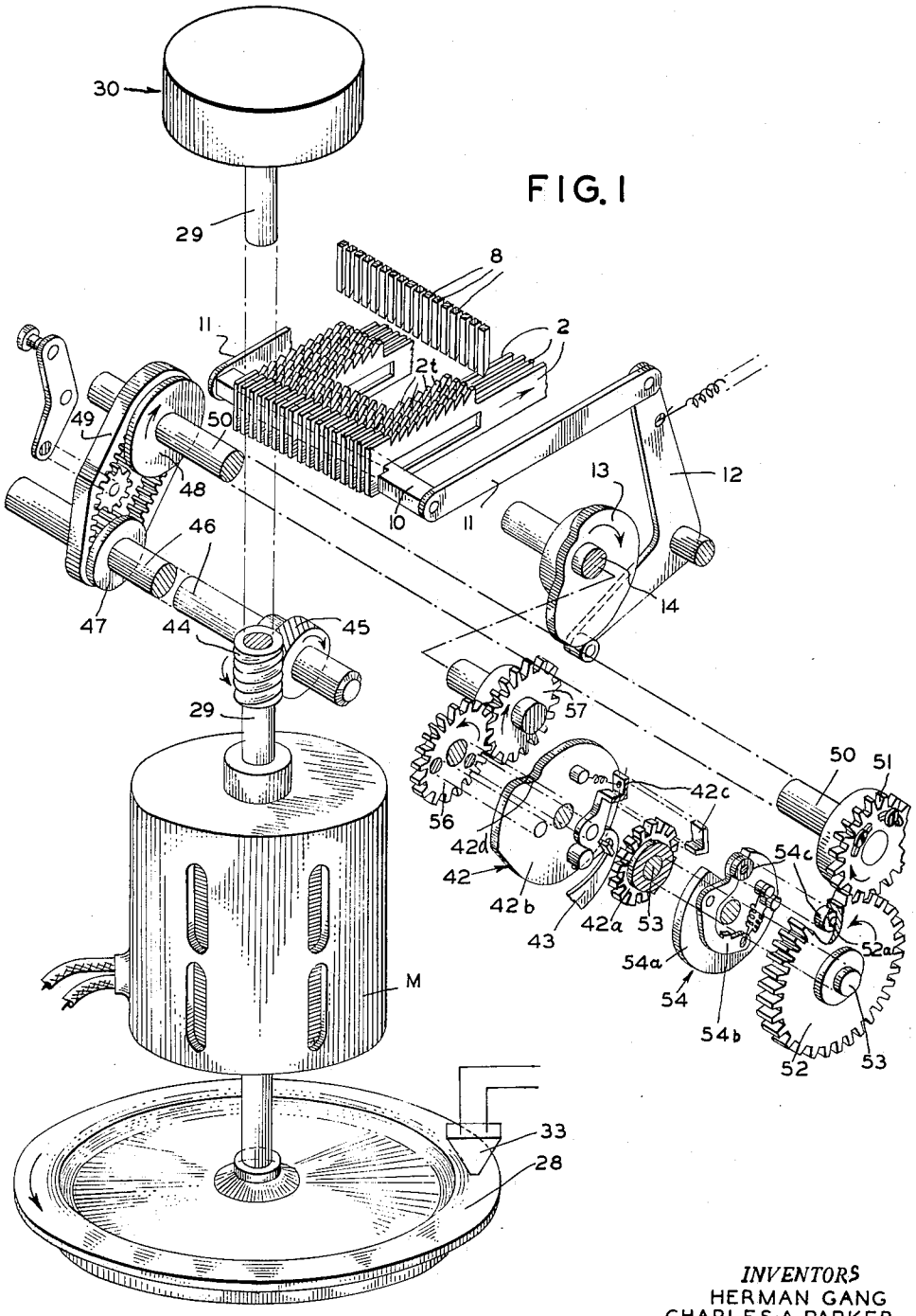
Feb. 1, 1966 H. GANG ETAL 3,233,080

READOUT APPARATUS

Filed May 18, 1961 3 Sheets-Sheet 1

FIG. 1



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READOUT APPARATUS

