

Aug. 30, 1960

L. B. HOLMAN ET AL
GYRATORY SEPARATOR

2,950,819

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2 Sheets-Sheet 1

Fig. 1.

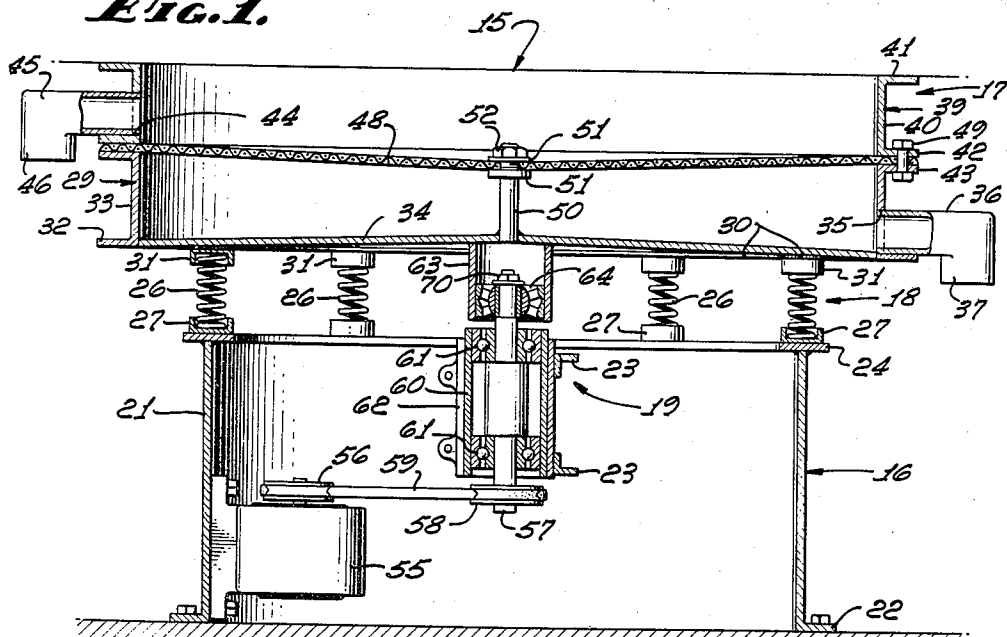


FIG. 3.

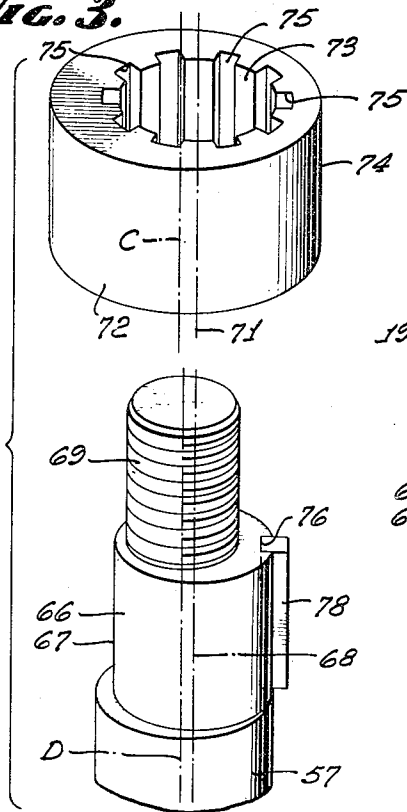
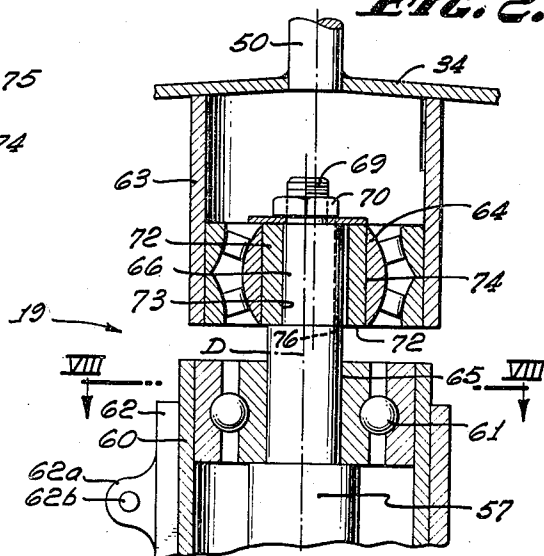


FIG. 2.



