United States Patent [19]

Takanashi et al.

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[45] **Aug. 27, 1974**

[54] **INTERMITTENT FEED MECHANISM**

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[73] Assignee: **Hitachi, Ltd.**, Tokyo, Japan

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[52] **U.S. Cl.** **74/436**

[51] **Int. Cl.** **F16h 55/04**

[58] **Field of Search** 74/436

[56] **References Cited**

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Attorney, Agent, or Firm—Craig & Antonelli

[57] **ABSTRACT**

A mechanism for obtaining intermittent feed motion through a driven wheel in engagement with a driving wheel, said driven wheel being formed by a slotted rotating plate and a rotating plate formed with arcuate cam-contacting recesses in such manner that each of the slots is adapted to engage a roller of the driving wheel and each of the cam-contacting recesses is adapted to engage a locking cam of the driving wheel.

10 Claims, 13 Drawing Figures

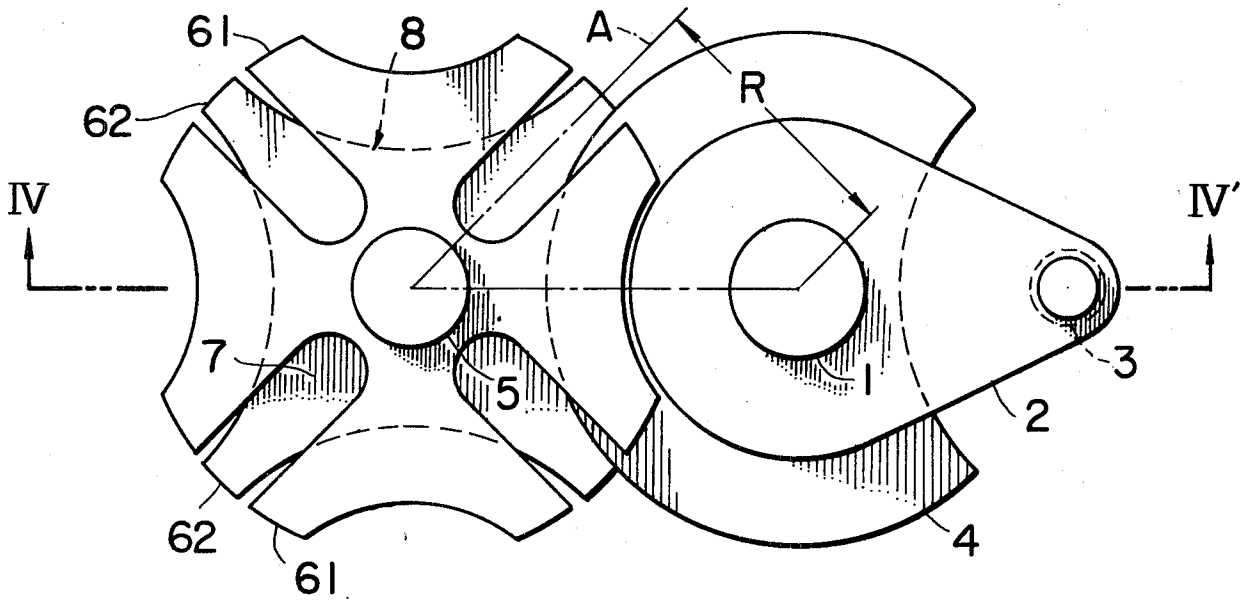


FIG. 1 PRIOR ART

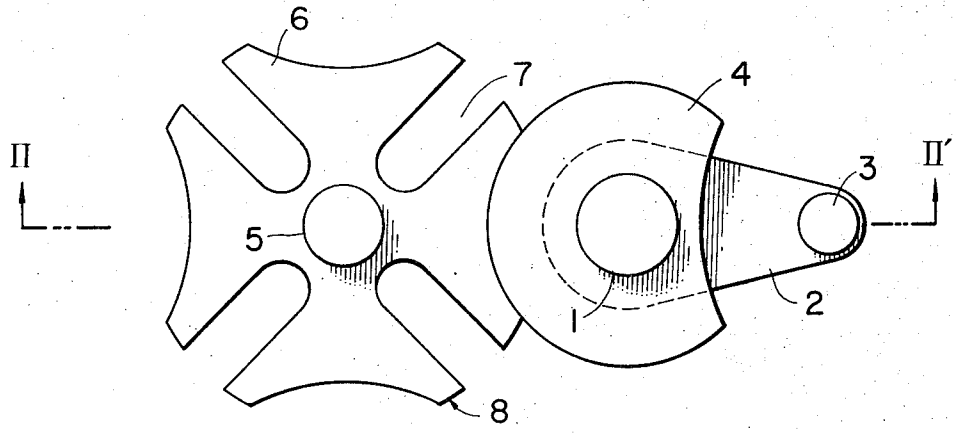


FIG. 2 PRIOR ART

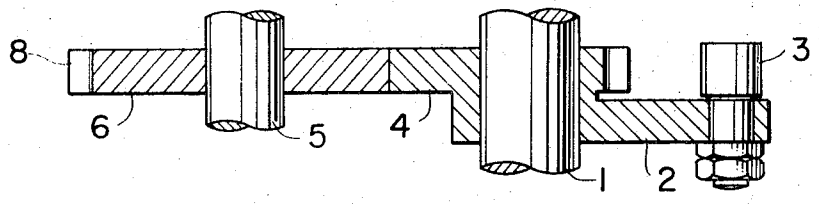


FIG. 3

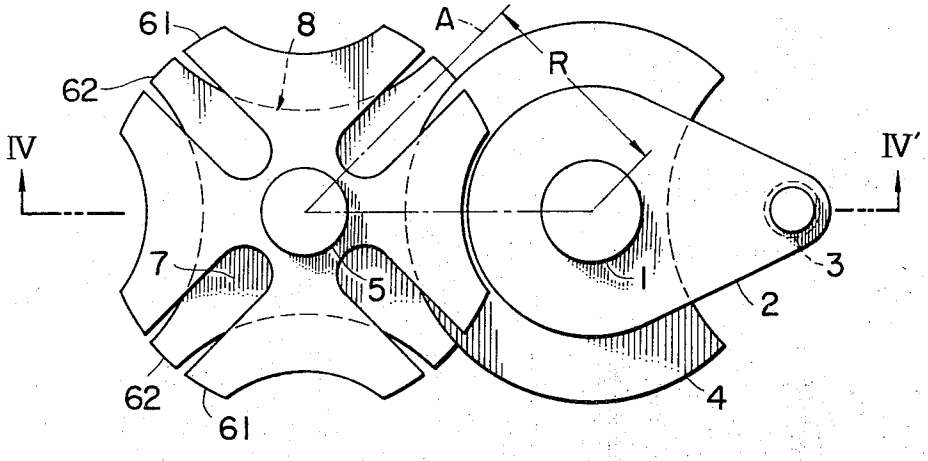


FIG. 4

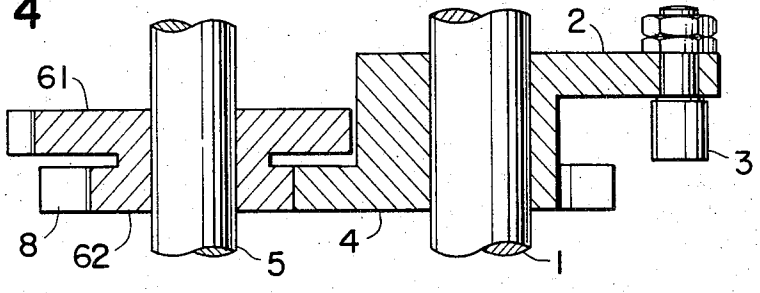


FIG. 5

