Jan. 17, 1956 I. FRIEDMAN 2,730,913

CLOCK MECHANISMS

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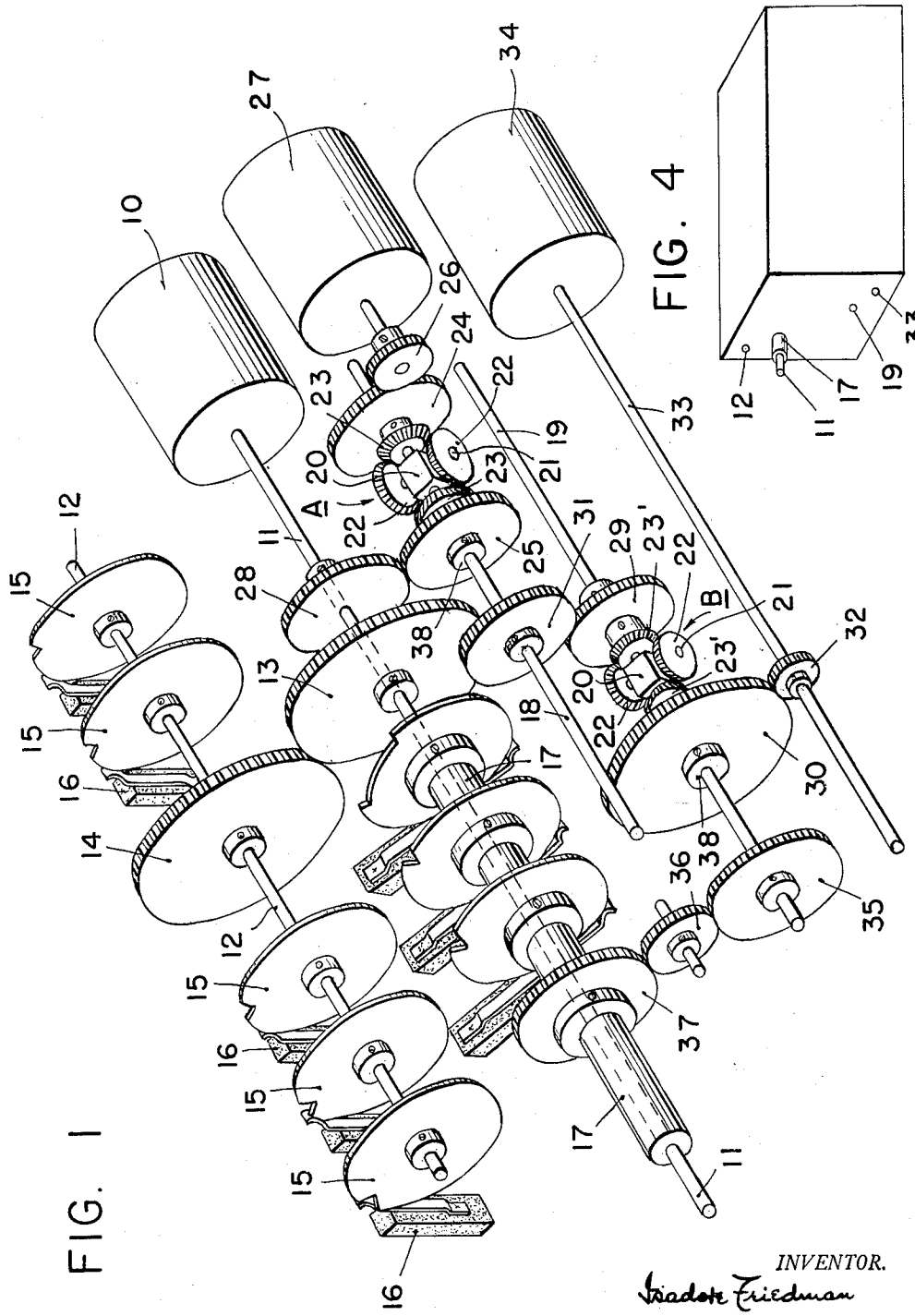


