Feb. 1, 1955 W. GUENST 2,700,838

ETCHING MACHINE

Filed May 10, 1954 5 Sheets-Sheet 1

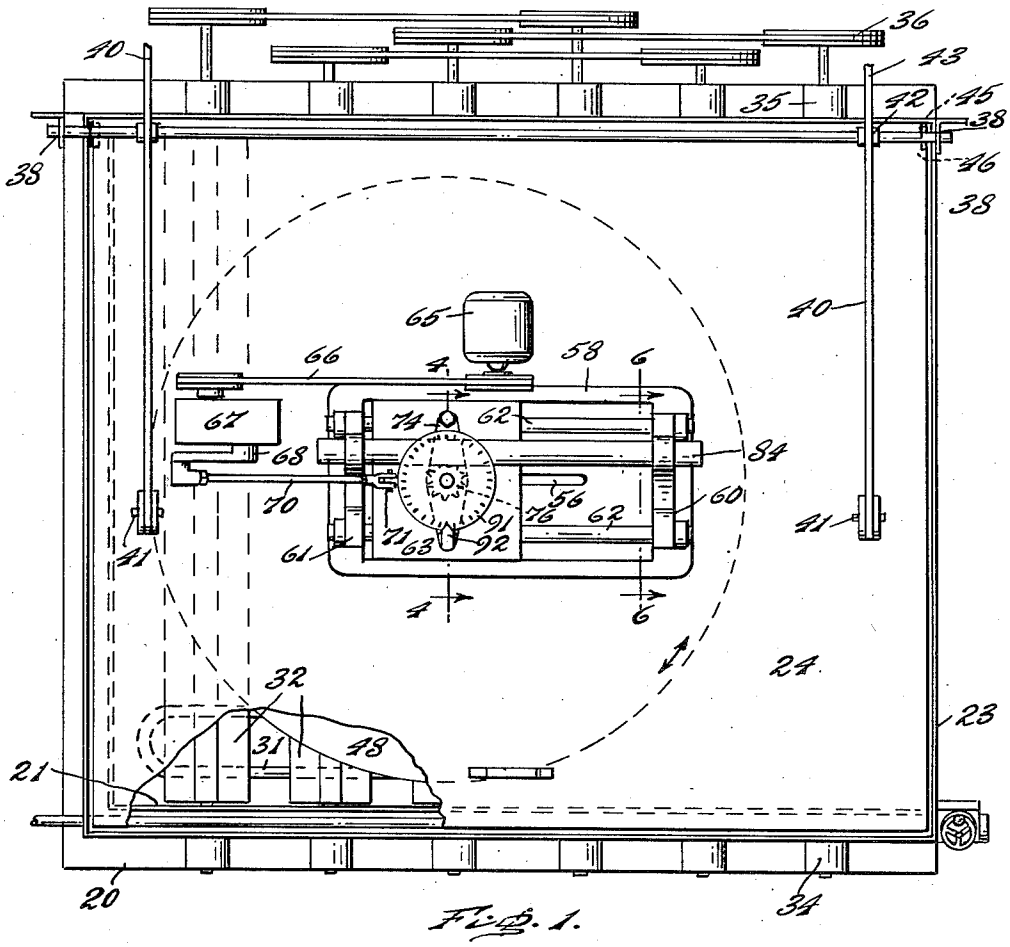


FIG. 1.