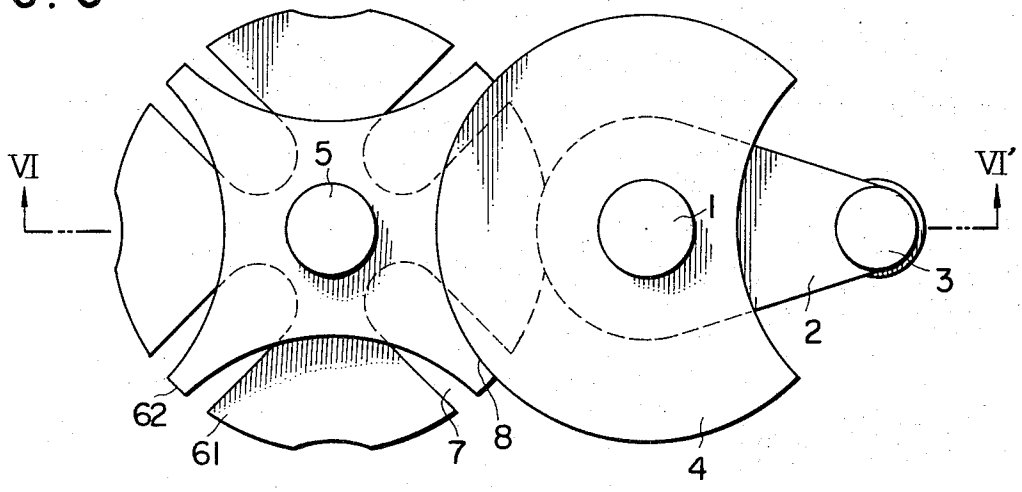


FIG. 6

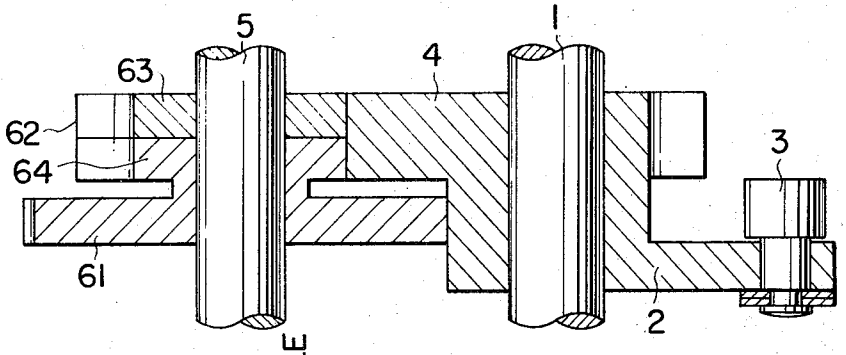


FIG. 7

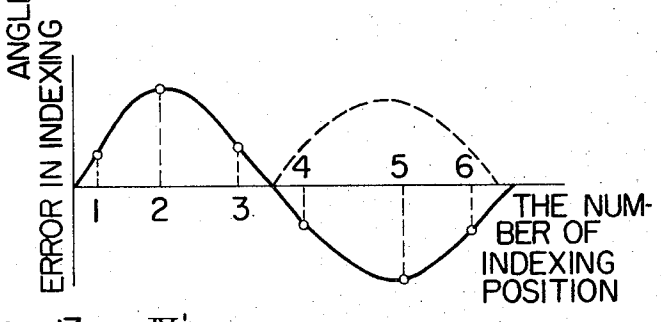


FIG. 8

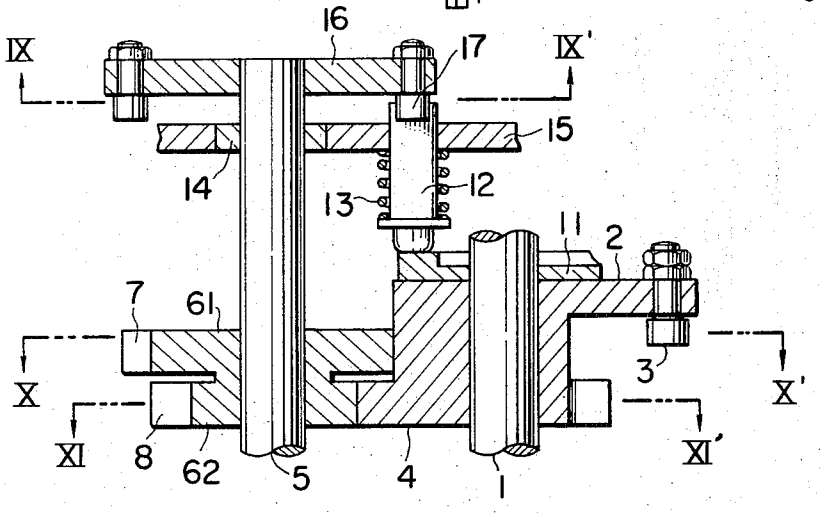


FIG. 9

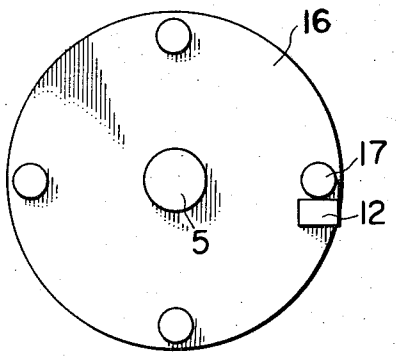


FIG. 10

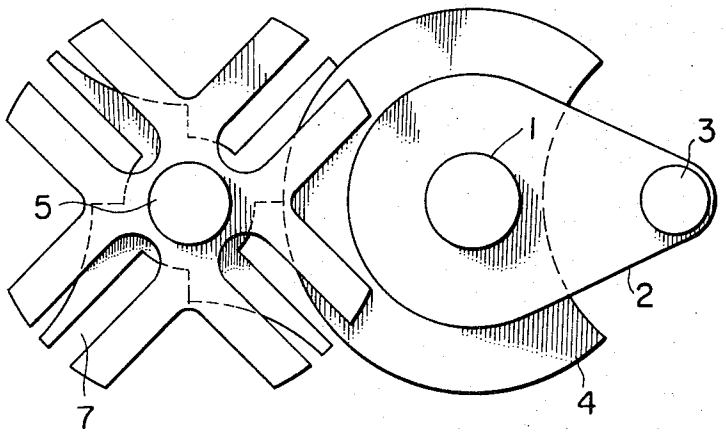


FIG. 11

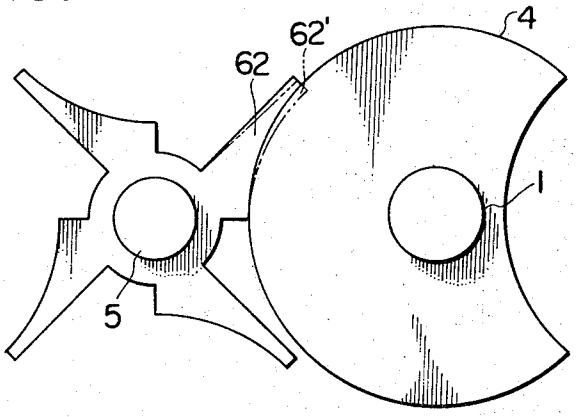


FIG. 12

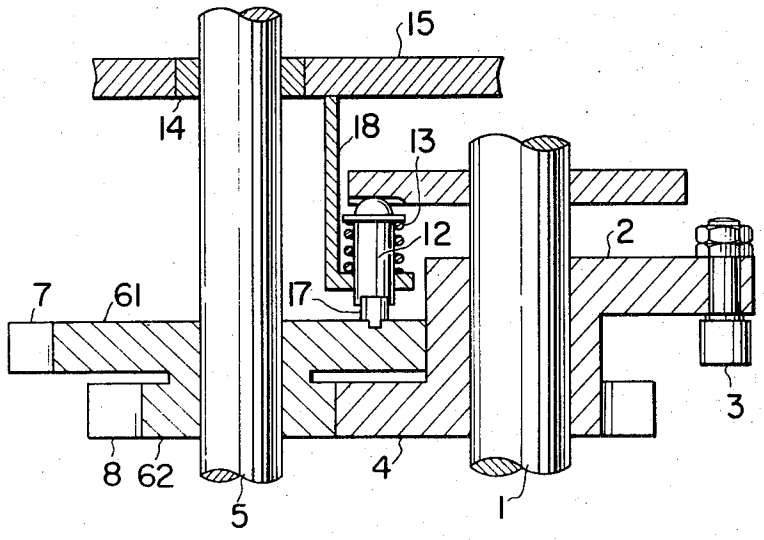
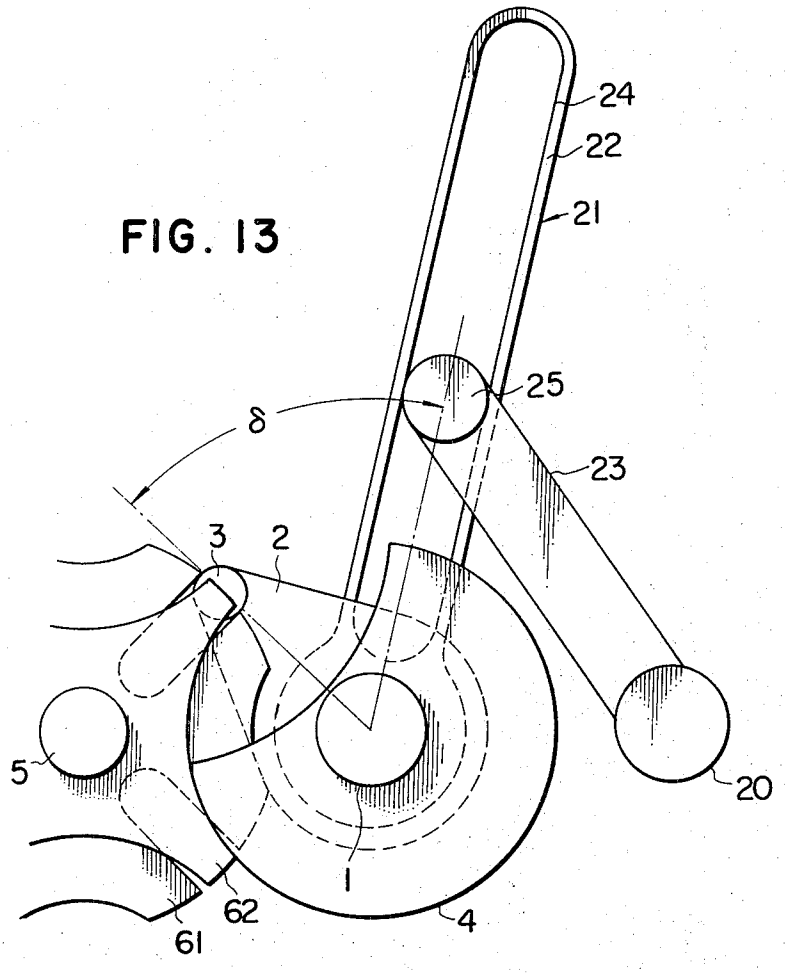