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FIG. 4.

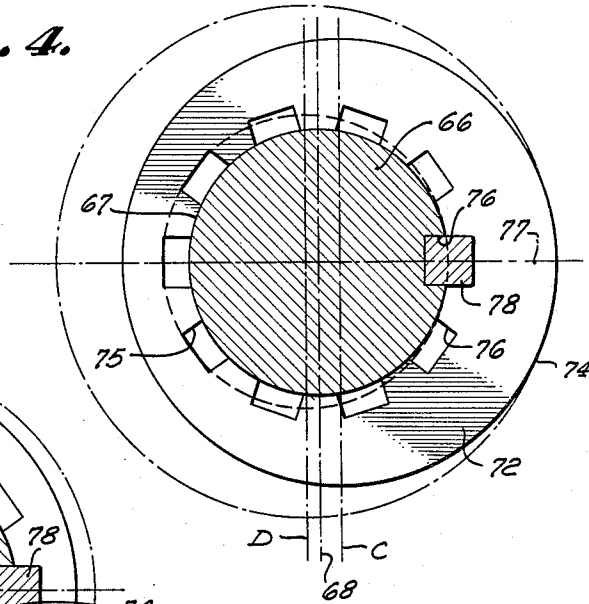
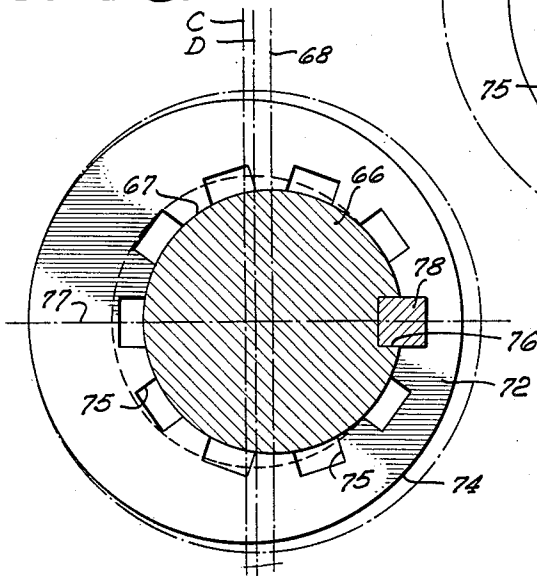


FIG. 5.



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5 Claims. (Cl. 209—326)

This invention relates to a separator of gyratory type and more particularly to a gyratory separator constructed and arranged to impart a gyratory motion including horizontal, generally circular and vertical motion components to a vibratable shaking box assembly adapted to screen and separate a material introduced thereto. The gyratory separator of this invention is useful, generally speaking, in the separation of particles of material of different characteristics and of solids from liquids. More specifically, the separator has industrial use in the separation of sand and gravel, vegetables, such as sizing peas, grain, purification of clays and many other materials.

The present invention contemplates a gyratory separator in which a circular shaking box or sieve means of one or more box sections is resiliently and limitedly, laterally, yieldably supported by a plurality of circularly arranged spaced resilient means or coil springs from a stationary frame means. The said gyratory motion is imparted to the shaking box assembly by an eccentric connection including a self-aligning bearing which produces, in combination with the circularly arranged coil springs, a progressively tilting of the shaking box during its generally circular horizontal motion. As a result of this combination of a self-aligning bearing associated with the vibratable shaking box and the resilient support thereof, material being separated is not only rapidly screened, but non-passable material tends to flow towards the periphery of the shaking box and thence along the periphery to a discharge outlet. During the course of this flow of material, the vertical motion component imparted to the shaking box tends to upset the material facilitating effective separation and preventing clogging of the screen fabric. The present invention also contemplates means for readily varying the flow pattern of the material to adapt the separator to material of different characteristics as by convenient adjustment of the amount of eccentricity provided in the eccentric connection.

Prior proposed separators of gyratory type have provided a somewhat similar flow pattern of material being separated by relatively complicated, complex constructions including eccentrically mounted weights for dynamically unbalancing the device. Such prior proposed devices were generally expensive to manufacture, subject to undue rapid wear of relative moving parts and were not readily adjustable to adapt such prior devices to materials of different characteristics.

