured to said carriage plate by a journalling assembly, the lower end of said shaft extending through said slot and having a work plate holder attached thereto, said shaft having a drive coupling member affixed thereto intermediate the ends of the shaft, flexible drive means coupled to said drive coupling member, said drive means comprising a closed loop, means for alternately holding said drive means stationary and then advancing said drive means unidirectionally in a repetitive manner, and means for driving said carriage plate in a reciprocatory motion parallel to said slot.

2. Apparatus in accordance with claim 1, wherein said means for driving said carriage plate comprises a hydraulic drive unit having a reversible piston.

3. Work plate moving apparatus for use with a splash type etching machine in which a work plate is moved in a plane above a bath of etchant fluid in both a translatory and a rotatory manner while the bath liquid is splashed up against the work plate, comprising a mounting plate adapted to be supported horizontally over the bath, and having an elongated slot extending therethrough, a carriage plate slidably mounted above said slot on ways and adapted to be moved in a translatory manner along an axis which is aligned with respect to said slot, a rotatable shaft including upper and lower end parts, the upper end part being secured to said carriage plate by a journalling assembly, the lower end of said shaft extending through said slot and having a work plate holder attached thereto, said shaft having a sprocket affixed thereto intermediate the ends of the shaft, chain drive means coupled to said sprocket, said chain comprising a closed loop, means for alternately holding said chain stationary and then advancing the chain unidirectionally in a repetitive manner, and means for driving said carriage plate in a reciprocatory motion parallel to said slot.

4. Apparatus in accordance with claim 3, wherein said means for alternately holding said chain stationary and then advancing the chain unidirectionally comprises friction means bearing against a ratchet which is secured to said shaft, the ratchet being adapted to be actuated by said carriage plate.

5. Work plate moving apparatus for use with a splash type etching machine in which a work plate is moved in a plane above a bath of etchant fluid in both a translatory and a rotatory manner while the bath liquid is splashed up against the work plate, comprising a mounting plate having an elongated slot extending therethrough, a carriage plate mounted above said slot on rod-like ways and adapted to be moved in a translatory manner along an axis which is aligned with respect to said slot, a rotatable shaft including upper and lower end parts, the upper end part being secured to said carriage plate by a journalling assembly, the lower end of said shaft extending through said slot and having a work plate holder attached thereto, said shaft having a drive coupling member affixed thereto intermediate the ends of the shaft, flexible drive means coupled to said drive coupling member, said drive means comprising a closed loop, means for alternately holding said drive means stationary and then advancing said drive means unidirectionally in a cyclic manner, and means for driving said carriage plate in a reciprocatory motion.

No references cited.