Filed May 18, 1961 3 Sheets-Sheet 2

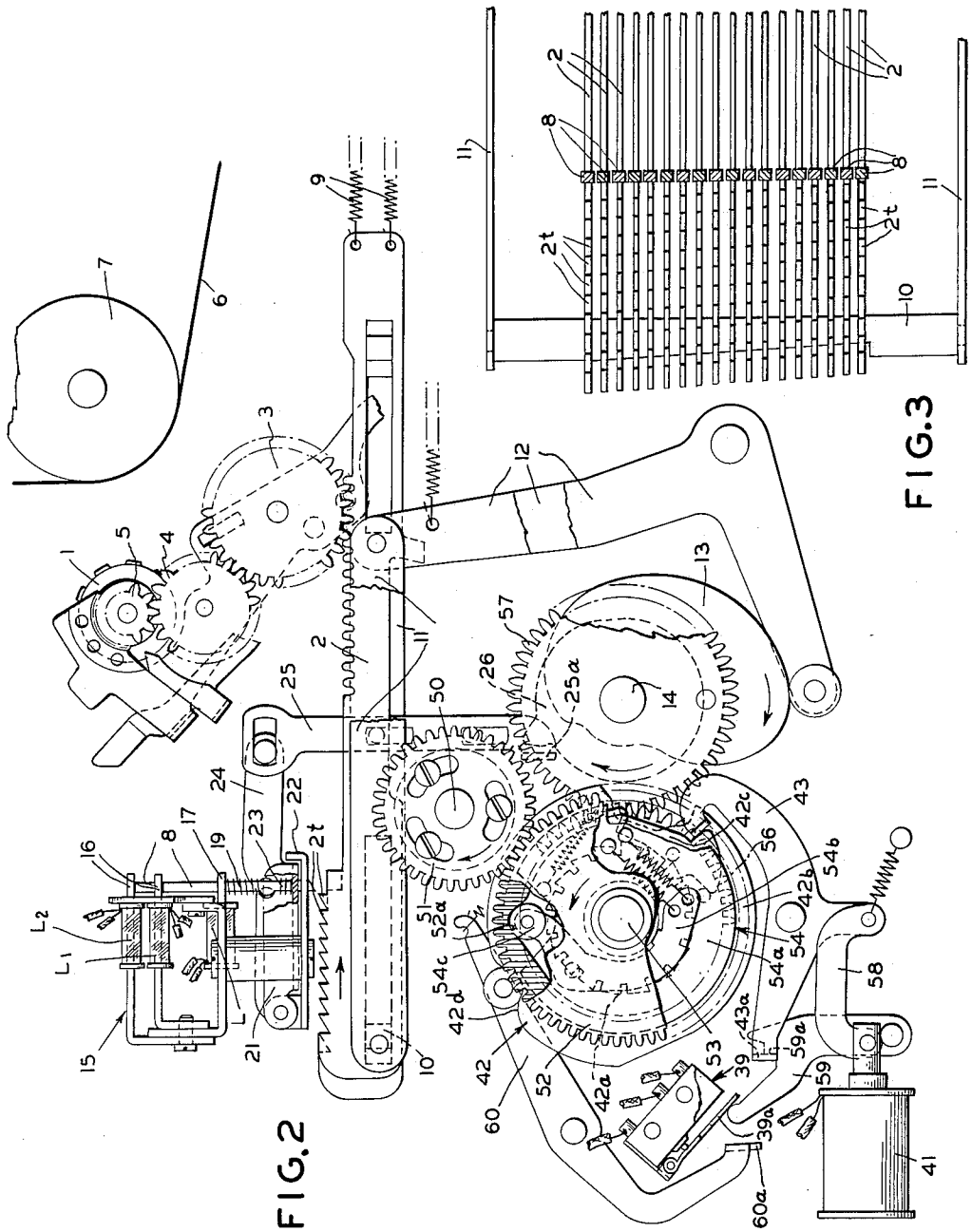

FIG.2

FIG.3

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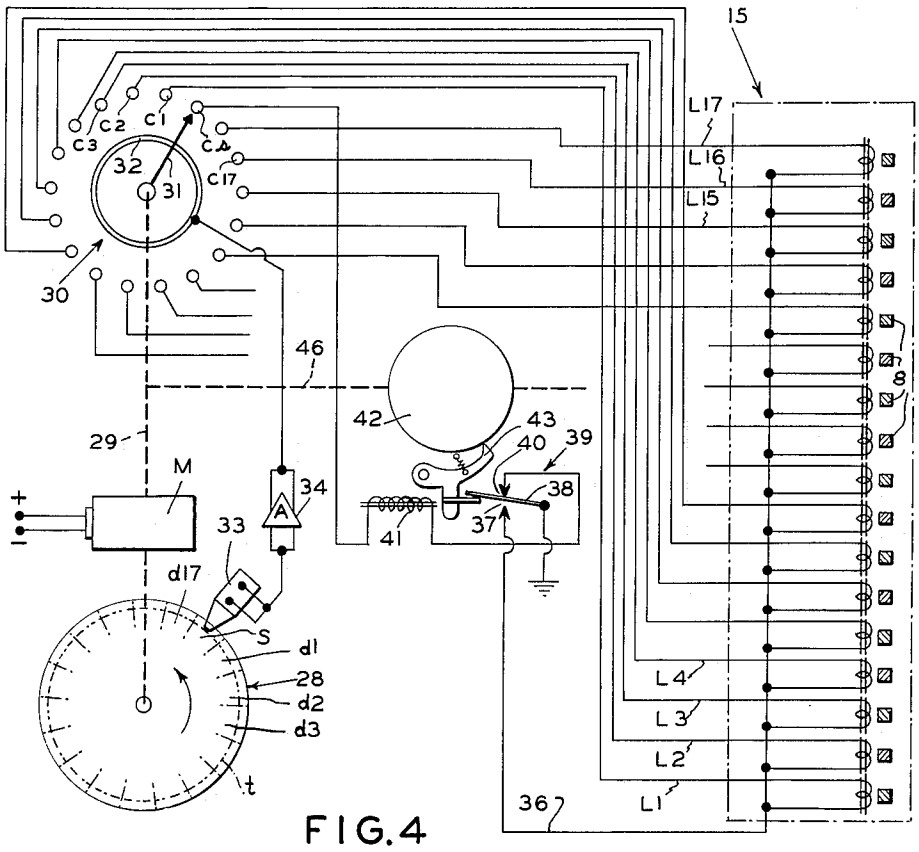