Therefore, the primary object of this invention is to disclose and provide a separator of gyratory type, of novel construction, in which the disadvantages of prior proposed separators are obviated and in which new advantages and results are achieved.

An object of this invention is to disclose and provide a gyratory separator of simple construction, of inexpensive manufacture and of convenient flexible adaptation to materials of different characteristics.

Another object of this invention is to disclose and provide a gyratory separator including a novel combina-

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tion of circularly arranged resilient means for supporting a shaking box assembly and a self-aligning bearing associated with said box assembly.

A more particular object of this invention is to disclose and provide a gyratory separator including an eccentric connection for imparting gyratory motion to a shaking box assembly and wherein said eccentric connection may be readily and conveniently adjusted to vary the amount of eccentricity.

A more specific object of this invention is to disclose and provide a gyratory separator wherein drive motor means is mounted in novel manner on a stationary frame means for modifying vibration characteristics of the shaking box assembly so as to not only vary the flow pattern of material being separated, but to vibrate said shaking box assembly at a most effective frequency.

The invention further contemplates a gyratory separator including circularly arranged resilient means supporting a shaking box assembly and a drive shaft having an eccentric connection to a self-aligning bearing associated with the shaking box assembly, said self-aligning bearing and drive shaft being vertically axially adjustable with respect to the shaking box assembly so as to modify the vibration characteristics of the shaking box assembly to adapt said box to materials of different characteristics.

These and many other objects and advantages of this invention will be readily apparent from the following description and drawings in which exemplary embodiments of this invention are shown.

In the drawings:

Fig. 1 is a sectional view of a separator embodying this invention, the section being taken in a vertical plane bisecting the device.

Fig. 2 is an enlarged fragmentary sectional view of an adjustable eccentric connection and self-aligning bearing used in the separator shown in Fig. 1.

Fig. 3 is a perspective view of the adjustable eccentric connection shown in Fig. 2.

Fig. 4 is a transverse sectional view of the eccentric connection of Figs. 2 and 3 showing maximum eccentricity.

Fig. 5 is a transverse sectional view of the eccentric connection showing minimum eccentricity.

An exemplary embodiment of a separator of gyratory type embodying this invention is indicated at 15 (Fig. 1) and generally includes a base frame means 16 and a vibratable shaking box assembly or sieve means 17 supported from the base frame means by a plurality of circumferentially spaced resilient means 18 such as coil springs. Means for imparting gyratory motion to the resiliently supported shaking box assembly 17 is generally indicated at 19 and is located below the shaking box assembly and centrally thereof.

The base frame means 16 may include a suitable stationary frame structure, in this example, a cylindrical metal frame 21 having a bottom flange 22 affording a means for connection to a base or foundation. The frame 21 may also include transverse frame members 23 adapted to support a portion of means 19. A top flange 24 provides an annular seat on frame 21 for the resilient means 18. It is understood that the base frame means may include other reinforcing structure (not shown) depending upon the size of the separator manufactured and the type of material to be separated thereby.

The resilient means 18 may comprise a plurality of circularly arranged circumferentially spaced compression coil springs 26. Springs 26 are of generally uniform resilient characteristics and may be positioned on flange 24 by spring seats 27 which confine the lower end of said springs and which may be secured in suitable manner to flange 24. The number of coil springs employed also

depends upon the size of the separator and the type of material to be separated.

The generally cylindrical shaking box assembly 17 is resiliently supported in coaxial relation on top of the circularly arranged coil springs 26, said shaking box assembly including a cylindrical bottom box section 29 having an annular member 30 of the same diameter as top flange 24 in order to provide a top annular seat for coil springs 26. Spring seats 31 similar to spring seats 27 may be secured to flange 30 for retaining and positioning the top ends of springs 26.

The bottom box section 29 of the shaking assembly may include a cylindrical wall 33 provided with out-turned bottom flange 32 and with a bottom wall 34. The bottom wall 34 may be slightly dome-shaped or cone-shaped. The cylindrical wall 33 may be provided with a discharge outlet opening 35 at a selected point in its circumference and at said discharge opening may be mounted a discharge duct 36 having a downturned outlet 37 for discharge of material separated into a trough (not shown) or other material handling means.