FIG. 1

FIG. 4

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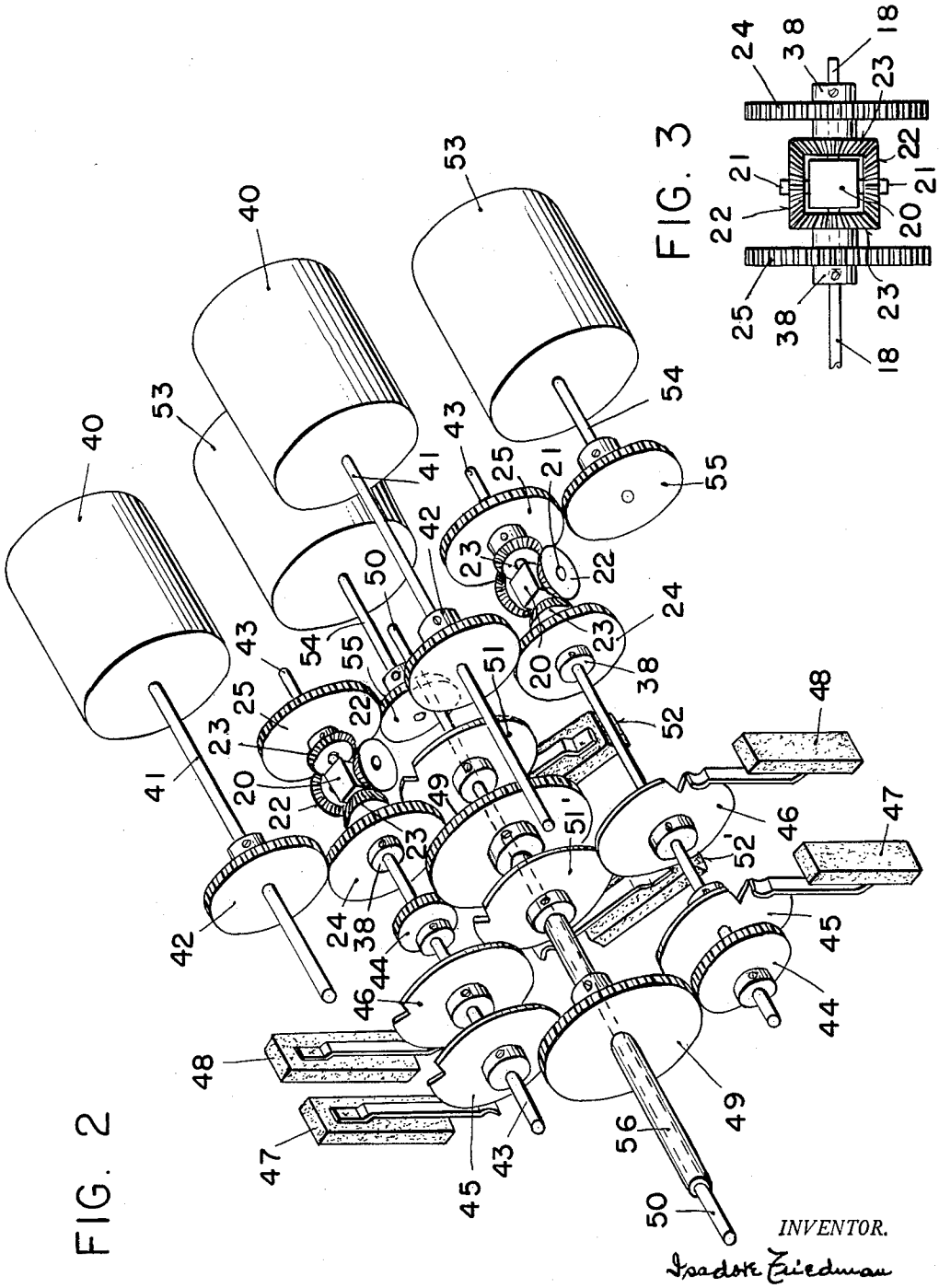