FIG. 13



INTERMITTENT FEED MECHANISM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an intermittent feed mechanism adapted for use with automatic machines, input-output units of electronic computers and the like.

2. Description of the Prior Art

Various automatic machines require periodic motions of many different elements having certain periods of pause at regular intervals, that is, intermittent motions converted from rotary motions. The steady progress of technology in the field is broadening the applications of such intermittent mechanisms in more and more sectors of the industry.

Among the devices for obtaining intermittent motion, the geneva gear or movement is well known. It comprises a driving wheel adapted to run at a constant speed and a driven wheel which is driven to provide intermittent motion, in such way that a driving roller mounted on the driving wheel is led into each of slots formed in the driven wheel, thereby forcing the latter a given distance forward, and then a locking cam provided on the driving wheel is brought into contact with one of cam-contacting recesses formed in the driven wheel so that the driven wheel is allowed to take a pause, the starting and stopping being thus repeated for intermittent feed.

A conventional geneva gear is so constructed that the driving roller and locking cam of the driving wheel and the slots and cam-contacting recesses of the driven wheel are all located on one and the same plane, flush with each other. Therefore, any attempt at increasing the diameter of the driving roller for additional rigidity leads to a widening of the slots in the driven wheel and a reduction of the radius of the locking cam which keeps the driven wheel stationary during indexing. Accordingly, a gap is formed between the locking cam and each cam-contacting recess and it seriously affects the indexing accuracy. In addition, the slots of the driven wheel must be deepened short of the wheel center and this renders it impossible for the driven wheel to maintain adequate structural strength.

SUMMARY OF THE INVENTION

It is a principal object of this invention to provide an intermittent feed mechanism capable of indexing with a high degree of precision.

Another object of the invention is to provide an intermittent feed mechanism having great mechanical strength.

These objects are realized, in accordance with the present invention, by dividing the driven wheel into two plates each formed with either slots or cam-contacting recesses, so that the slotted plate is combined with the driving roller of the driving wheel to form a plane and the other plate having the cam-contacting recesses is combined with the locking cam of the driving wheel to form another plane.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of a conventional intermittent feed mechansim;

FIG. 2 is a sectional view taken along line II — II′ of FIG. 1;

FIG. 3 is a front view of an intermittent feed mechanism embodying the present invention;

FIG. 4 is a sectional view taken along line IV — IV′ of FIG. 3;

FIG. 5 is a front view of another embodiment of the invention;

FIG. 6 is a sectional view taken along line VI — VI′ of FIG. 5;

FIG. 7 is graph indicating the indexing accuracy of the mechanism of FIG. 5;

FIG. 8 is a sectional view of still another embodiment of the invention;

FIG. 9 is a sectional view taken along line IX — IX′ of FIG. 8;

FIG. 10 is a sectional view taken along line X — X′ of FIG. 8;

FIG. 11 is a sectional view taken along line XI — XI′ of FIG. 8;

FIG. 12 is a sectional view of yet another embodiment of the invention; and

FIG. 13 is a front view of a part of a further embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1 and 2, which are respectively a plan view and a sectional view of a conventional intermittent feed mechanism providing a geneva motion, a driving wheel assembly is shown as comprising a driving wheel shaft 1, an arm 2, a roller 3, and a locking cam 4; and, a driven wheel assembly is shown as comprising a driven wheel shaft 5 and a driven wheel body 6 formed with slots 7 and arcuate recesses 8 for contact with the locking cam 4.