FIG. 4

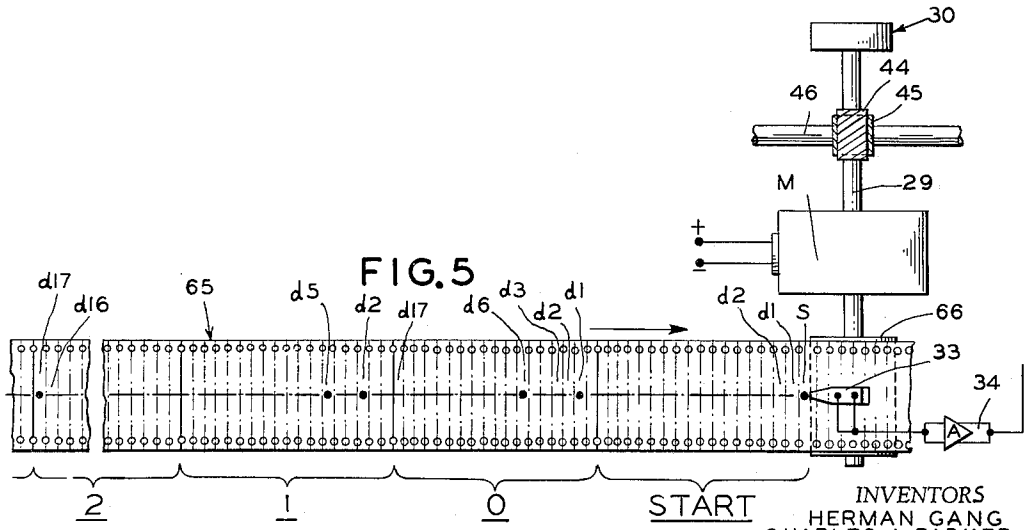

FIG. 5

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United States Patent Office 3,233,080 Patented Feb. 1, 1966

3,233,080

READOUT APPARATUS

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Filed May 18, 1961, Ser. No. 110,917
12 Claims. (Cl. 235—61.9)

The present invention relates to registering apparatus wherein an ordinal series of differentially movable actuating members for a corresponding series of differentially settable character display or of type members are adapted to be arrested in positions to set the display or type members in accordance with data to be registered. More particularly, the invention relates to registering apparatus of the above type for use in a readout system wherein storage means of a computing system is sensed serially, order by order, and in each complete sensing operation only given like characters are transmitted to the registering apparatus. For example, if digital values are recorded in the storage, in one cycle of the sensing means the 0 digits will be transmitted serially to the registering mechanism, in the next cycle the 1 digits will be transmitted, etc.

It is a primary object of the invention to provide control means for registering apparatus of the above type which will permit a substantial increase in speed with reliability of operation in a readout system wherein the data to be recorded is received serially as described above.

A more specific object of the invention is to provide control means for registering apparatus in a readout system having the operational advantages as stated above wherein the data to be recorded is stored on a rotatably driven magnetic storage drum or disc.

A further specific object of the invention is to provide control means in a readout system having the operational advantages specified wherein the data is stored on a storage tape.

A further object of the invention is to provide a readout system of the above character including particularly compact and reliable drive means for operating the recording apparatus in synchronism with the storage means in sensing of the storage means.

In a preferred embodiment of the invention the registering machine is of the type wherein an ordinal series of digit type wheels are settable by a respective series of actuator racks from 0–9 digit printing positions inclusive. During simultaneous forward excursions of the racks, the type wheels are rotated from 0 through the successive digit printing positions to 9 digit position.

A stop means is associated with each actuator rack and is adapted to engage any one of a series of teeth on the associated rack corresponding to the digit printing positions of the associated type wheel. Control means in the readout system is adapted to cause engagement of each stop with a tooth of its rack to arrest rotation of the associated type wheel when the type wheel is in the digit printing position corresponding to the digital value in the corresponding order of the computer magnetic storage.

In a printing machine of the above type, it is usual for the type wheels to arrive simultaneously at each like digit printing position. In the above it has been noted that like digits are transmitted serially from the storage to the printing machine. It will be seen therefore that each successively operated stop will have less time than the stop before to arrest movement of the associated rack in the correct position. Obviously, the machine can be operated no faster than will be permitted by the last operated stop in the transmission of a series of like digits to the machine.

The devices of the invention control operation of the

actuator racks to give each stop means equal operating time for arresting movement of its rack. More specifically, the racks are controlled so that the type wheels arrive successively from order to order at each like printing position. The invention, however, will best be understood from the following description with reference to the accompanying drawings in which:

FIG. 1 is an exploded fragmentary perspective view of the readout system.

FIG. 2 is a side elevation of the actuator racks of the printing mechanism, and the stop means and the drive means for the racks.

FIG. 3 is a plan view of the actuator racks and the restore bail for the racks.

FIG. 4 is a circuit diagram disclosing the readout controls from the magnetic storage disc to the printing machine.

FIG. 5 is a view of a magnetic storage tape which is usable in the readout system alternatively of the storage disc.

The printing mechanism

The printing mechanism (FIG. 2) may be of the same general type disclosed in application Serial No. 819,174, now Pat. No. 3,057,547, to Heinrich W. Wagemann. The printing mechanism includes an ordinal series of digit type wheels 1 each having spaced around its periphery a series of digit type ranging in values from 0 to 9 inclusively. Each type wheel 1 is entrained with an actuator rack 2 by a train of gears 3, 4, and 5.

For an understanding of the invention, it is necessary to disclose herein only the means whereby actuator racks 2 are controlled in forward excursions in a readout operation to rotate type wheels 1 to positions for printing in accordance with the values in the storage. At the completion of the forward excursions of racks 2, type wheels 1 are fired to effect the printing operation by bringing the appropriate type against a paper tape 6 carried by a platen 7. At the conclusion of the printing operation, racks 2 are restored thereby rotating type wheels 1 to normal. As shown in the drawings, there are seventeen racks 2. Therefore, provision is made for readout from a seventeen order storage. Reference is made to the aforenoted application for a description of the printing operation and other operations of the printing mechanism not disclosed herein.

