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DUAL-RATE INSTRUMENT

Filed June 5, 1958

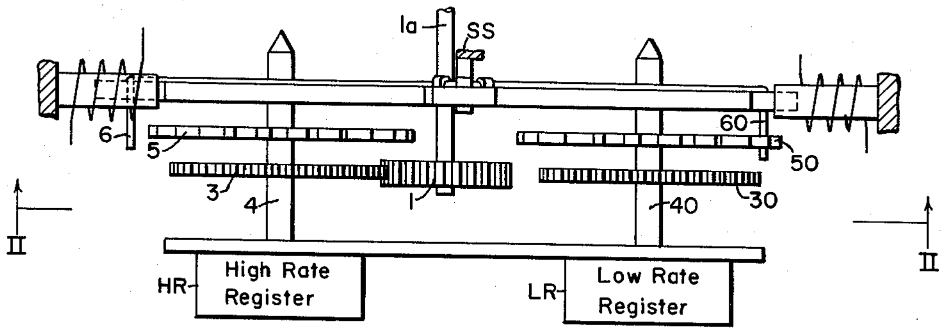

Fig. 1.

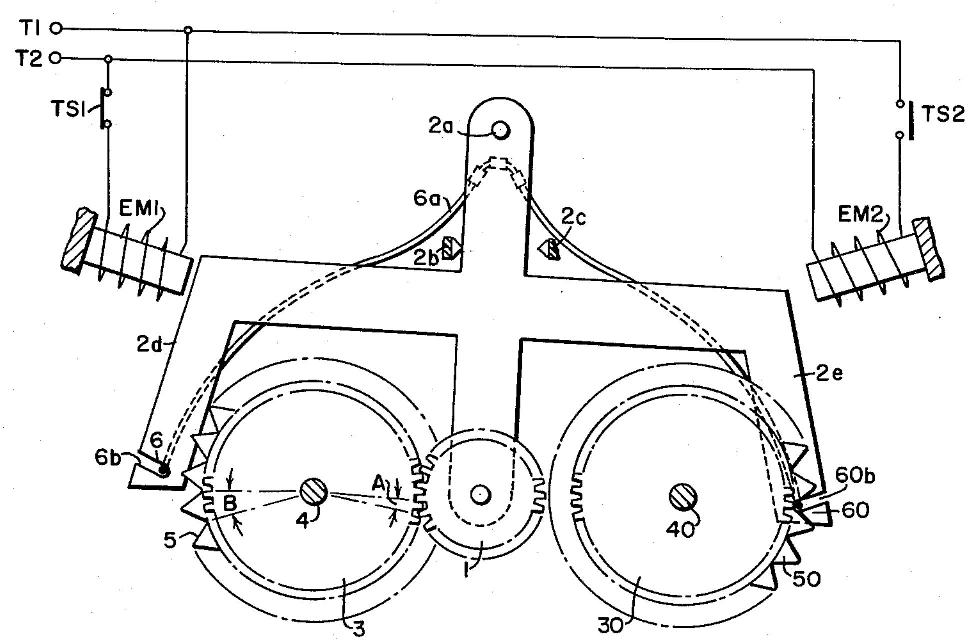

Fig. 2.

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DUAL-RATE INSTRUMENT

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This invention relates to selective coupling mechanism and it has particular relation to selective coupling mechanism wherein a common coupling member is selectively operable into engagement with any of a plurality of associated coupling members.

In many devices it is the practice to employ a common coupling member which may be operated selectively into engagement with any of a plurality of associated coupling members. The invention is particularly applicable to a dual-rate registering mechanism.

In a conventional dual-rate registering mechanism, a high-rate register is provided which includes a coupling member such as a gear. The registering mechanism also includes a low-rate register which is operated from a coupling member such as a gear. A common coupling member which may take the form of a pinion is selectively operable into engagement with either of the register gears.

Only one of the registers is operated at any time. The remaining register should remain idle or inactive. However, vibration either intentional or unintentional may urge the idle or inactive register in one direction to introduce an error in the register reading. Furthermore, the engagement and disengagement of the pinion with the associated gears may introduce a further displacement of the idle or inactive register. Although this displacement may tend to average out over a period of time, it is objectionable for installations wherein one of the registers is not in operation for substantial periods of time.