With the construction above described, the driving wheel runs at a constant speed about the shaft 1. As the roller 3 of the driving wheel is led into one of the slots of the driven wheel and slides therein, the driven wheel revolves about the shaft 5. However, the driven wheel remains stationary while the locking cam 4 is in contact with one of the arcuate recesses 8 in the manner as shown.

In such an ordinary intermittent feed mechanism, as shown in FIG. 2, the roller 3 of the driving wheel, locking cam 4, and slots 7 and cam-contacting recesses 8 of the driven wheel are all included in one and the same plane, flush with one another.

With such a mechanism it is necessary to increase the width of the slots 7 if the diameter of the driving wheel roller 3 is to be increased for added strength. This means that the radius of the locking cam 4, which holds the driven wheel at the time of indexing, has to be reduced. This tends to provide gaps between the locking cam 4 and the arcuate faces of the driven wheel recesses 8, such gaps in turn seriously affecting the indexing accuracy of the driven wheel. Another disadvantage associated with the increase in the diameter of the roller 3 is that the slots 7 of the driven wheel must be accordingly increased in depth closer to the center of the driven wheel body 6, thus making it impossible for the latter to maintain adequate strength any longer. This is particularly true of a driven wheel having a small number of slots.

In FIGS. 3 and 4, which are respectively a front view and a sectional view of an intermittent feed mechanism embodying the present invention, a driven wheel body securely mounted on a shaft is divided into two rotating plates 61 and 62, the rotating plate 61 being formed

with slots 7 and the rotating plate 62 with arcuate recesses 8 for contacting a locking cam. These plates 61 and 62 are formed into one piece.

On the other hand, a roller 3 is so located as to engage the slots 7 of the driven wheel, and a locking cam 4 of the driving wheel is adapted to engage the arcuate recesses 8 of the driven wheel. This mechanism works in entirely the same manner as the one shown in FIG. 1.

The construction above described enables the mechanism of the invention to have a driven wheel body with ample rigidity even though its slots 7 are widened or cut deeper toward its center to accommodate a larger driving wheel roller 3. Moreover, the fact that the radius of the locking cam 4 may be increased to nearly the theoretical radius R with which the cam periphery touches the center line A of an adjacent slot, contributes to a remarkable improvement of the indexing accuracy.

It is to be understood, of course, that although the two rotating plates 61 and 62 of the driven wheel body and the roller 3 and the locking cam 4 of the driving wheel assembly constituting the embodiment of FIG. 3 are both of unitary structures, they may be completely separated into individual parts to serve the same purpose.

FIGS. 5 and 6 are front and sectional views, respectively, of another embodiment of the intermittent feed mechanism according to the present invention. The embodiment illustrated in FIGS. 3 and 4 has a limitation to its possible indexing accuracy for the reason that, when the machined center of the driven wheel deviates from the theoretical desired location, the wheel is indexed with a corresponding deviation.

The embodiment of FIGS. 5 and 6 is directed to elimination of this possibility. To attain the desired end, the driven wheel plate 61 formed with the arcuate recesses 8 to contact the locking cam is further divided into two plate members 63, 64.

In the manufacture of this mechanism, the two plate members 63, 64 of the driven wheel plate 61 are fixed together, machined to form the arcuate cam-contacting recesses 8, and separated. Following this, one of the two plate members is turned 180° about the driven wheel shaft 5, and the two are again secured together for assembling.

In the manner described the cumulative pitch error of an existing geneva mechanism can be halved. The fact will now be explained with reference to FIG. 7. The solid curve in the graph represents the indexing accuracy of a feed mechanism as measured upon assembling after the two plate members were integrally fixed together and machined for engagement with a locking cam. In the graph the error in indexing angle is plotted along the ordinate and the number of the index position is plotted along the abscissa, the data being obtained in an operation of six intermittent runs per revolution of the driven wheel. It will be manifest, then, that the maximum cumulative pitch error as measured in this way is equal to the difference between the peak and bottom of the solid curve.

On the other hand, when either plate member is turned 180° and fixed together with the other member and machined in the manner described above, the resulting feed mechanism gives an index accuracy as represented by the dotted curve. As can be seen, the valley of the solid curve is removed but the hill is substantially left as it is. This means that the maximum cumulative pitch error is reduced to one half of the solid curve or of the conventional mechanism.