Each actuator rack 2 is provided at its upper left end (FIGS. 1, 2, 3) with a series of ten teeth 2*t* corresponding to the digits 0–9. The rightmost tooth is the 0 tooth, the next tooth is the 1 tooth, etc. Operatively associated with each rack 2 is a stop pin 8. Normally pins 8 are held raised as later described with their lower ends slightly above and out of the path of movement of teeth 2*t* when racks 2 are moved toward the right in their forward excursions.

Just prior to or during the forward movement of racks 2, each pin 8 is adapted to be released at a predetermined time with respect to the movement of the racks as later disclosed and moved downwardly to engage one of the ten teeth 2*t* of the associated rack 2 to arrest movement of the rack. Accordingly, when a rack 2 is arrested, the type wheel 1 driven by the rack will be in the digit printing position corresponding to tooth 2*t* which is engaged by the associated pin 8.

Normally, actuator racks 2 are held to the left in restored position, against the urge of operating springs 9, by a restore bail 10. The holding edge of bail 10, from lower to higher orders of racks 2, is inclined toward the left, as best seen in FIG. 3, to hold racks 2 in staggered relationship. With racks 2 in restored staggered relationship, the lowest order type wheel 1 will be held in 0 printing position and the highest order wheel will be

backed one digit space from the lowest order wheel and held in 9 printing position. Accordingly, the type wheels between the lowest and highest orders will be held in respective positions between 0 and 9.

Stop pins **8** are in a line perpendicular to the movement of racks **2** with pin **8** of the lowest order rack immediately to the right of the 0 tooth **2***t* when the racks are in normal restored position as best seen in FIGS. 2 and 3. Therefore pin **8** of the highest order rack **2** will be one tooth space to the right of the 0 tooth **2***t* and the intermediate pins will be proportionate fractional distances to the right of the 0 teeth of the associated racks from lower to higher orders. From the above, it will be seen that as bail **10** is moved toward the right, springs **9** will likewise move racks **2** in staggered relationship until arrested by stop pins **8** as later described.

It will be noted that when any tooth **2***t* of the lowest order rack is moved into position where it may be engaged by the associated pin **8**, the corresponding tooth of the highest order rack will be one tooth space from the position where it may be engaged. Obviousely, therefore, the teeth **2***t* corresponding to any given digit will be moved successively from lower to higher orders into position for engagement.

A pin **8** may be released to engage a given tooth **2***t* of the associated rack **2** immediately after the leading edge of the preceding tooth has passed beneath the pin. Such timing of the pin release will permit maximum operating speed of the printing mechanism. As noted before, the readout is effected serially from lower to higher orders for each plurality of like value digits and means later described is operable to release corresponding order pins **8** serially from lower to higher orders. Thus it will be seen that the stagger of racks **2** will compensate for the difference in time of the release of pins **8** upon transmission of any series of like value digits and that pins **8** will each be released when the respective racks **2** each arrives at the same registering position. Each pin **8** therefore will have equal time to engage the selected tooth **2***t*.

Bail **10** is mounted between the left ends of a pair of links **11** which at their right ends are supported at the upper ends of vertically disposed arms of a pair of bell cranks **12** which operate as cam followers. Bell cranks **12** are spring biased clockwise and each includes a leftwardly extending arm having a roller which engages a cam **13**, one of which is shown in FIGS. 1 and 2. Cams **13** are fast on a main drive shaft **14** and are of like contour with their respective high portions normally engaged by the rollers of cranks **12**. Thus cranks **12** are normally held counterclockwise with bail **10** in left restored position.

One clockwise rotation of shaft **14** will effect a cycle of operation of the printing mechanism. Upon rotation of shaft **14**, cams **13** will permit clockwise movement of cranks **12** and bail **10** will therefore be moved toward the right in a forward stroke to permit like movement of racks **2** by springs **9** in forward excursions. After completion of the rightward movement of bail **10** with racks **2** arrested in positions as determined by released pins **8**, the parts will dwell and type wheels **1** will be fired to effect a printing operation. After the printing operation, completion of the rotation of shaft **14** and cams **13** will restore the parts. Drive means for timing operation of the printing mechanism with sensing of the magnetic storage means will be described later.

The electromagnetically controlled stop means

The means for holding stop pins **8** raised and means for releasing the pins for engagement with teeth **2***t* is disclosed as operating substantially as disclosed in application Ser. No. 88,244 to Nathaniel B. Wales, Jr.

The stop unit generally indicated by the numeral **15** (FIG. 2) comprises a plurality of pole fingers **16** mounted on a pole plate **17**. The alternate pole fingers are at different levels to achieve close lateral spacing. Stop pins **8** extend through pole plate **17** and each pin at its upper end is adapted to engage the underside of a related pole finger **16**.

An elongated holding coil L embraces pole plate **17** and is therefore common to all pole fingers **16**. A constant direct current potential (not shown) is applied to coil L and thus a magnetic circuit will be completed through a pin **8** when it is in raised engagement with its pole finger **16**. Normally pins **8** are in raised engagement with pole fingers **16** and the magnetic attraction is just sufficient to hold them raised against the downward urge of springs **19** which engage protrusions on the pins and bear against the underside of pole plate **17**. The attracting force however is not sufficient to raise the pins against the urge of these springs.

Each pole finger **16** from lower to higher orders is embraced by a release coil **L1**, **L2**, etc. (also FIG. 4). Now if current of given amplitude is passed through a release coil **L1**, **L2**, etc., in a direction opposite to that passing through holding coil L, the magnetic flux level will be reduced in the related pole finger **16** below the holding level and the related pin **8** will be released for downward movement by its spring **19** to engage a tooth **2***t* of the associate rack **2**. The holding flux induced by coil L is just sufficient to hold pin **8** against the urge of spring **9** and therefore a low amplitude pulse through a release coil **L1**, **L2**, etc., will be effective to reduce the holding flux and the release level.