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Filed May 10, 1954 5 Sheets-Sheet 2

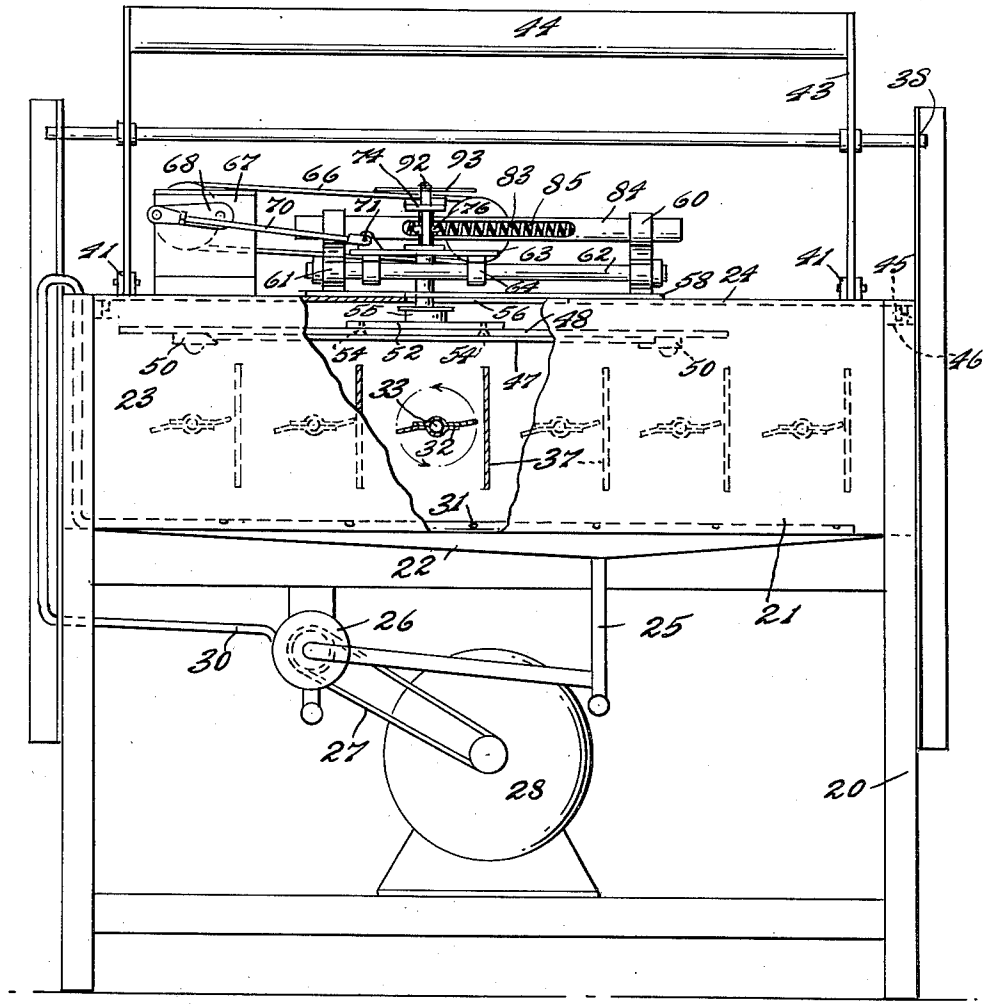


Fig. 2.

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Filed May 10, 1954 5 Sheets-Sheet 3

Fig. 3.