On top of bottom box section 29 may be supported a top box section 39 including a cylindrical wall 40 of the same diameter as wall 33. Cylindrical wall 40 may be provided with outturned top and bottom annular flanges 41 and 42, the bottom annular flange 42 providing a connection to top outturned annular flange 43 of the bottom box section 29. The cylindrical wall 40 includes a discharge opening 44 leading to a discharge duct 45 having a downturned outlet 46 for discharge of material separated from the top box section 39. It is understood that one or more box sections may be stacked and secured together on top of the bottom box section depending upon the number of separations to be made of the material.

A circular screen means 48 of any suitable screening material or fabric such as metal wire mesh, plastic, or cloth screening material of selected mesh size and strength is stretched across the shaking box assembly and is secured between bottom annular flange 42 and top annular flange 43 in suitable well known manner. The flanges 42, 43 may be secured together with margins of the screen means therebetween by a plurality of spaced bolt and nut assemblies 49.

The screen means 48 may be stretched and shaped into a relatively shallow inverted cone shape by means of an axial upstanding bolt member 50 secured to bottom wall 34 and extending through an axial opening in the center of screen means 48. Means to support and secure the center portion of the screen means may include a pair of circular metal discs 51 receiving the screen means therebetween and secured by a nut 52 threaded on top of bolt member 50. It is understood that other suitable means may be employed for supporting the center of the circular screen means 48 and that, if desired, the screen means may lie in a plane perpendicular to the axis of the shaking box assembly instead of being stretched into an inverted cone shape.

The means 19 for imparting gyratory motion including horizontal generally circular motion components and vertical motion components to produce a progressively tilting and circular motion of the shaking box assembly 17, may comprise a drive means such as a drive motor 55 supported in suitable manner on base frame means 16. The axis of the motor shaft of motor 55 is vertically positioned and at its top end portion may carry a pulley 56. Centrally of base frame means 16 may be supported a jack or drive shaft 57 having a pulley 58 aligned with pulley 56 and connected thereto by an endless pulley belt 59. Shaft 57 may be supported with its axis of rotation vertical in a cylindrical bearing casing 60 vertically adjustably secured in a clamp means 62 carried on any transverse frame members 23. Clamp means 62 may include a longitudinally split, cylindrical member having spaced laterally juxtaposed lugs 62a ported to re-

ceive bolts 62b for drawing the split clamping member tightly around casing 60. The shaft 57 may be mounted in casing 60 by a pair of axially spaced bearings 61 in well known manner. The upper end of shaft 57 extends into a horizontal planar zone defined by the circularly arranged coil springs 26 and into a hollow depending cylindrical bearing housing 63 secured as by welding to bottom wall 34 of the shaking box assembly.

Bearing housing 63 includes an axially extended finished internal surface along which may be adjustably positioned the outer race of a self-aligning bearing means 64 which is provided with an eccentric connection to the top portion of drive shaft 57. The details of this eccentric connection are best seen in Figs. 2-5 which illustrate an adjustable eccentric connection. In Fig 2 the axis of drive shaft 57 is indicated at D and said drive shaft is provided with a bearing land 65 of reduced diameter and coaxial with axis D. An eccentric portion 66 having a cylindrical face 67 of reduced diameter is coaxial with its eccentric axis 68 which may be spaced a selected distance from axis D. Drive shaft 57 may be provided with a top threaded end 69 for receiving a securing nut 70 for securing the bearings in position on shaft 57.

The eccentric portion 66 with eccentric cylindrical face 67 extends within an eccentrically formed adjustment collar 72 slidably and rotatably adjustable thereon, said collar having an inner cylindrical surface 73 and an outer cylindrical surface 74 formed about an axis C which is eccentric to axis 71 of the inner cylindrical surface. The axis 71 of the inner cylindrical surface coincides with the axis 68 of the eccentric portion 66 when collar 72 is positioned thereon. The inner surface 73 may be provided with a plurality of circularly spaced longitudinally extending grooves 75 which are adapted to be selectively positioned opposite a mating longitudinal keyway 76 provided in cylindrical face 67 of eccentric shaft portion 66.