Referring now to FIG. 8 there is shown, in cross section, still another embodiment of the present invention directed to prevention of inaccurate indexing which would otherwise result from the gaps between the locking cam of the driving wheel and the arcuate recesses of the driven wheel contacting the cam.

In this embodiment the rotating plate 62, which is combined with the other plate 61 to constitute the driven wheel and is itself formed with the cam-contacting recesses 8, is made of an elastic material. The driven shaft 5 is journaled in a bearing 14 which is secured to a housing 15 with a high rigidity, and runs intermittently. On the driven shaft 5 is securely mounted a turntable 16 which in turn carries a desired number of jigs 17 which serve as reference points for index positioning. To the housing 15 is secured a slide spring 13 which accommodates a slide 12 and is adapted to be expanded and compressed in conformity with the contour of a cam 11.

With the foregoing construction, the mechanism works as follows. In an indexing position, the spring 13 is compressed upward by a land of the cam 11, thus pushing up the slide 12 into contact with one of the jigs 17 carried by the turntable 16 to provide a reference point as shown in FIG. 9. The relative positions of the driving and driven wheels in this indexing position are illustrated in FIG. 10.

The elastic plate 62 of the driven wheel is shaped as shown in FIG. 11 and usually the machining center of each cam-contacting arcuate recess, designated 62', is not aligned to the center of the driving shaft 1. Therefore, in the indexing position, the plate 62 is deflected as shown by the locking cam 4 and a jig 17 secured to the turntable 16 is pressed by this flexibility against the slide 12 and held accurately in the indexing position. In this manner the driven wheel can be fixed in an indexing position without any objectionable gap and its indexing accuracy can be enhanced.

It should be appreciated that the contour of the plate 62 of the drive wheel is not confined to the one illustrated in FIG. 11 but the plate may take any other shape provided that it has recesses adapted to contact the locking cam 4.

FIG. 12 shows yet another embodiment of the invention wherein the turntable 16 of FIG. 8 is omitted for the simplification of construction. Instead, the jigs 17 which serve to provide the reference points are provided on the plate 61 of the driven wheel, and the slide spring 13 is supported by a holder 18 secured to the housing 15. This embodiment works exactly in the same manner as the embodiment of FIG. 8.

FIG. 13 shows a further embodiment of the present invention. In any of the devices thus far shown in FIGS. 1 through 12, the driving shaft runs at a constant speed and, given the indexing number of the driven wheel, the dynamic characteristic of the mechanism and the ratio of the period of motion to the period of pause in each cycle of the intermittent motion will be predetermined. Then it follows that the variables which a designer can freely alter for choice are limited. He thus finds difficulty in obtaining a mechanism that can satisfy certain desired conditions. This is in many case a limiting factor for the use of geneva movements.

In view of the foregoing, the driving wheel of the embodiment shown in FIG. 13 is caused to run at an in-

constant speed by a slider crank so that the ratio of the period of motion to the period of pause of the driven wheel can be adjusted to a desired value.

For the purpose given above, an input shaft **20** for effecting constant-speed running is provided in addition to the driving wheel shaft **1** and the driven wheel shaft **5**, the input shaft **20** being connected to the driving shaft **1** via slider crank means **21**. The slider crank means **21** consists of an arm **22** secured at one end to the driving shaft **1** and an arm **23** connected at one end to the input shaft **20**. The arm **22** is formed with a slot **24**, in which a roller **25** supported at the other end of the arm **23** is slidably fitted.

With the afore-described construction, the input shaft **20** is allowed to run at a constant speed; whereas, the driving shaft **1** runs irregularly. Thus, the rotational irregularity of the driving shaft **1** can be set to a desired value by changing the distance between the driving shaft **1** and the input shaft **20** to a suitable value. In this way the ratio of the motive period to the quiescent period in each cycle of intermittent feed motion can be freely controlled. It is further possible to obtain the kinetic characteristic best suited to given operating conditions by suitably choosing the angle δ that the arm **2** of the driving wheel makes to the arm **22**.

What is claimed is:

1. An intermittent feed mechanism comprising a driven wheel shaft, a first driven wheel member having slots and fixedly mounted on the driven wheel shaft, a second driven wheel member having cam-contacting recesses and fixedly mounted on the driven wheel shaft, said first and second driven wheel members being axially displaced on said driven wheel shaft and fixedly mounted to each other, a driving wheel shaft, a driving roller secured to the driving wheel shaft and positioned to engage each of the slots of the first driven wheel member in succession upon rotation thereof, and a locking cam secured to the driving wheel shaft and positioned to engage each of the cam contacting recesses of the second driven wheel member.