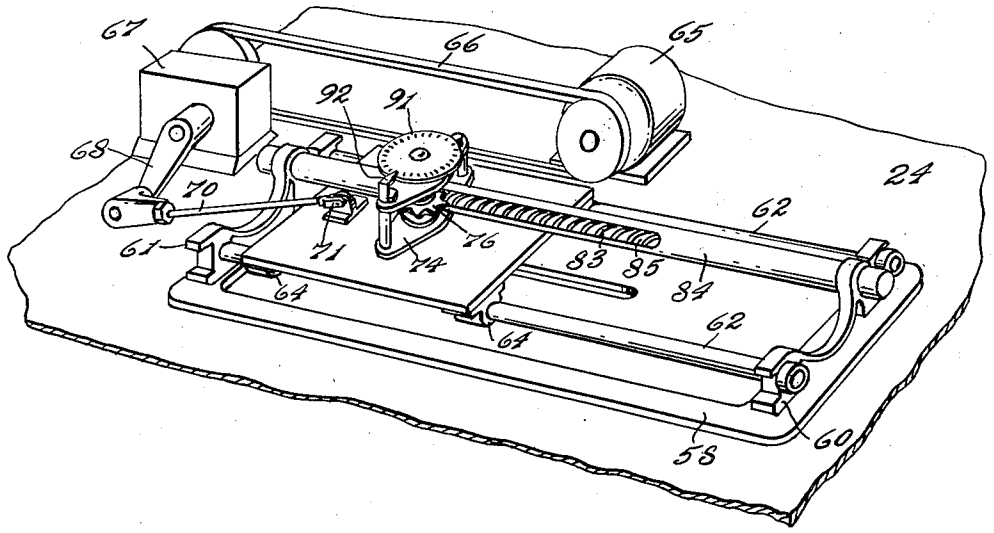
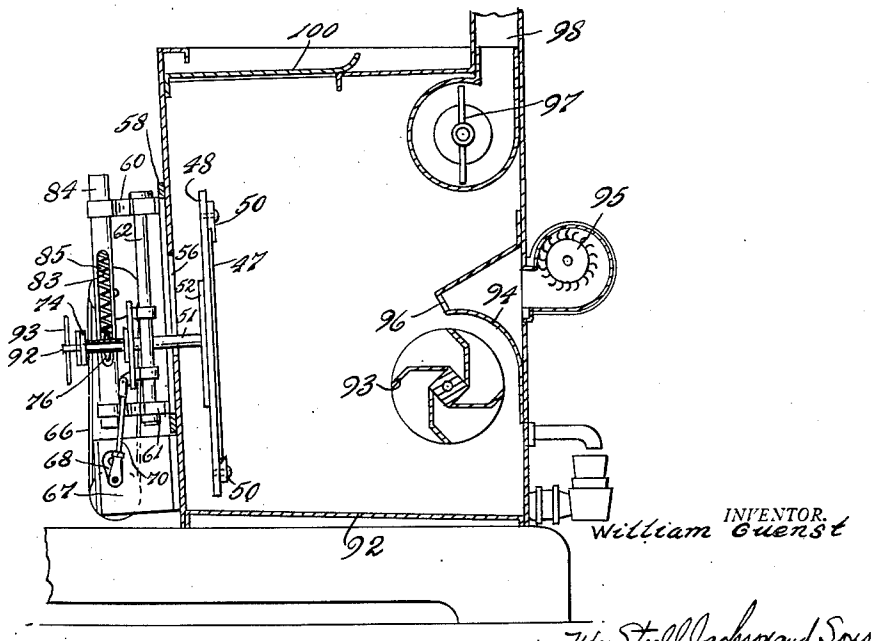


Fig. 9.



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ETCHING MACHINE

Filed May 10, 1954 5 Sheets-Sheet 4

Fig. 4.