For example, a consumer of electrical energy having a dual-rate registering mechanism may decide not to consume energy during periods of time when the high rate or tariff is in effect. Thus, he may employ a time switch for disconnecting his load during the high-rate periods. In such a case, a high-rate register should not indicate any consumption of energy. However, the aforesaid displacement of the idle high-rate register may introduce an erroneous reading.

In accordance with the invention an idle or inactive coupling member is held against movement. To this end, each of the coupling members which may be inactive is provided with a toothed wheel such as a star wheel which rotates therewith. A detent which preferably is of a resilient construction coacts with the star wheel to prevent rotation of the star wheel and of its associated coupling member.

In the case of the dual-rate registering mechanism the detents do not engage gears employed for driving the registers and consequently do not produce wear of the gears. Furthermore, the provision of the separate toothed or star wheels permits substantial freedom in the design of such wheels.

Preferably, the star wheels are provided with teeth having a large angular pitch compared to the angular pitch of the gears employed for driving the registering mechanism. Furthermore, the teeth of the toothed wheels preferably are shaped to provide a cam or centering action. The parts preferably are so related that a detent enters its detenting position with respect to a toothed wheel before the gear associated with the toothed wheel is completely disengaged.

It is therefore an object of the invention to provide an

improved detent mechanism for the idle or inactive one of two coupling members.

It is a further object of the invention to provide each of a plurality of coupling members which are selectively engageable, with a separate toothed wheel for receiving a detent when the associated coupling member is to be idle or inactive.

It is an additional object of the invention to provide a dual-rate registering mechanism having selectively-engageable coupling members with a separate toothed wheel for each of the coupling members having teeth shaped to provide a camming action when engaged by a detent.

It is also an object of the invention to provide a dual-rate registering mechanism having selectively operable coupling members with a toothed wheel for each of the coupling members and a detent for each of the toothed wheels, each of the two detents being operable to detent its associated toothed wheel shortly in advance of decoupling of the associated coupling member.

It is another object of the invention to provide a dual-rate registering mechanism having a pair of gears and a pinion operable for selectively engaging either of the gears with a separate star wheel for each of the gears and detent mechanism for engaging the teeth of the inactive one of the star wheels, the star wheels having a toothed pitch substantially larger than the toothed pitch of the gears.

Other objects of the invention will be apparent from the following description taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is a view in top plan of a dual-rate registering mechanism embodying the invention with parts broken away; and

FIGURE 2 is a view in elevation taken along the line II—II of FIG. 1.

Referring to the drawing, FIG. 1 shows a dual-rate registering mechanism which includes a high-rate register HR having an operating shaft **4**. As well understood in the art, the high-rate register HR may include a rotation counter or other device responsive to rotation of the shaft **4**.

The registering mechanism further includes a low-rate register LR which has a shaft **40**. The low-rate register includes a rotation counter or other device responsive to rotation of the shaft **40**. The two registers HR and LR are mounted in any suitable manner as by a supporting structure SS to maintain the shafts **4** and **40** parallel and spaced apart in a radial direction.

In order to rotate the shaft **4**, a suitable coupling member such as a gear **3** is secured to the shaft. A similar coupling member or gear **30** is secured to the shaft **40** for rotating such shaft.

In order to rotate the gears on the shafts **4** and **40**, a common coupling member such as a pinion **1** is provided for selectively engaging either of the gears **3** and **30**. The pinion **1** may be mounted on a shaft **1**_a_ for rotation in accordance with a quantity to be measured. In a preferred embodiment of the invention, the shaft **1**_a_ and the pinion **1** are rotated in accordance with electrical energy supplied to a load in the manner set forth in the Lenehan Patent 2,295,349 which issued September 8, 1942.

In order to operate the pinion **1** selectively into engagement with either of the associated gears, the shaft **1**_a_ is mounted for rotation about its axis in an arm **2** which, in turn, is pivoted on a shaft **2**_a_ secured to the supporting structure SS. The arm **2** may be moved into engagement with a stop **2**_b_ to position the pinion **1** in driving engagement with the gear **3** as shown in FIGS. 1 and 2. Alternatively, the arm **2** may be positioned in engagement with a stop **2**_c_ in order to position the pinion **1** in driving engagement with the gear **30**.