FIG. 2

FIG. 3

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CLOCK MECHANISMS

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3 Claims. (Cl. 74—675)

The present invention relates in its broadest aspects, to new and improved relationships of parts in clock mechanisms. More particularly, the invention—in presently-preferred applications thereof—has especial relation to sports clock mechanisms. It will be understood, however, that the invention may be used to indicate and/or measure other time intervals than time periods in sports events; thus, for example, the mechanism according to the invention may be utilized in connection with time studies in various manufacturing operations, and for other purposes which will be evident to those skilled in the art.

A desideratum in clock mechanisms, regardless of the particular use or application to which they may be put, is that they be accurate, reliable, compact and easily replaceable, exchangeable or repairable in the event of breakdown. This is particularly so in the case of sports clock mechanisms where massive clocks proper, i. e. dial-and-hand assemblies or groups, are employed so that ready detachment of an impaired mechanism and its replacement by a properly operating unit—without disturbing the clock proper—are of the essence.

A primary object of the present invention is the embodiment of a relationship or relationships of parts in mechanism of the mentioned type, whereby the said desideratum is realized.

A further object of the invention is the embodiment of such a mechanism in sports clocks—i. e. in clocks which are used for the demarcation and indication of time periods in sports events.

Still another object of the invention is the embodiment of clock mechanisms of the aforementioned character which are readily adapted for the measurement of time periods in general and wherein the extent of the periods may readily be altered without altering the essential relationship of the parts.

The accomplishment of these objects—as well as of other objects and advantages which will be evident from the following detailed description of presently-preferred forms of the invention—is made possible, briefly stated, inter alia, by the incorporation into the mechanism of at least one differential gear device in the novel arrangement hereinafter described and by the employment of dynamically braked actuating motors. The resultant achievable compactness makes it a simple matter to remove and replace an entire mechanism unit for purposes of inspection, repair or the like.

In the following description, reference is made to the accompanying sheets of drawing wherein the aforesaid relationships of parts are diagrammatically illustrated. The description refers, by way of example, to sports clocks but, as aforesaid, the same mechanism may be used for the measurement of other than sports periods. On the said sheets,

Fig. 1 is a perspective diagrammatic view showing the essential features of one relationship of parts according to the invention;

Fig. 2 is a similar view showing a second embodiment of such relationship of parts;

Fig. 3 shows a detail of the differential construction according to the invention; and

Fig. 4 shows a perspective view of a casing wherein an assembly according to the invention may be housed.

Referring first to the embodiment according to Fig. 1, reference numeral **10** designates the motor which operates the second hand (not shown) of the clock via the shaft **11**. The dial is subdivided into 60 seconds so that the second hand makes a complete revolution in 1 minute. To this end, the motor **10** is a 1 R. P. M. motor wherefore the shaft **11** which it drives turns at a speed of 1 R. P. M. Motor **10**, like every other motor employed according to the invention, is braked by the application of D. C. current to the field of the motor. This direct current is applied immediately upon the interruption of the operating A. C. current, whereby the motor is brought to an immediate stop, without any coasting.

Mounted in parallel relationship to shaft **11** is the 1 R. P. M. cam shaft **12**. This shaft is driven from shaft **11** through interengaging gears **13**, **14**, fixedly mounted respectively on shafts **11** and **12**. Gears **13** and **14** are identical, i. e. are in a 1:1 ratio, whereby, as gear **13** turns at 1 R. P. M. with its shaft **11**, gear **14** and its shaft **12** are also turned at 1 R. P. M. Mounted on cam shaft **12** are those cams **15** which it is desired to operate at 1 R. P. M., such for example as a cam for periodically ringing a gong or sounding a horn, etc. The functions of the cams, which are notched to coact with the spring-pressed followers of the coacting switches **16**, are variable in accordance with purposes of the clock mechanism and are per se no part of the present invention.