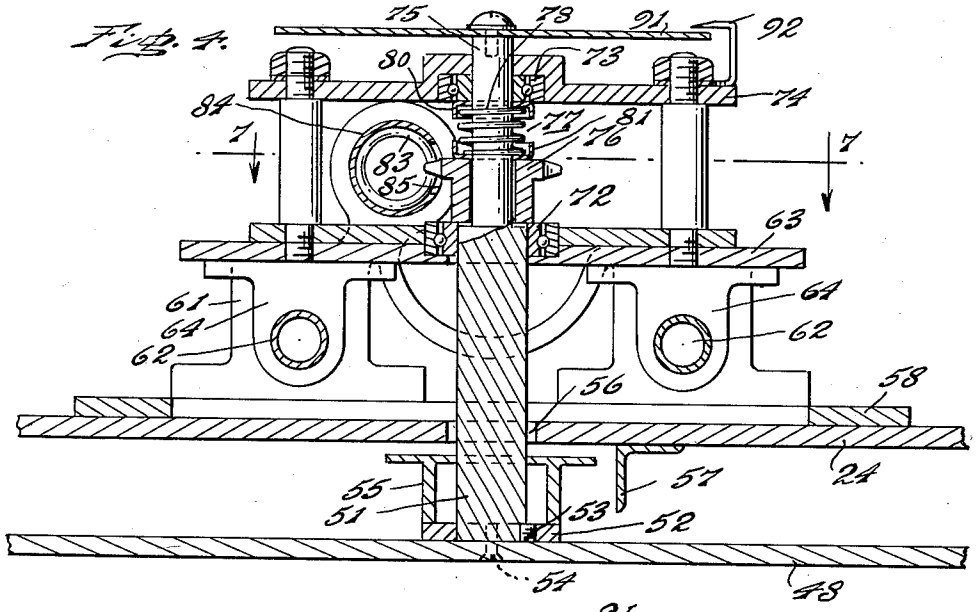


Fig. 5.

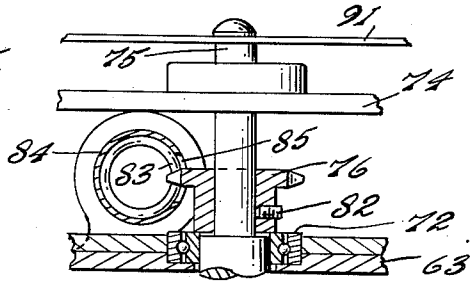
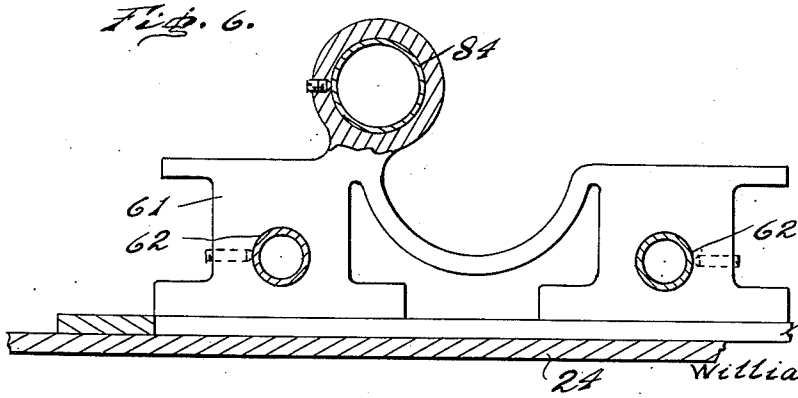


Fig. 6.



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Feb. 1, 1955 W. GUENST 2,700,838