For an understanding of the invention, it is necessary to disclose herein only the means whereby current pulses **2** are transmitted to release coils **L1**, **L2**, etc., in timed relationship with a cycle of operation of the printing mechanism as later described. For a complete disclosure of stop unit **15** reference is made to the aforenoted application. Furthermore, it will be understood that the release coils could control stop pins **8** by direct solenoid operation or could operate to release latch means which would restrain the pins against the urge of springs **19**.

At the completion of a cycle of operation of the printing mechanism, means is operable to restore all released stop pins **8** to engagement with their pole fingers **16**. The restore means comprises a restore plate **21** normally resting on a bed plate **22** and pivotally mounted on a pair of ears on the bed plate. Stop pins **8** extend loosely through clearance holes in restore plate **21** and are slidably journalled in bed plate **22**. A floating reset spring **23** on each pin **8** is freely trapped between protrusions on the pin and restore plate **21**.

A rightwardly extending arm **24** is fixed to restore plate **21** and has slot and pin connection at its right end with the upper end of an upright slide **25**. The lower end of slide **25** has a lug **25***a* which engages a cam **26** fast on drive shaft **14** of the printing mechanism.

Near the end of each printing cycle, a high part of cam **26** will engage and then pass beyond lug **25***a* of slide **25** to raise and then release said slide. When slide **25** is raised, arm **24** and restore plate **21** will be rocked counterclockwise to raise reset springs **23**. Thus springs **23** will be brought into engagement with the protrusions on pins **8** to raise said pins against the urge of springs **19** which are weaker than springs **23**. Accordingly, each released pin **8** will be moved into contact with its pole finger **16** where it will be held by the magnetic attraction.

The magnetic storage and the distributor

The magnetic storage as disclosed in FIGS. 1 and 4 is in the form of a disc **28** on which a plural order digital value may be recorded on a single circumferential track as indicated by the dot-dash line *t* (FIG. 4). There is provision for recording of a seventeen order digital value on track *t* corresponding to the orders of the previously described printing mechanism. Furthermore, there is an eighteenth position *s* at which a start signal may be recorded. Each digit of a number is recorded on track *t* in an angular position corresponding to the order of the digit as indicated by the positions *d*1 (lowest order) *d*2, *d*3,

etc. These positions are indicated as located between the radial dot-dash lines of FIG. 4. Disc 28 is directly driven at a substantially constant speed by the drive shaft 29 of a motor M. The speed may be of the order 3,600 r.p.m. which is usual for this type apparatus. Obviously, a magnetic storage drum could be substituted for the disc.

A distributor 30 is located on the opposite side of motor M from disc 28 and has a contact arm 31 directly driven by motor shaft 29. Disc 28 and contact arm 31 (FIG. 4) are therefore driven at a one-to-one ratio. In FIG. 1, distributor 30 is shown as enclosed in a cylindrical casing.

Distributor 30 includes seventeen contacts *c1*, *c2*, *c3*, etc., corresponding to the digit recording positions *d1*, *d2*, *d3*, etc., of disc 28. Furthermore, there is an eighteenth contact *cs* corresponding to the start position *s* of disc 28. These eighteen contacts are engaged successively by arm 31 which continuously engages a conductor ring 32.

Contacts *c1*, *c2*, etc., (FIG. 4) respectively of distributor 30 are connected to release coils L1, L2, etc., of the rack control unit 15 for the printing mechanism. The release coils have a common lead 36 which is connected to a normally open contact 37 of a switch 39. Contact 37 is adapted to be engaged by a switch arm 38 to connect the coils to ground. Switch arm 38 is resiliently biased toward engagement with contact 37 but normally is held by a clutch detent 43 (later described) in engagement with a contact 40 of switch 39. Contact 40 is connected to one side of a solenoid coil 41, the other side of which is connected to contact *cs* of distributor 30. Solenoid 41, as later described, is operated to engage a clutch which drives the printing mechanism in time with disc 28 and distributor 30.

A pick-up head 33 is operable to sense the start position *s* and the digit positions *d1*, *d2*, etc., of track *t* serially upon each rotation of storage disc 28. When each of the positions *s*, *d1*, *d2*, etc., is sensed, arm 31 of distributor 30 will engage the corresponding respective contacts *cs*, *c1*, *c2*, etc. Pick-up head 33 is connected via an amplifier 34 to distributor arm 31 via conductor ring 32.

It will be recalled that in one cycle of the storage means digits 0 are transmitted by the sensing means, in the next cycle 1 digits are transmitted, etc. Such sequential operation by pick-up head 33 may be effected by operation of the computing mechanism to record the start signal in position *s* during a first rotation of disc 28, in a second rotation to record the 0 digits in their correct ordinal positions *d1*–*d17*, in a third rotation the 2 digits would be recorded, etc. From the above, it will be seen that pick-up head 33 will first transmit the start signal, then the 0 digit signals, etc.

In an alternative arrangement, the complete series of digits comprising a value may be stored on disc 28 and sensed by head 33 upon each rotation of the disc. A digit selection means (not shown) would be interposed between head 33 and distributor 30. The selection means is operable to transmit first 0 digits, then 1 digits, etc. Such selection means is disclosed in Patent No. 2,882,817 to Gerhard Wolf and British Patent No. 835,243.