Superposed upon the 1 R. P. M. shaft **11** is the shaft **17** for driving the minute hand. It will be assumed for illustrative purposes that the clock is to be used as a boxing clock and, alternatively, as a hockey clock. In the former event, the clock is intended to demarcate the 4-minute rounds; in the latter, the 20-minute periods. The minute dial may therefore be provided with duplicate face markings, one where each quadrant represents 1 minute and a complete revolution is 4 minutes, and the other where the clock is sub-divided into 20 equal parts and a complete revolution is effected in 20 minutes. In the first case, it is necessary that the minute dial, i. e. that the dial shaft **17** rotate at ¼ R. P. M. and, in the other case, that the dial shaft **17** rotate at 1/20 R. P. M. It will be understood, however, that by a suitable correlation of the gears hereinafter described, the clock may be adapted for different time periods than those here selected for illustrative purposes.

In order to realize the ¼ R. P. M. and 1/20 R. P. M. operations of shaft **17**, two differential shafts **18** and **19** are provided. Each shaft is provided with an integral enlargement **20** for supporting two diametrically opposed stub shafts **21** on each of which a beveled gear **22** rotates. Each beveled gear **22** in differential A is in engagement with a beveled gear **23**, the two gears **23** being integral, respectively, with a differential input gear **24** or **25** of the said differential A. The gear units **23**, **24** and **23**, **25** are mounted freely upon differential shaft **18**. Gear **24** is in meshed engagement with gear **26** which is fixedly mounted on the drive shaft of a second 1 R. P. M. motor **27**, while gear **25** is in meshed engagement with gear **28** which is secured to shaft **11** and rotates therewith at 1 R. P. M.

Each beveled gear **22** in differential B is in engagement with a beveled gear **23'**, the two gears **23'** being integral, respectively, with a differential input gear **29** or **30**. The gear units **23'**, **29** and **23'**, **30** rotate freely upon differential shaft **19**. Gear **29** is in engagement with gear **31** fixed to differential shaft **18** to rotate therewith, and gears

29 and 31 are in a 1:1 ratio to each other. Gear 30 is in engagement with gear 32 fixedly mounted on reset-motor shaft 33 or reset motor 34.

Differential shaft 19 is further provided, in operatively integral relation, with gear 35 which is in engagement, via idler gear 36, with gear 37 of the minute hand shaft 17, the ratio between gears 35 and 37 being 1:1.

Collars 38, fixed to the respective shafts, keep the gear units in place.

To operate the 4-minute cycle of the device, motor 10 is started; motors 27 and 34 remain cut out and braked. Operation of the motor 10 rotates shaft 11 and its gear 28 at 1 R. P. M. Due to the 1:1 relationship therebetween, gear 28 rotates input gear unit 25, 23 of differential A at the same 1 R. P. M. speed. Gear 26 and therewith gear unit 24, 23 remain locked in place by motor 27. Rotation of the two output gears 22 of differential A effects a reduction of speed to ½ R. P. M. which is transmitted to the differential shaft 18.

Gear 31, thus rotating at ½ R. P. M., rotates its intermeshed 1:1 gear 29—i. e. unit 29, 23'—at this same speed. Motor 34 locks gear 32 and unit 30, 23'. Rotation of the two output gears 22 of the differential B effects a further reduction of speed to ¼ R. P. M. which is transmitted to the differential shaft 19 and to gear 35 fixed thereto. In this way, gear 37 and associated shaft 17 are, via idler 36, driven at a speed of ¼ R. P. M.

While shaft 17 and the minute hand operated thereby are thus turned at a ¼ R. P. M. speed, shaft 11 and its associated second hand operate at a 1 R. P. M. speed directly from the 1 R. P. M. motor 10. In this way, the 60-second dial is traversed 4 times by the second hand, while the 4-minute dial is traversed once by the minute hand.