2. An intermittent feed mechanism comprising a driven wheel shaft, a first driven wheel member having slots and fixedly mounted on the driven wheel shaft, a second driven wheel member having cam-contacting recesses and fixedly mounted on the driven wheel shaft, the second driven wheel member being formed by two similar slotted plates, one of which slotted plates being turned 180° about the driven wheel shaft with respect to the other after the forming of the cam-contacting recesses therein and then set at that angle when assembled, a driving wheel shaft, a driving roller secured to the driving wheel shaft and positioned to engage each of the slots of the first driven wheel member in succession upon rotation thereof, and a locking cam secured to the driving wheel shaft and positioned to engage each of the cam contacting recesses of the second driven wheel member.

3. An intermittent feed mechanism comprising a driven wheel shaft, a first driven wheel member having slots and fixedly mounted on the driven wheel shaft, a second driven wheel member having cam-contacting recesses and fixedly mounted on the driven wheel shaft, a driving wheel shaft, a driving roller secured to the driving wheel shaft and positioned to engage each of the slots of the first driven wheel member in succession upon rotation thereof, a locking cam secured to the driving wheel shaft and positioned to engage each of the cam contacting recesses of the second driven wheel member, an input shaft for constant-speed running, and crank means connected to the input shaft and the driving wheel shaft to cause the latter to run at an irregular speed.

4. An intermittent feed mechanism according to claim **3** wherein the crank means comprises a first arm secured at one end to the driving wheel shaft and slotted along its length to the other end portion, a second arm secured at one end to the input shaft, and a roller secured at the other end to the second arm and slidably fitted in said slot.

5. An intermittent feed mechanism comprising a driven wheel shaft, a driven wheel body having slots and fixedly mounted on the driven wheel shaft, an elastic driven wheel member having cam-contacting recesses and fixedly mounted on the driven wheel shaft, a turntable mounted on the driven wheel shaft, jigs provided on the surface of said turntable for providing indexing points therein, a housing having a bearing to support the driven wheel shaft, a slide slidably held by the housing for pressure contact with one of said jigs, a driving wheel shaft, a driving roller secured to the driving wheel shaft and positioned to engage one of the slots of the driven wheel body, a locking cam secured to the driving wheel shaft and positioned to engage each of the cam-contacting recesses of the elastic driven wheel member, a cam secured to the driving wheel shaft and positioned to cause sliding of the slide in accordance with its contour, and a spring secured to the housing for elastically supporting the slide.

6. An intermittent feed mechanism according to claim **5** including an input shaft for constant-speed running and crank means connected to the input shaft and the driving wheel shaft to cause the latter to run at an irregular speed.

7. An intermittent feed mechanism according to claim **6** wherein the crank means comprises a first arm secured at one end to the driving wheel shaft and slotted along its length to the other end portion, a second arm secured at one end to the input shaft, and a roller secured at the other end to the second arm and slidably fitted in said slot.

8. An intermittent feed mechanism comprising a driven wheel shaft, a driven wheel body having slots and fixedly mounted on the driven wheel shaft, an elastic driven-wheel member having cam-contacting recesses and fixedly mounted on the driven wheel shaft, a housing having a bearing to support the driven wheel shaft, jigs provided on the surface of the driven wheel member for providing indexing points thereon, a slide slidably held by the housing for pressure contact with one of the jigs, a spring secured to the housing and elastically supporting the slide, a driving wheel shaft, a driving roller secured to the driving wheel shaft and positioned to engage one of the slots of the driven wheel body, a locking cam secured to the driving wheel shaft and positioned to engage each of the cam-contacting recesses of the elastic driven wheel member, and a cam secured to the driving wheel shaft and positioned to cause sliding of the slide in accordance with its contour.

9. An intermittent feed mechanism according to claim **8** including an input shaft for constant-speed running and crank means connected to the input shaft and the driving wheel shaft to cause the latter to run at an irregular speed.

10. An intermittent feed mechanism according to claim **9** wherein the crank means comprises a first arm secured at one end to the driving wheel shaft and slotted along its length to the other end portion, a second arm secured at one end to the input shaft, and a roller secured at the other end to the second arm and slidably fitted in said slot.

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