When the start signal is sensed at position *s* of disc 28 by head 33, a current pulse will be transmitted to solenoid coil 41 via distributor arm 31 and contact *es* (FIG. 4) of distributor 30. Solenoid coil 41 is normally grounded through contacts 38, 40 and therefore will be operated to engage clutch 42 which drives the printing mechanism. To engage clutch 42, a clutch detent 43 is rocked clockwise by solenoid 41 and this moves switch arm 38 to open contact 40 and to close contact 37 thereby connecting release coils L1–L17 to ground via line 36. Clutch 42 and its operation of the printing mechanism in timed relation with the digit sensing by head 33 will be described later.

After transmisison of the start signal, disc 28 will complete a cycle of rotation and then in the next cycle of rotation the digit positions *d1*, *d2*, etc., will be sensed and pulses for 0 digit storage in any of the positions will be transmitted via distributor 30 to the corresponding order release coils L1, L2, etc. In the next cycle of disc 28, pulses for 1 digit storage will be transmitted to the corresponding order release coils and in the next cycle transmission for 2 digit storage, etc., until transmission has been effected for all digits 0–9. During this time, racks 2 of the printing mechanism will be moving in their forward excursions in timed relation with transmission of the digit pulses until arrested by stop pins 8 which are released when digit pulses are transmitted to the associated release coils. A drive transmisison for controlling operation of the printing mechanism to move rack 2 in timed relation with the transmission of the digit pulses is described in the following.

Drive transmission of the printing mechanism

The drive transmission (FIGS. 1, 2) for the printing mechanism includes a worm 44 fast on shaft 29 of motor M. Worm 44 drives a worm gear 45 fast on a transverse shaft 46. A cog wheel 47 fast on shaft 46 drives a cog wheel 48 through a cog belt 49. An idler cog wheel, intermediate wheels 47 and 48, engages belt 49 and is laterally adjustable to regulate the tension of belt 49.

Cog wheel 48 is fast on a transverse shaft 50 on which the hub of a gear 51 is secured. Gear 51 is secured on its hub by slot and bolt connection and is thereby rotatably adjustable. The drive transmission therefore can be accurately timed to operate the printing mechanism with respect to rotation of storage disc 28 as later described.

Gear 51 drives a gear 52 rotatably mounted on a shaft 53 and the ratios of the various parts of the afore-described drive train is such that storage disc 28 is rotated eighteen times for each rotation of gear 52. There is a one-to-one drive means including clutch 42 between gear 52 and drive shaft 14 of the printing mechanism. Therefore after clutch 42 is engaged, one cycle of the printing mechanism will be effected for eighteen rotations of storage disc 28.

Interposed between gear 52 and clutch 42 is a yieldable safety coupling 54. Coupling 54 comprises a disc 54*a* rotatably mounted on shaft 53 to which is fixed a tooth wheel 42*a* comprising the driving member of clutch 42. A spring loaded crank 54*b* is mounted on the right face (FIG. 1) of disc 54*a* and has a roller 54*c* normally engaging a notch 52*a* in an inner raceway of gear 52.

Normally, roller 54*c* will be held in engagement with notch 52*a* of gear 52 by spring loaded crank 54 and therefore driving member 42*a* of clutch 42 will be driven with gear 52. However, if there is a bind or jam in the printing mechanism, crank 54*b* will yield thereby disengaging roller 54*c* from notch 52*a* and permitting gear 52 to rotate with respect to disc 54*a*. When the bind has been relieved, the engagement of notch 52*a* with roller 54*c* will again be effective to drive disc 54*a* and clutch member 42*a* with the parts in the initial angular relationship.

The driven member of clutch 42 comprises a cam disc 42*b* rotatably mounted on shaft 53. A gear 56 is secured for rotation with disc 42*b* and drives a gear 57 of the same size fast on drive shaft 14 of the printing mechanism. Accordingly, one cycle of clutch 42 will effect a cycle of operation of the printing mechanism and during a clutch cycle, storage disc 28 will be rotated eighteen times. Clutch 42, in conjunction with switch 39, is operated and controlled as follows.

Clutch and switch control

A clutch pawl 42*c* is mounted on driven member 42*b* of clutch 42 and is spring biased toward engagement with the driving member of the clutch comprising tooth wheel 42*a*. Pawl 42*c* however is normally held from engagement with wheel 42*a* by detent 43 which is spring urged counterclockwise to position to engage the pawl. Clockwise movement of detent 43 will release pawl 42*c*

for engagement with a tooth of wheel 42*a* thereby engaging the clutch. Wheel 42*a* has eighteen teeth and is therefore rotated one tooth space for each rotation of storage disc 28. Consequently, whenever pawl 42*c* is moved to engagement with a tooth space of wheel 42*a*, storage disc 28 will be at the same position with respect to pick-up head 33. Therefore readout from disc 28 will always begin at the same time with respect to a cycle of operation of the printing mechanism.

Clutch detent 43, as previously noted, is operated by solenoid 41 and in addition to controlling clutch 42 also controls switch 39. Detent 43 which is spring biased counterclockwise has link connection 58 (FIG. 2) with the armature of solenoid 41. An arm of detent 43 extends toward the left and terminates in a lug 43*a* normally engaging a shoulder 59*a* of an upstanding arm 59 which is pivotally mounted at its lower end.

The upper end of arm 59 engages and normally restrains a pivotally mounted arm 39*a* of switch 39 in counterclockwise position. Arm 39*a*, when restrained counterclockwise, restrains resilient switch arm 38 (FIG. 4) from movement to engagement with contact 37 and holds it in engagement with contact 40.

When solenoid 41 receives the start pulse as previously described, link 58 will be moved to the left thereby rocking detent 43 clockwise to release pawl 42*c* (FIG. 1) to engage clutch 42. Clockwise movement of detent 43 will raise lug 43*a* from engagement with shoulder 59*a* thereby releasing arm 59 and switch arm 39*a* of switch 39. As a result, contact arm 38 (FIG. 4) of switch 39 will move to open contact 40 and close contact 37 thereby disconnecting solenoid 41 and connecting release coils L1–L17 to ground for the readout operation.