In order to detent the idle or inactive register, each of the shafts **4** and **40** is provided with a separate toothed wheel, respectively, wheels **5** and **50**. Inasmuch as the gear **3** and the wheel **5** are secured to a common shaft they rotate in unison. In a similar manner the gear **30** and the wheel **50** are secured to the shaft **40** and rotate in unison therewith.

Detents are provided for engaging the toothed wheels. To this end, the arm **2** has secured thereto a pair of auxiliary arms **2***d* and **2***e* which are positioned, respectively, adjacent the peripheries of the toothed wheels **5** and **50**. Each of the auxiliary arms positions a detent adjacent a separate one of the toothed wheels.

In a preferred embodiment of the invention, the detents are provided by a resilient wire **6***a* which has a central portion secured rigidly to the arm **2** in any suitable manner. The left-hand end of the resilient wire **6***a*, as viewed on the drawing, is bent at right angles to form a detent **6** which is positioned adjacent the periphery of the toothed wheel **5**. In a similar manner, the remaining end of the resilient wire is bent at right angles to form a detent **60** positioned adjacent the periphery of the toothed wheel **50**.

The detents are positioned by the auxiliary arms **2***d* and **2***e*. Thus, the arm **2***d* is provided with a slot **6***b* opening to the left of the auxiliary arm as viewed in FIG. 2. By inspection of FIG. 2, it will be noted that the resilient wire **6***a* biases the detent **6** against the base of the slot **6***b*. In an analogous manner the auxiliary arm **2***e* is provided with a slot **60***b* opening towards the right of the auxiliary arm as viewed in FIG. 2, and the wire **6***a* biases the detent **60** into engagement with the base of the slot **60***b*.

Preferably, the teeth of the toothed wheels **5** and **50** are provided with an angular pitch which is substantially larger than that of the gears **3** and **30**. For example, in FIG. 2 the angular pitch or angular spacing of successive teeth of the gear **3** about the axis of the gear is represented by the angle A. The angular pitch or spacing of successive teeth of the toothed wheel **5** about the axis of the wheel is represented by an angle B in FIG. 2. In a preferred embodiment of the invention, the magnitude of the angle B is of the order of 2 to 3 times the magnitude of the angle A.

Furthermore, the shape of the teeth employed for the toothed wheels preferably differs from that employed for the gears. The teeth for the gears **3** and **30** and for the pinion **1** preferably are selected in accordance with conventional practice to provide optimum quietness and life with minimum friction. However, the shape of the teeth employed for the toothed wheels preferably is selected to provide a camming or an aligning action as a detent enters the space between two of the teeth. In a preferred embodiment of the invention, the teeth employed for the wheels **5** and **50** have a triangular configuration as clearly shown in FIG. 2 with sides less steep than those of the teeth on the gears. Thus, the wheels **5** and **50** are in the form of star wheels.

The pinion **1** may be operated from engagement with one of the gears into engagement with the other of the gears in any suitable manner. For example, the pinion may be operated by a timing mechanism in the manner set forth in the aforesaid Lenehan patent. However, for present purposes it will be assumed that two electromagnets EM1 and EM2 are employed for operating the pinion **1** selectively into engagement with either of the associated gears. The electromagnet EM1 has a winding which is connected to a source of electrical energy represented by terminals T1 and T2 through a time switch TS1. The electromagnet EM2 has a winding which is connected to the terminals T1 and T2 through a time switch TS2.

The auxiliary arms **2***d* and **2***e* are assumed to be constructed of a soft magnetic material such as iron. When the electromagnet EM1 is energized, the auxiliary arm **2***d* is attracted to move the pinion **1** into driving engagement with the gear **3**. When the electromagnet EM1 is deenergized and the electromagnet EM2 is energized, the pinion **1** is actuated into driving engagement with the gear **30**.

The time switches TS1 and TS2 may be conventional time switches which are so adjusted that the time switch TS1 is closed only during periods of time when a high tariff is to be charged for electrical energy, whereas the time switch TS2 is closed only for periods when a low tariff or rate is to be charged for electrical energy.

The operation of the mechanism illustrated in FIGS. 1 and 2 now may be set forth. With the parts in the positions illustrated on the drawing, the pinion **1** is in engagement with the gear **3** and the high-rate register HR consequently is operated in accordance with the quantity being measured, in this case, electrical energy. It should be noted that the detent **6** is clear of the star wheel **5** and consequently does not impede operation of the high-rate register. The detent **60***b* is located between two teeth of the star wheel **50** and prevents operation of the idle low-rate register LR.