ETCHING MACHINE

Filed May 10, 1954 5 Sheets-Sheet 5

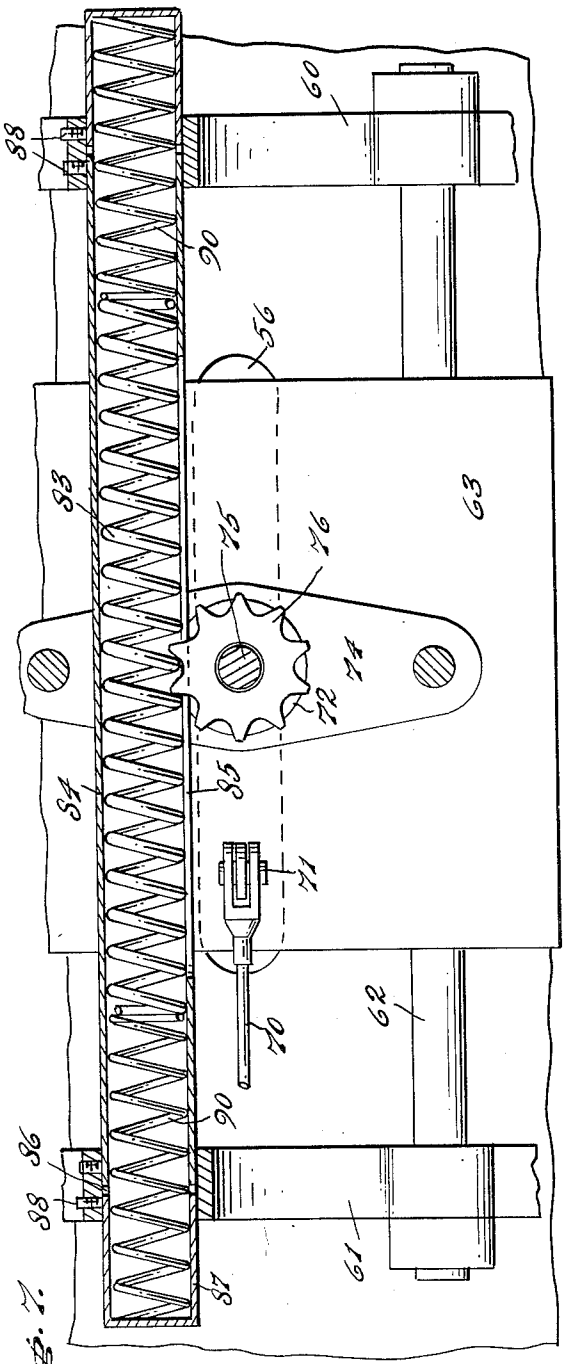


Fig. 7.

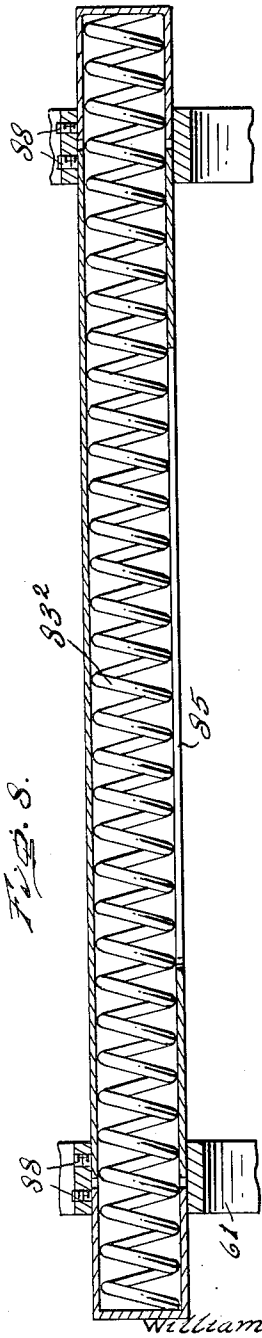


Fig. 8.

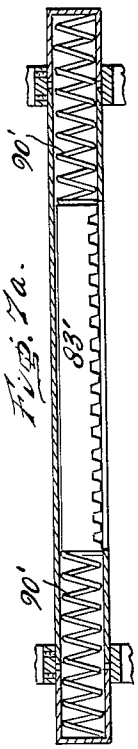


Fig. 7a.

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United States Patent Office 2,700,838 Patented Feb. 1, 1955

2,700,838

ETCHING MACHINE

William Guenst, Elkins Park, Pa.

Application May 10, 1954, Serial No. 428,573

9 Claims. (Cl. 41—9)

The present invention relates to etching machines of the character which are employed in etching printing plates.

A purpose of the invention is to create a random motion of a printing plate with a wider scatter band of variation in angle.

A further purpose is to provide a rack, which rotates a plate mounting as a carriage reciprocates, with a pivotal mounting on a longitudinal axis and make the rack of screw form, preferably a helical coil and most desirably a helical coil spring, so that the reaction forces of the cooperating gear against the rack can rotate the rack and change the angle of motion of the plate support.

A further purpose is to compress a helical spring in a housing to restrain it against turning while permitting chance turning, and desirably to adjust the compression.