It will be recalled that after the start signal is sensed by pick-up head 33 (FIG. 4), storage disc 28 completes one rotation before the start of the 0 digit sensing operation. The 0 sensing must be completed before movement of racks 2 in their forward excursions otherwise the 0 teeth 2*t* of the racks would be moved past the position to be engaged by stop pins 8. To provide for 0 sensing before movement of racks 2, there is a short dwell on cams 13 (FIGS. 1, 2) effective at the beginning of a cycle of the printing mechanism. This dwell is of such duration that racks 2 will start to move at the completion of 0 sensing and just before sensing for 1 digits. From the above it will be seen that from the time the start signal is sensed until racks 2 start to move, two rotations of storage disc 28 will have occurred. This timing is determined by the operating time for the start signal to be effective to engage clutch 42 and by the dwell of cam 13. As noted before, gear 51 is rotatably adjustable to precisely time the operation as described above.

Racks 2 will move forward one tooth space for each rotation of storage disc 28 until arrested by stop pins 8. The timing is such that during each of the nine cycles of disc 28 when the positions *d*1–*d*17 are successively sensed for one of the digit values 1–9 respectively, the corresponding order racks, because of their staggered relationship, will arrive successively at the positions where the associated stop pins 8 may be released for engagement with the respective teeth 2*t* corresponding to the digit value being sensed. Accordingly, it will be seen that although a plurality of stop signals for any one digit value are transmitted successively to the selected release coils L1–L17, each associated rack 2 will be advanced to the same registering position when its stop pin 8 is released, and therefore maximum operating speed of the printing mechanism may be achieved.

From the above, it will be seen that storage disc 28 will complete eleven cycles of rotation from the time the start signal is transmitted until completion of the digit 9 sensing cycle and at this time racks 2 will be arrested in the positions determined by the released stop pins 8. After this disc 28 will complete seven additional cycles of rotation as clutch 42 completes its cycle of operation. During this operation of clutch 42, the printing operation will be effected and then the printing mechanism will be restored. When clutch 42 completes its cycle of operation it is disengaged and switch 39 is restored as follows.

A cam follower comprising a lever 60 (FIG. 2) is spring biased clockwise to engage a roller mounted adjacent one of its ends with a peripheral recess 42*d* in cam plate 42*b* which comprises the driven member of clutch 42. The other end of lever 60 terminates in a lug 60*a* which is adapted to engage the upper end of arm 59.

Upon initial counterclockwise movement of plate 42*b*, recess 42*d* will be moved from engagement with the roller of lever 60 thereby rocking said lever counterclockwise. This will bring lug 60*a* of lever 60 immediately adjacent the upper end of arm 59 which, it will be recalled, is rocked counterclockwise from the position of FIG. 2 when clutch 42 is engaged.

Near the end of the cycle of clutch 42, a high part of cam plate 42*b* will be brought into engagement with the roller of lever 60 thereby rocking said lever further counterclockwise. This will engage lug 60*a* with arm 59 and restore said arm clockwise and switch arm 39*a* counterclockwise to the positions of FIG. 2. As a result, clutch detent 43 will be spring rocked counterclockwise to reengage lug 43*a* with shoulder 59*a* and into position to engage pawl 42*c* thereby disengaging clutch 42 at the end of the cycle. At the end of the cycle, recess 42*d* will reengage the roller of lever 60 thereby permitting said lever to be restored clockwise. Erasing means (not shown) is operable after the readout operation to remove the recordings from storage disc 28 so that clutch 42 will not be reengaged after switch 39 is normalized.

Modification

It is within the scope of the invention to read out from a storage tape to the printing mechanism in lieu of from a rotary storage disc or drum. With reference to FIG. 5, the tape 65 includes eleven fields for the recording of a plural digit number on a track *t* indicated by the longitudinal dot-dash line. Each of the fields corresponds to a cycle of rotation of disc 28 (FIGS. 1, 4) starting with the transmission of the start signal, i.e., the starting cycle, and the 0–9 sensing cycles. Four of these fields are shown in the drawing and are bracketed and indicated as start, 0 digit, 1 digit, etc. Each field includes eighteen positions corresponding to the *s* position and the *d*1–*d*17 order positions on disc 28. These positions are indicated as located between the transverse dot-dash lines on tape 65.

Tape 65 may be magnetic or punched and the stippled dots on track *t* indicate magnetic recordings which would obviously be invisible. The only recording in the start field is in the *s* position. The digit recordings shown in the drawing represent a seventeen digit number which includes 0 digits in the first and sixth orders, 1 digits in the second and fifth orders, a 2 digit in the seventeenth order, etc.

Pick-up head 33 is located to sense track *t* as tape 65 is transported toward the right by a sprocket drum 66. Drum 66 is directly driven by shaft 29 of the motor M in the same manner as storage disc 28. Each rotation of drum 66 will advance tape 65 one field past pick-up head 33. This corresponds to one rotation of disc 28. Consequently the drive from the motor to the printing mechanism is the same as described with reference to FIGS. 1 and 2, and the circuitry will be the same as described with reference to FIG. 4. Obviously, a sensing head for punched tape could be substituted for head 33 without other alteration of the system.

The readout has been disclosed as from digit storage to a digit printing mechanism. However, obviously, the system could be modified to read out other stored data such as alphabetical, etc., without departing from the principles of operation. Furthermore, the readout could be a display device such as a register. The invention

therefore is to be restricted only as necessitated by the scope and spirit of the appended claims.