When the low-rate register is to be placed in operation, the electromagnet EM2 is energized and the electromagnet EM1 is simultaneously deenergized. As a result of these changes in energization of the electromagnets, the pinion **1** is moved towards the gear **30**. However, slightly before the pinion **1** is completely decoupled from the gear **3**, the detent **6** enters the space between two teeth of the star wheel **5** to prevent movement of the high-rate register. The pinion **1** thereafter is completely decoupled from the gear **3** and engages the gear **30**. During the final part of the movement of the pinion **1**, the detent **60** is moved outside the path of the teeth of the star wheel **50** and consequently frees the low-rate register for movement.

As the detent **6** moves to the right, it engages the adjacent teeth of the star wheel **5** with a camming action to retain the star wheel in a definite position.

When the registering mechanism is to be returned to the high-rate registering position, electro-magnet EM2 is deenergized by the time switch TS2 and the electromagnet EM1 is energized by the time switch TS1. This moves the pinion **1** in a clockwise direction about the shaft **2***a*, as viewed in FIG. 2. Shortly before the pinion **1** completely leaves the gear **30**, the detent **60** enters the space between two adjacent teeth of the star wheel **30** to prevent further movement of the low-rate register LR. Continued movement of the pinion decouples the pinion from the gear **30**, and the detent **60** retains the star wheel **50** in a fixed position. The pinion on its continued movement begins to mesh with the gear **3**. On continued movement of the pinion the detent **6** is moved clear of the star wheel **5**, and the pinion **1** is moved into its final meshing position with the gear **3**.

Since the detents do not operate on the gears **3** and **30**, these gears are free of wear due to the operation of the detents. Furthermore, since the star wheels **5** and **50** are not employed for driving purposes, the teeth of these star wheels may be spaced and shaped to provide a desired positive detenting operation. Inasmuch as each detent enters the space between adjacent teeth of the associated star wheel before the associated gear is completely disengaged by the pinion **1**, it follows that neither of the registers is free at any time to move under the influence of vibration or shock.

Although the invention has been described with reference to certain specific embodiments thereof, numerous modifications falling within the spirit and scope of the invention are possible.

I claim as my invention:

1. In a selective coupling device, a supporting structure, a first coupling gear mounted for rotation relative to the supporting structure, a second coupling gear mounted for rotation relative to the supporting structure, a third coupling gear to be selectively coupled to either

the first or second coupling gear, mounting means mounting the third coupling gear for rotation, said mounting means being operable selectively to place said third gear into either of first and second positions, said third coupling gear in the first position being in coupling engagement with the first coupling gear and being disengaged from the second coupling gear, said third coupling gear in the second position being in coupling engagement with the second coupling gear and being disengaged from the first coupling gear, a first toothed wheel mounted for rotation with the first coupling gear, a second toothed wheel mounted for rotation with the second coupling gear, and locking means responsive to operation of the mounting means into the second position for intermeshing with part of the teeth of the first toothed wheel to lock the first toothed wheel against rotation about the first axis, said locking means in the second position of the mounting means being disengaged from the second toothed wheel, said locking means being responsive to operation of the mounting means into the first position for intermeshing with part of the teeth of the second toothed wheel to lock the second toothed wheel against rotation about the second axis, said locking means in the first position of the mounting means being disengaged from the first toothed wheel, each of said toothed wheels having an angular tooth pitch substantially larger than the angular tooth pitch of each of said gears, said locking means including a locking finger movable into and out of the space between two teeth for each of the toothed wheels.