A further purpose is to restrain the helical coil spring by one or preferably two opposed weaker springs acting on the housing against the rack spring, and preferably to wind the weaker spring or springs in the same direction as the rack spring.

A further purpose is to provide a friction clutch in the drive to further vary the angle of turning according to a random distribution.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a top plan view of the preferred embodiment of the etching machine of the invention.

Figure 2 is a front elevation of the etching machine of Figure 1 partially broken away to show the plate mounting.

Figure 3 is an enlarged fragmentary perspective of the random drive.

Figure 4 is an enlarged section on the line 4—4 of Figure 1, showing the random drive.

Figure 5 is a view corresponding to Figure 4 and showing a modification.

Figure 6 is an enlarged section on the line 6—6 of Figure 1.

Figure 7 is a plan section taken on the line 7—7 of Figure 4.

Figure 7*a* is a view similar to Figure 7 but showing a modification.

Figure 8 is a fragmentary view corresponding to Figure 7 and showing a modification.

Figure 9 is a vertical section of a modified etching machine in which the plate is supported in generally vertical position rather than in horizontal position.

Describing in illustration but not in limitation and referring to the drawings.

In etching machines for printing plates it is desirable to spray acid on the plate, and in some machines, in order to secure a maximum of uniformity of acid distribution, the plate is moved, desirably being reciprocated and rotated as shown for instance in Easley U. S. Patent 2,669,048, dated February 16, 1954, for Etching Machine.

Efforts have been directed toward producing motions of the plate mounting according to a random or chance plan, in order to avoid channeling or prevent local concentration of acid etch due to the position of reversal or modification of the motion, but limited success has

been obtained, due in part to the tendency of such mechanisms to follow a restricted pattern and not give a wide scatter band of motion, and also because vibratory forces introduced in an effort to obtain random variation in the motion have tended to destroy the mechanism.

The present invention is concerned particularly with obtaining a motion of the plate mounting which will vary widely and without restriction of pattern, so as to assure that the point of change or variation of the motion will not be localized or preferentially concentrated with respect to the area of the plate, and very uniform etching will be obtained.

Furthermore, in accordance with the present invention, a very high degree of ruggedness is introduced into the mechanism, and forces incident to starting, stop and reversing are absorbed resiliently and are made to contribute to the chance variation of the motion without destroying the mechanism.

In accordance with the invention a rack is employed to turn or rotate the plate mounting which is of helical form and capable of turning under the reaction. The rack is preferably a helical coil of wire or the like and is most desirably a helical compression spring. The spring is also desirably placed under compression to retard but not prevent rotation about the longitudinal axis of the spring. In the preferred form, a weaker spring or weaker springs, preferably of the same diameter and preferably wound in the same direction, apply compression at the ends of the rack spring.

Also in the preferred embodiment the chance variation is increased by use of a friction clutch in the drive between the gear and the plate mounting.

Considering now the form of the invention of Figures 1 to 8 inclusive, the etching machine comprises a frame **20** supporting a tank **21** which is provided with a sloping bottom **22**, side walls **23** and a cover **24**. The circulation of acid to create the acid spray, as well known in the art, is accomplished by withdrawing acid from the bottom through a pipe **25**, and pumping by a pump **26** driven through a pulley and belt arrangement **27** from an electric motor **28**, the pump circulating through pipes **30** to acid sprays **31** inside the tank.

The acid level in the bottom of the tank is high enough to reach the bottom of distributing paddles or impellers **32** on shafts **33** which are journaled on the outside of the tank in bearings **34** and **35**, but not high enough to cause leakage at the bearings. The paddles are driven by a system of pulleys and belts **36** from the motor **28** as well known.

The compartments in which the respective paddles operate are separated by vertical baffles **37** which run the length of the tank.