We claim:

1. In a registering apparatus: a series of registering devices each settable to a succession of registering positions; a series of differential actuators for said registering devices; means for advancing said actuators in staggered relationship to bring said actuators successively to each of a succession of registering positions corresponding respectively to said registering positions of said registering devices; and stop means operable during advance of each actuator between any and the next registering position to arrest said actuator in said next registering position; and means for operating said stop means respectively during the successive advance of said actuators between any and the next registering position.

2. The invention according to claim 1: wherein each actuator is staggered a substantially equal distance ahead of the next actuator of said series with respect to the direction of advance of said actuators to provide for arrival of said actuators successively at usbstantially equal time intervals at each of said succession of registering positions.

3. In a registering apparatus: a series of registering devices each settable to a succession of registering positions; a series of differential actuator racks for said registering devices; yieldable drive means for advancing said racks to a succession of registering positions corresponding respectively to said registering positions of said registering devices; restoring means operable to restrain said racks in a staggered relationship against the urge of said yieldable drive means with each rack in an advanced position with respect to the next rack of said series, said restoring means being operable in a forward stroke to control advance of said racks by said yieldable drive means in said staggered relationship to bring said racks successively to each of said succession of registering positions and in a return stroke to restore said racks to a home position; stop means operable during advance of each rack between any and the next registering position to arrest said rack in said next registering position; and means for operating said stop means respectively during the successive advance of said racks between any and the next registering position.

4. The invention according to claim 3: wherein said restoring means for said racks comprises a bail having a restraining edge engaging said racks and inclined with respect to a line normal to said racks.

5. The invention according to claim 3: each actuator rack having a succession of teeth corresponding respectively to its successive registering positions; said racks being restrained by said restoring means with each rack advanced a fraction of a tooth space with respect to the next rack of said series; and said stop means for each rack being operable to arrest said rack during advance thereof by engagement with any one of said teeth.

6. In a registering system: a series of registering devices each settable to a succession of registering positions; a series of differential actuators for said registering devices; means for advancing said actuators in staggered relationship to bring said actuators successively to each of a succession of registering positions corresponding respectively to said registering positions of said registering devices; an electrically operated stop means operable during advance of each actuator between any and the next registering position to arrest said rack in said next registering position; and means for transmitting a succession of electrical pulses to said stop means respectively during the successive advancement of said actuators respectively between any and the next registering position.

7. The invention according to claim 6; said means for transmitting a succession of electrical pulses to said stop means respectively during the successive advance of said actuators respectively between each and the next registering position comprising a distributor having a contact member for each stop means and a contact arm operable to engage said contact members successively; a means connecting each contact member with the related stop means; means for transmitting said succession of pulses to said contact arm; and means operable during the successive advance of said actuators respectively between each and the next registering position to engage said contact arm successively with said contact members.

8. A readout system for registering data recorded on a rotary storage means having successive storage areas in which data may be recorded: comprising a series of registering devices each settable to a succession of registering positions; a series of differential actuator racks for said registering devices: yieldable drive means for advancing said racks to a succession of registering positions corresponding respectively to said registering positions of said registering devices; an electrically operated stop means for arresting each rack during advance thereof in any one of its registering positions; a distributor having a contact member for each stop means and a rotary contact arm for engaging said contact members successively; means connecting each contact member with the related stop means; sensing means operable to sense said storage areas of said storage means successively upon rotation thereof; means connecting said sensing means with said contact arm of said distributor; a motor for rotating said storage means and said contact arm at a one-to-one ratio; a drive train including a reduction drive transmission for controlling said yieldable drive means for advancing said racks; a clutch in said drive train, and means operable to engage said clutch for a single cycle of operation upon rotation of said storage means and contact arm to a predetermined position.

9. A readout system for registering data recorded on a movable storage means having successive storage areas in which data may be recorded: comprising a series of registering devices each settable to a succession of registering positions; a series of differential actuator racks for said registering devices; yieldable drive means for advancing said racks to a succession of registering positions corresponding respectively to said registering positions of said registering devices; restoring means operable to restrain said racks in a staggered relationship against the urge of said yieldable drive means with each rack in an advanced position with respect to the next rack of said series, said restoring means being operable in a forward stroke to control advance of said racks by said yieldable drive means in said staggered relationship to bring said racks successively to each of said succession of registering positions and in a return stroke to restore said racks for arresting each rack during advance thereof in any one of its registering positions; a distributor having a contact member for each stop means and a rotary contact arm for engaging said contact members successively; means connecting each contact member with the related stop means; sensing means operable to sense said storage areas of said storage means successively upon movement of said storage means; means connecting said sensing means with said contact arm of said distributor; and drive means for moving said storage means, for rotating said contact arm to engage said contact members successively during the successive sensing of said storage areas respectively and for operating said restoring means to control advance of said racks successively between one and the next registering position during successive engagement of said contact members respectively.

10. The invention according to claim 9: wherein said storage means is rotary; and the second said drive means is operable to rotate said storage means and contact arm at a one-to-one ratio, and to operate said restoring means to control advance of said racks successively between one and the next registering position during one rotation of said contact arm and storage means.

11. The invention according to claim 10: wherein said drive means comprises a motor; said storage means and contact arm are rotated by direct drive from said motor; and said restoring means is operated by said motor through a reduction drive transmission.

12. The invention according to claim 11: wherein a clutch is interposed between said transmission and said restoring means, means is provided to engage said clutch for a single cycle of operation upon rotation of said storage means and contact arm to a predetermined position; and a single cycle of said clutch is operable to

operate said restoring means in a forward and return stroke of operation.

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