As shown in Figs. 4 and 5, the collar 72 may be provided with an index mark 77. When collar 72 is rotated about eccentric portion 66 until the index mark 77 is adjacent and opposite keyway 76 and a key 78 is driven into keyway 76 and a selected aligned groove 75, it will be noted that the outer cylindrical surface 74 of the collar is positioned to provide maximum eccentricity when the shaft is rotated about its axis D; that is, axis C is spaced a maximum distance from axis D.

In Fig. 5 is shown collar 72 with index mark 77 rotated to a position 180° from keyway 76. In such position, axis C of collar 72 is positioned a minimum distance from axis D to provide minimum eccentricity of outer cylindrical surface 74 with respect to the drive shaft axis D. It will be apparent that the eccentric relation of collar 72 to the drive shaft may be variably adjusted between maximum and minimum eccentricity by selection of a different groove 75.

The collar 72 may be fitted within the inner race of self-aligning bearing 64, the outer race of said bearing 64 being fitted within bearing housing 63. It will thus be readily apparent that the axis of the shaking box assembly which is coaxial with the bearing housing 63 is thus eccentrically related to the axis of drive shaft 57.

It should be noted in this embodiment that the axial center of the shaking box assembly is generally non-yieldable in a vertical direction because of the eccentric connection with drive shaft 57 positioned centrally therebelow. The peripheral margins of the box assembly are vertically yieldable because of the resilient supporting coil springs. In this example, the self-aligning bearing is located in the planar zone of the coil springs and serves as a limited central pivot means for the shaking box assembly about its axis so that when the box assembly is driven through the eccentric connection, a tilting motion may be produced which progresses in the direction of rotation of the box assembly. It is understood that the vertical location of the self-aligning bear-

ing relative to the coil springs and to the center of gravity of the shaking box assembly may be varied by axial adjustment of casing 60 with its related drive shaft and bearings in clamp means 62 in order to modify the tilting motion.

In operation of this embodiment of this invention, material to be separated may be introduced into the top box section 39 of the shaking box assembly in convenient well known manner. Upon rotation of drive shaft 57 by energization of the drive motor 55, the shaking box assembly 17 will be imparted a circular gyratory motion because of the eccentric connection of the drive shaft 57 thereto and the circularly arranged coil springs will wobble or yield laterally about their vertical axes because of the eccentric motion being imparted to the box assembly. The shaking box assembly will tiltingly yield vertically at its outer periphery on coil springs 26, the self-aligning bearing permitting such movement, the amount and character of such tilting being dependent upon the distance between the self-aligning bearing and the center of gravity of the shaking box with the material therein. There will thus be imparted to the shaking box assembly a progressively tilting vertical motion component combined with horizontal circular motion components derived from the self-aligning bearing eccentrically connected to the drive shaft 57 and from the circularly arranged coil springs.

The circular tilting vibratory motion produced in the shaking box assembly imparts to material in the box sections a motion which causes the material to flow from the center outwardly to the peripheral edges and thence along the peripheral edges until the material reaches a discharge outlet. Material in the top box section during its movement in its path toward the periphery is caused to climb the inverted cone-shaped screen means and such climbing of the material is effective to facilitate rapid separation of the material. During the flow of material along the path mentioned, it will be readily apparent that the vertical motion component imparted by the combination of coil springs and self-aligning bearing causes the material to upset and thus separation is further facilitated. Upsetting the particles of material also prevents screen clogging or blinding.

It will be apparent to those skilled in the art that in the exemplary embodiment of this invention that motion-transmitting means have been employed between a drive shaft and the axis of a resiliently supported shaking box assembly or sieve means, and that said motion-transmitting means includes an eccentric connection and a self-aligning bearing between the eccentric connection and the vibratable shaking box assembly. It will be understood that the gyratory motion imparted to the shaking box assembly is one which appears as a rapid vibration which may be of selected frequency depending upon the revolutions per minute at which the drive shaft is driven. A change in the number of revolutions per minute of the drive shaft will also tend to affect the flow pattern of the material being separated. Generally, a relatively rapid frequency of vibration is employed.

It will be understood by those skilled in the art that various modifications and changes may be made in the exemplary embodiments of this invention described above, and all such changes and modifications coming within the scope of the appended claims are embraced thereby.