This four-minute cycle takes care of the 3-minute boxing period and the one-minute rest period which are conventional in prize fights.

As the precedingly-described operation proceeds, gear 14 is driven at 1 R. P. M. from gear 13, whereby cam shaft 12 and cams 15 rotate at this same speed. One of the cams 15 and its coacting switch may for example operate a stepping relay which is manually set to close the circuit through the other switches at the proper moment. This feature per se is, however, no part of the present invention proper.

To operate the 20-minute cycle of the device, both motors 10 and 27 are actuated; re-set motor 34 remains braked, thereby locking gear 32 and input gear unit 30, 23'. Shafts 11 and 12 and parts integrated therewith operate as described for the 4-minute cycle. Gear 28 imparts a 1 R. P. M. rotation to input gear unit 25, 23. Gear 26 also rotates at 1 R. P. M. but due to the 4:5 size relationship between gears 26 and 24, there is a speed reduction at this point and input gear unit 24, 23 is rotated at a speed of ⅘ R. P. M. Since unit 25, 23 turns in one direction (1 R. P. M.) and unit 24, 23 rotates in the opposite direction (⅘ R. P. M.), the net input speed to differential A is ⅕ R. P. M. This speed is again reduced through the differential at a 2 to 1 ratio, turning the shaft 18 and output gear 31 at 1/10 R. P. M. Gear 31 drives input gear unit 29, 23 at this same speed which, however, is again reduced by one-half through the differential B so that the output gear 35 is driven at 1/20 R. P. M. This is transmitted through idler 36 to gear 37 at a 1:1 ratio, turning the shaft 17 and its minute hand at 1/20 R. P. M.

To reset the clock, motor 34 comes into play. Motor 27 is cut out, but motor 10 may be operated to reset the second hand. Motor 34 operates at 42 R. P. M., but this speed is reduced to 7 R. P. M. by the 6 to 1 reduction at gears 32 and 30, and is further reduced to 3½ R. P. M. through the differential B whereby resetting of the minute hand is rapidly effected.

The modification according to Fig. 2 of the drawings also embodies the novel relationship of parts according to the invention and is particularly adapted for use where two complete timing units—such, for example, as penalty timing units—are required. According to the invention, two such units may be combined and comprised within a single compact assembly.

The one timing unit comprises a dial hand operating motor 40, on the motor shaft 41 of which is fixed a gear 42. The adjacent differential shaft 43 is provided with a differential assembly like those previously described, comprising beveled gears 22 mounted on hub 20 integral with the shaft and two input gear units 23, 24 and 23, 25 which are loose on the shaft, being retained in place however by collars as shown. Gear 24 is in engagement with gear 42. Fixedly mounted on shaft 43 are also gear 44 and cam members 45 and 46 which cooperate with switches 47 and 48. The cam-and-switch arrangements may be varied according to needs and desire and per se constitute no real part of the present invention.

Gear 44 is in engagement with gear 49 fixedly mounted on one dial shaft 50, on which is also secured cam 51 which cooperates with switch 52. Gears 42 and 24 are in 1:1 relationship, while gears 44 and 49 are in 1:5 relationship.

The unit being described also comprises a re-set motor 53, on the shaft 54 of which is fixedly mounted a gear 55 which is in operative engagement with gear 25 of gear unit 23, 25.

In operation, motor 40—which may have a speed of 2 R. P. M.—turns shaft 41 and gear 42 at this speed. The latter, in turn, actuates gear unit 23, 24 at this same speed. Gear unit 23, 25 and gear 55 are locked by the braked motor 53. The 2 R. P. M. speed of gear unit 23, 24, being transmitted through the two beveled gears 22, effects a reduction thereof so that differential shaft 43 turns at a speed of 1 R. P. M. as does gear 44 fixed thereon. The latter being in a 1:5 ratio with its meshed gear 49, a further speed reduction takes place, and gear 49 as well as shaft 50 and cam 51 rotate at ⅕ R. P. M. This is the speed at which the corresponding hand on the clock will travel. The dial may be a 5-minute dial so that it takes 5 minutes for the hand to make a complete rotation. The cam-and-switch arrangements, together with a manually-settable stepping relay, make it possible to measure penalty periods from 1 to 5 minutes in duration.