2. In a selective coupling device, a supporting structure, a first coupling gear mounted for rotation relative to the supporting structure, a second coupling gear mounted for rotation relative to the supporting structure, a third coupling gear to be selectively coupled to either the first or second coupling gear, mounting means mounting the third coupling gear for rotation, said mounting means being operable selectively into either of first and second positions, said third coupling gear in the first position being in coupling engagement with the first coupling gear and being disengaged from the second coupling gear, said third coupling gear in the second position being in coupling engagement with the second coupling gear and being disengaged from the first coupling gear, a first toothed wheel mounted for rotation with the first coupling gear, a second toothed wheel mounted for rotation with the second coupling gear, and locking means responsive to operation of the mounting means into the second position for intermeshing with part of the teeth of the first toothed wheel to lock the first toothed wheel against rotation about the first aixs, said locking means in the second position of the mounting means being disengaged from the second toothed wheel, said locking means being responsive to operation of the mounting means into the first position for intermeshing with part of the teeth of the second toothed wheel to lock the second toothed wheel against rotation about the second axis, said locking means in the first position of the mounting means being disengaged from the first toothed wheel, each of said toothed wheels having an angular tooth pitch substantially larger than the angular tooth pitch of each of said gears, said locking means including a locking finger movable into and out of the space between two teeth for each of the toothed wheels, said locking finger being resiliently mounted to effect a yieldable engagement with one of the toothed wheels.

3. In a measuring device, first translating means having a first gear mounted for rotation, second translating means having a second gear mounted for rotation, a third gear rotatable in accordance with a quantity to be measured, movable mounting means selectively movable into first and second positions, means supporting said third gear on said movable mounting means, said mounting means being operable when in the first position to couple the first and third gears and to decouple the second and third gears, said mounting means being operable when in the second position to couple the second and third gears and to decouple the first and third gears, a first star wheel mounted for rotation with the first gear, a second star wheel mounted for rotation with the second gear, the teeth of said star wheels having an angular pitch substantially larger than the angular pitch of the teeth of the gears, a first resilient detent movable from a position clear of the star wheels to a position between the teeth of the second star wheel in response to operation of the mounting means from the second to the first position, and a second resilient detent movable from a position clear of the star wheels to a position between the teeth of the first star wheel in response to operation of the mounting means from the first to the second position.

4. In a measuring device, first translating means having a first gear mounted for rotation, second translating means having a second gear mounted for rotation, a third gear rotatable in accordance with a quantity to be measured, movable mounting means selectively movable into first and second positions, means supporting said third gear on said movable mounting means, said mounting means being operable when in the first position to couple the first and third gears and to decouple the second and third gears, said mounting means being operable when in the second position to couple the second and third gears and to decouple the first and third gears, a first star wheel mounted for rotation with the first gear, a second star wheel mounted for rotation with the second gear, the teeth of said star wheels having an angular pitch substantially larger than the angular pitch of the teeth of the gears, a first resilient detent movable from a position clear of the star wheels to a position between the teeth of the second star wheel in response to operation of the mounting means from the second to the first position, and a second resilient detent movable from a position clear of the star wheels to a position between the teeth of the first star wheel in response to operation of the mounting means from the first to the second position, each of said detents being positioned to enter the space between two teeth of the associated star wheel before the gear mounted for rotation with such star wheel is disengaged from the third gear.

5. In a measuring device, a supporting structure, first and second spaced shafts rotatably supported on said structure, first and second gears carried respectively by said shafts and lying in a first plane, an arm pivotally carried by said structure and having a first portion located intermediate said shafts, said arm having second and third portions located on opposite outer sides of said shafts, each said second and said third arm portions having apertures, a third shaft rotatably carried by said arm first portion, a third gear carried by said third shaft and lying in said first plane, said arm having first and second rotative positions, said arm when in said first position holding said first and said third gears meshed and said second and said third gears unmeshed, said arm when in said second position holding said first and said third gears unmeshed and said sceond and said third gears meshed, first and second star wheels carried respectively by said first and second shafts and located in a second plane, and a resilient member carried by said arm and having a pair of detent portions individually located in said apertures of said arm portions, said second and said third arm portions being so proportioned relative to said wheels that with said arm in said first position the one of said detents which is associated with said second arm portion is in engagement with said second wheel and the other of said detents which is associated with said third arm portion is disengaged from said first wheel, said proportion being such that with said arm in said second position said one detent is disengaged from said second wheel and said other detent is engaged with said first wheel.