The lid is mounted for ready insertion and removal of the work, conveniently by pivoting at **38** at one side of the top of the tank, and providing counterbalance arms **40** which are pivotally connected at an intermediate point on the top of the tank at **41**, and which extend out beyond pivot supports **42** to form extensions **43** which carry a counterweight **44**. When the lid is tilted to raise it, its lower ends travel on rollers **45** on a track **46** at the top of the machine.

Considering now the random drive mechanism more in detail, the printing plate **47** to be etched is supported on the lower end of a plate mounting **48** as by adjustable clips **50** at the corners. The plate mounting **48** is secured to the bottom of a shaft **51**, as by a bar **52** which is secured to the shaft by screw **53**, screws **54** connecting the plate mounting to the bar. A baffle **55** is placed above the bar **52** to prevent acid spray from leaving the tank through slot **56** in the lid **24**. Along one side of the baffle **55** an angle baffle **57** is secured to prevent spray from intruding into the space between the baffle **55** and the lid. The angle baffle **57** desirably runs somewhat beyond the range of movement of the shaft in the slot **56** at either end.

On the top of the lid a base **58** is mounted which carries end brackets **60** and **61** which secure guide rods **62** in generally horizontal parallel relation above the lid. A carriage **63** slides on the guide rod **62**, having sliding bearings **64** beneath the carriage which guide the carriage

in reciprocation through a range of movement permitted by the slot **56**. The reciprocation of the carriage is controlled by electric motor **65** on the lid, driving through pulley and belt combination **66** to speed reducer **67** which operates crank **68** pivotally connected to connecting rod **70**, the opposed end of which is pivotally connected at **71** to the top of the carriage to reciprocate the carriage.

The shaft **51** is journaled in antifriction bearings **72** and **73** mounted on the carriage in a superstructure **74**. At the upper end the shaft **51** has a reduced diameter portion **75** which is surrounded by gear **76** which is preferably of sprocket formation to engage a helical rack as later explained. In the preferred embodiment the gear is permitted to relatively move with respect to the shaft by friction clutch **77**, consisting of a helical spring **78** surrounding the shaft, and opposed spring cups **80** and **81** around the shaft acting respectively against the inner retainer of bearing **73** and the gear **76**. While the frictional clutch engagement of the gear to the shaft is preferred, the gear may be secured to the shaft as by a set screw **82** shown in Figure 5.

The gear engages a helical rack **83** which is preferably a helical compression spring, which extends throughout the interior of a tubular housing **84** having a longitudinal slot **85** through which the teeth of the gear extend. The tubular housing is desirably rigidly mounted at the ends in the brackets **60** and **61**. In the preferred embodiment, as shown best in Figure 7, the housing **84** comprises an intermediate portion **85** which extends part way through mounting sockets **86** at the end, and also cup portions **87** at the ends having closed ends and held in the sockets **86** by set screws **88**. The cup portions are adjustable in position lengthwise to control the compression of the spring **83**.

In the preferred embodiment, the rack spring **83** substantially conforms to the inside diameter of the housing, and is engaged at one or preferably at both ends by weaker helical springs **90** which are under compression between the ends of the housing, and tend to restrain the rack spring against turning. The weaker springs and the rack spring are preferably wound in the same direction to give satisfactory bearing areas at the ends. The weaker springs and the rack spring are also preferably of the same diameter.

In Figure 7*a* I show the center rack **23'** as of solid material with teeth **83'**, but with the end spring **90'** the same as in Figure 7.

In some cases the weaker spring can be omitted, and as shown in Figure 8 the rack spring **83²** in this case extends the full length of the housing and is under slight compression longitudinally to provide some restraint against turning.

At the top of the shaft **51** is carried a dial indicator **91** which indicates the relative angular position of the shaft and therefore of the printing plate by reference to an index finger **92** on the superstructure of the carriage.