To re-set the clock, the re-set motor 53 is actuated while the motor 40 is not. Motor 53 may conveniently be a 42 R. P. M. A. C.-motor. Gear 55 is therefore operated at 42 R. P. M. as is the differential input gear unit 23, 25, while gear unit 23, 24 remains locked by the bracked motor 40, via gear 42. The speed is reduced through the differential so that differential shaft 43 runs at a speed of 21 R. P. M. The further reduction at gears 44, 49 results in a re-set speed for shaft 50 of a little over 4 R. P. M.

The other unit comprised within the embodiment of the invention according to Fig. 2 is constructed like that of the first-described unit; corresponding parts are correspondingly labeled, and the operation is as aforedescribed. However, dial shaft 56, corresponding to shaft 50 of the first unit, takes the form of a hollow shaft mounted about shaft 50 and on which is mounted cam 51' cooperating with switch 52', corresponding to previously mentioned parts 51 and 52, respectively.

In the event that a single time period indicator only is desired, an assembly may be established according to the relationships and principles of the device according to Fig. 2 but including only one of the two units there involved.

For the sake of simplicity and clarity, the bearings and bearing supports for the several shafts, etc. shown on Figs. 1 and 2 of the drawings have been omitted. These per se form no part of the invention. The entire assembly in each disclosed embodiment may be encased within a housing or casing as shown diagrammatically in Fig. 4, to constitute a unitary assembly of the entire device in

each case. The clock hand-moving shafts which extend out of the casing or housing or retaining plates may be disconnectably associated with their respective hands in any suitable and conventional readily releasable manner.

The beveled gears **22** which turn with the differential shaft of each differential may be designated planetary gears, while the gears in which they enmesh but which are not entrained by the differential shaft on which they are mounted may be designated sun gears.

It will be evident from the foregoing that the invention provides constructions which realize the initially stated desideratum, objects and advantages.

Having thus disclosed the invention, what is claimed is:

1. In a sports clock device, a clock hand-actuating shaft, and means for operating said shaft selectively at different speeds, said means comprising a motor and motor shaft, a differential shaft with a differential gear assembly mounted thereon, said assembly comprising sun-gear gear units mounted for free rotation on said differential shaft and planetary gears enmeshed with the sun gears of said units and mounted for translatory movement with said differential shaft, a gear on said motor shaft in meshing engagement with the gear of one of said sun-gear gear units, a second differential shaft with a differential gear assembly mounted thereon, said last-named differential gear assembly comprising sun-gear gear units mounted for free rotation on said second differential shaft and planetary gears enmeshed with the sun gears of said last-named units and mounted for translatory movement with said second differential shaft, a gear on said first-named differential shaft in meshing engagement with the gear of one of said last-named sun-gear gear units, means for severally locking each of the other sun-gear gear units of said differential gear assemblies, and means for transmitting rotational movement of said second differential shaft to said clock hand-actuating shaft

each said locking means comprising a motor, a motor shaft and a gear on said motor shaft, said gear being in meshing engagement with the gear of sun gear-gear unit being locked, whereby said locking means motors also constitute driving means for said differential shafts so that by operating the first-named motor alone said clock hand-actuating shaft is driven at one speed, while when operating the first-named motor simultaneously with a selected one of the other motors said clock hand-actuating shaft may be driven at another speed.

2. A relationship of parts according to claim 1, wherein the gear of said locking means is of a size different from the size of the gear enmeshed thereby.

3. A relationship of parts according to claim 1, wherein said clock hand-actuating shaft is a hollow shaft mounted concentrically on one of said last-mentioned motor shafts.

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