We claim:

1. In a gyratory separator providing combination gyratory, horizontal and vertical motion components, the combination of: a stationary frame means; a plurality of circularly arranged spaced coil springs seated on said frame; a circular shaking box supported on said coil springs; motor means mounted on said stationary frame means and including a driving shaft having a vertical axis of rotation; means connecting the shaking box to the

drive shaft for imparting a gyratory, horizontal and progressively tilting motion to the shaking box, said connecting means including a bearing housing secured to the bottom of said shaking box in coaxial alignment therewith; a self-aligning bearing vertically adjustably positionable in said housing in the horizontal planar zone of said coil springs; and means providing an eccentric connection between the self-aligning bearing and said drive shaft and including adjustment means for selectively varying the eccentricity of said connection.

2. In a gyratory separator having a sieve means supported upon spaced resilient means lying in a transverse zone, said resilient means being supported from a stationary frame, the provision of a non-thrust loaded drive means for said sieve means including a drive shaft provided with a shaft portion extending into said transverse zone and having an axis eccentric to the axis of the shaft, means for anti-frictionally supporting said drive shaft, a hollow member provided with an elongated internal cylindrical surface of uniform diameter defining an axis about which said sieve means is imparted a rotary motion component, and self-aligning bearing means between and interconnecting the hollow member and the shaft portion including an inner race means on said shaft portion and adjustable relative thereto to vary the eccentric relation of the self-aligning bearing means to the axis of the shaft, and an outer race means adjustably movable along said internal cylindrical surface whereby said drive means is free from thrust loads resulting from loading of said sieve means with material to be separated.

3. In a gyratory separator having a sieve means supported upon spaced resilient means which are supported from a stationary frame, the provision of: a thrust-free drive means for imparting gyratory horizontal and tilting motion to said sieve means and including a drive shaft having a shaft portion eccentric thereto, a self-aligning bearing means including an inner race means carried by said shaft portion and an outer race means, and a bearing housing provided with an internal cylindrical surface retaining said outer race means, said outer race means being adjustably axially movable along said internal cylindrical surface whereby axially directed loads on said sieve means are compensated by said adjustable positioning of said outer race means with said cylindrical surface, said inner race means including means for adjustment of eccentricity between said drive shaft and the axis of said self-aligning bearing.

4. In a gyratory separator providing combination gyratory, horizontal, and vertical motion components, the combination of: a stationary frame means; a plurality of peripherally spaced resilient means seated on said frame; a shaking box supported from said resilient means; motor means mounted on said stationary frame means and including a driving shaft having a vertical axis of rotation; means connecting the shaking box to the drive shaft for imparting a gyratory, horizontal, and progressively tilting motion to the shaking box, said connecting means including a bearing housing depending from the bottom of the shaking box in coaxial alignment with said box; a self-aligning bearing vertically adjustably positionable in said bearing housing; means providing an eccentric connection between the self-aligning bearing and said drive shaft and including adjustment means for selectively varying the eccentricity of said connection; and means on the stationary frame means for vertical adjustment of the driving shaft.

5. In a gyratory separator having a sieve means supported upon spaced resilient means which are supported from a stationary frame, the provision of: a drive means for imparting gyratory, horizontal and tilting motion to said sieve means and including a drive shaft having a shaft portion eccentric thereto; a self-aligning bearing means including an inner race means carried by said eccentric shaft portion and an outer race means; a bearing

housing connected with said sieve means and provided with an internal cylindrical surface sleeved over and retaining said outer race means, said outer race means being adjustably movable along said internal cylindrical surface whereby axially directed loads on said sieve means are compensated by adjustable positioning of said outer race means with respect to said cylindrical surface; and means connected with said self-aligning bearing means for adjustment of eccentricity between the axis of the drive shaft and the axis of the bearing housing.

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References Cited in the file of this patent

UNITED STATES PATENTS

1,354,319	Lowe	Sept. 28, 1920
2,008,296	Soldan	July 16, 1935
2,159,549	Cecka	May 23, 1939
2,191,923	Cecka	Feb. 27, 1940
2,194,721	Piper	Mar. 26, 1940

FOREIGN PATENTS

913,125	Germany	June 8, 1954
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