The invention can be applied as shown in Figure 9 for mounting a printing plate in which the plate is generally vertical, as well known in etching machines of the character of my U. S. Patent 2,651,869, granted September 15, 1953, for Etching Machine. In this form the tank **92** has a rotating paddle **93** which projects acid through a curved guiding channel **94** and receives air from a blower **95** through inlet jets **96** entering the acid stream. The plate mounting **48** and the mechanism for driving it may conform exactly to that already described except that it is placed on the vertical side instead of on the top in a horizontal or vertical position. The etching machine is suitably provided with an exhaust blower **97** and a gas flue **98** and is closed by a removable cover **100**. In operation in any of the forms shown it will be evident that as the carriage reciprocates back and forth it will carry the shaft bodily and with it the gear, and the gear will turn in cooperation with the turns of the helical rack except insofar as the load is great enough to rotate the rack about its longitudinal axis.

This rotation of the rack about its longitudinal axis will occur to some extent under the reaction, particularly at points of reversal where the load may correspondingly increase, and will introduce a chance feature in the turning of the gear, as it will depend upon the frictional drag of the housing on the helical rack, and also the spring loading of the auxiliary springs **90**, where used, at the ends of the housing. There will also be a certain amount of longitudinal yield of the helical rack when it is of spring form, and this in itself will constitute a chance element in the turning of the gear.

While there will be a chance element introduced in this way it will be understood that there will be a resilient or cushioning effect which will not cause damaging vibration or shock since the springs can yield and the yielding will accommodate to the load of the gear.

If the gear is directly connected to the shaft as in Figure 5, the chance distribution or random distribution of the range of turning of the gear will turn the plate mounting accordingly, as the plate mounting is reciprocated by the carriage, and if, as in Figure 4, the gear is connected to the shaft by friction clutch, a further chance element is introduced, as the friction gear is free to slip to a variable extent with respect to the shaft.

It will therefore be evident that each time the plate is reciprocated through a series of revolutions or parts of revolutions it will end and reverse its rotation at different points. Thus, depending upon the setting, that is, the compression of the spring which retards the rotation of the helical spring rack, and the load on the friction clutch, it is possible to change the position of reversal or the total angle of turning by anywhere from a few degrees to 15 or 20 degrees or more each time the carriage reciprocates.

It will be understood that this can be adjusted as by adjusting the setting of the cups **87** longitudinally to tighten or loosen the springs **90**.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An etching machine including a tank and means in the tank for spraying acid on a printing plate to be etched, in combination with a carriage, means for reciprocating the carriage, a shaft rotatably mounted on the carriage, a plate support on the shaft on which the printing plate is mounted, a gear on the shaft, a rack in operative relation to the gear having a screw form and means for mounting the rack rotatably about an axis longitudinal of the rack in response to reaction forces of the gear against the rack, whereby a chance variation in the range of rotation of the plate support is obtained as the carriage reciprocates.

2. An etching machine according to claim 1, in which the rack is a helical coil.

3. An etching machine according to claim 1, in which the rack is a helical coil spring longitudinally under compression.

4. An etching machine according to claim 1, in which the rack is a helical coil spring longitudinally under compression, in combination with means for adjusting the longitudinal compression of the spring.

5. An etching machine according to claim 1, in which the rack is a helical coil, and the means for mounting permitting rotation of the same constitutes a slotted housing in which the helical coil is free to turn.

6. An etching machine according to claim 1, in which the rack and the means for mounting therefor comprise a housing having an opening therein, a first helical spring in the housing adapted to engage the gear, and an additional helical spring weaker than the first placed endwise with respect to the first and compressing the first spring longitudinally.

7. An etching machine according to claim 6, having a spring weaker than the first in the housing at each end of the first spring and retarding rotation of the first spring.

8. An etching machine according to claim 6, having additional helical springs in the housing on opposite ends of the first spring and under longitudinal compression, the additional springs being wound in the same direction and of the same diameter as the first spring but weaker than the first spring.

9. An etching machine according to claim 1, in combination with a friction clutch interposed in the drive between the gear and the plate mounting.

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