6. In a measuring device, a supporting structure, first and second spaced shafts rotatably supported on said

structure, first and second gears carried respectively by said shafts and lying in a first plane, an arm pivotally carried by said structure and having a first portion located intermediate said shafts, said arm having second and third portions located on opposite outer sides of said shafts, each said second and said third arm portions having apertures, a third shaft rotatably carried by said arm first portion, a third gear carried by said third shaft and lying in said first plane, said arm having first and second rotative positions, said arm when in said first position holding said first and said third gears meshed and said second and said third gears unmeshed, said arm when in said second position holding said first and said third gears unmeshed and said second and said third gears meshed, first and second star wheels carried respectively by said first and second shafts and located in a second plane, and a resilient member carried by said arm and having a pair of detent portions individually located in said apertures of said arm portions, said second and said third arm portions being so proportioned relative to said wheels that with said arm in said first position the one of said detents which is associated with said second arm portion is in engagement with said second wheel and the other of said detents which is associated with said third arm portion is disengaged from said first wheel, said proportion being such that with said arm in said second position said one detent is disengaged from said second wheel and said other detent is engaged with said first wheel, said first and said second gears each having teeth of a first angular pitch, said wheels having teeth of a second angular pitch which is in the order of 2 to 3 times said first pitch.

7. In a measuring device, a supporting structure, first and second spaced shafts rotatably supported on said structure, first and second gears carried respectively by said shafts and lying in a first plane, an arm pivotally carried by said structure and having a first portion located intermediate said shafts, said arm having second and third portions located on opposite outer sides of said shafts, each said second and said third arm portions having apertures, a third shaft rotatably carried by said arm first portion, a third gear carried by said third shaft and lying in said first plane, said arm having first and second rotative positions, said arm when in said first position holding said first and said third gears meshed and said second and said third gears unmeshed, said arm when in said second position holding said first and said third gears unmeshed and said second and said third gears meshed, first and second star wheels carried respectively by said first and second shafts and located in a second plane, and a resilient member carried by said arm and having a pair of detent portions individually located in said apertures of said arm portions, said second and said third arm portions being so proportioned relative to said wheels that with said arm in said first position the one of said detents which is associated with said second arm portion is in engagement with said second wheel and the other of said detents which is associated with said third arm portion is disengaged from said first wheel, said proportion being such that with said arm in said second position said one detent is disengaged from said second wheel and said other detent is engaged with said first wheel, said first and said second gears each having teeth of a first angular pitch, said wheels having teeth of a second angular pitch which is in the order of 2 to 3 times said first pitch, the teeth of said wheels being of substantially triangular configuration and having sides less steep than those of said teeth on said gears.

8. In a measuring device, a supporting structure, first and second spaced shafts rotatably supported on said structure, first and second gears carried respectively by said shafts and lying in a first plane, an arm pivotally carried by said structure and having first, second and third spaced depending arm portions lying in a second plane spaced from said first plane, said first shaft extending between said first and said second arm portions and said second shaft extending between said first and said third arm portions, a third shaft rotatably carried by said first arm portion, a third gear carried by said third shaft and lying in said first plane, said arm having spaced armature portions, a pair of spaced electromagnets cooperable individually with said armature portions and effectively cooperable therewith to place said arm in a first position upon energization of a first of said magnets and to place said arm in a second position upon energization of a second of said magnets, said arm when in said first position holding said first and said third gears meshed and said second and said third gears unmeshed, said arm when in said second position holding said first and said third gears unmeshed and said second and said third gears meshed, first and second star wheels carried respectively by said first and second shafts and located in a third plane positioned intermediate said first and second planes, an elongated resilient member having a central portion and opposite end portions, said end portions being bent substantially at right angles to the remaining portion of said resilient member, said second and third arm portions being provided with elongated slots, means securing said central portion of said resilient member to said arm with said resilient member end portions individually extending through said slots, said gears and said star wheels each having teeth, the pitch angle of said teeth of said star wheels being substantially 2 to 3 times the pitch angle of said teeth of said gears, the one of said end portions which extends through said slot in said second arm being engageable with said teeth of said first wheel when said arm is in its said second position, the other of said end portions which extends through said slot in said third arm being engageable with said teeth of said second wheel when said arm is in its said first position.

References Cited in the file of this patent

UNITED STATES PATENTS

817,916	Horton	Apr. 17, 1906
1,373,786	Zaiden	Apr. 5, 1921
1,440,911	Daly et al.	Jan. 2, 1923
1,557,944	Reisbach	Oct. 20, 1925
1,926,190	Borden	Sept. 12, 1933
2,084,396	Hennessy	June 22, 1937
2,462,846	Clark	Mar. 1, 1949