April 14, 1959 G. R. KEEHN ET AL 2,881,634

SETTING MECHANISM

Filed Oct. 9, 1956

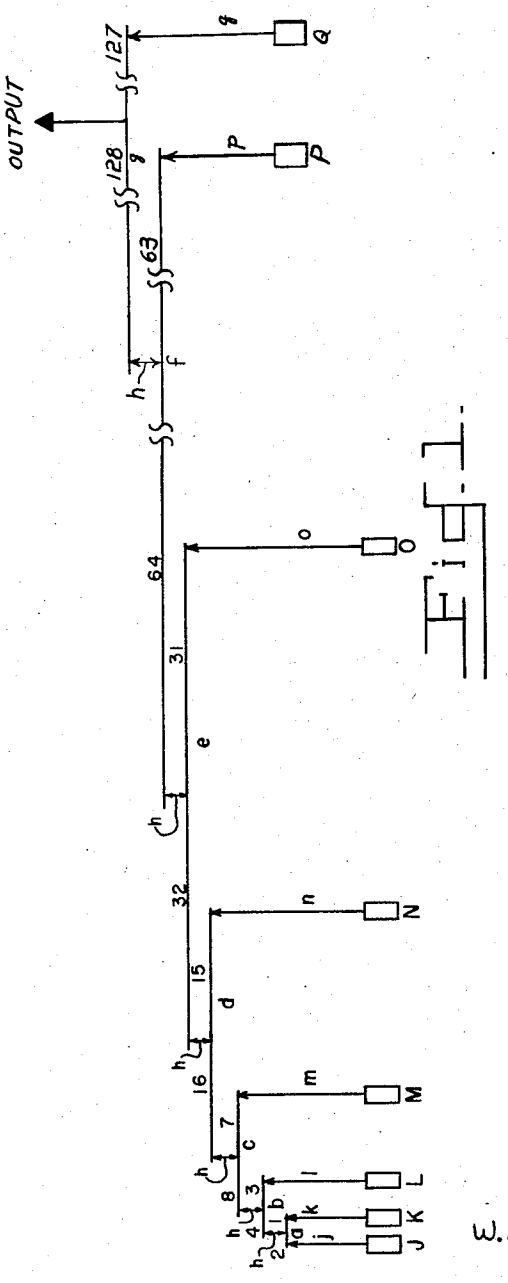


Fig. 1

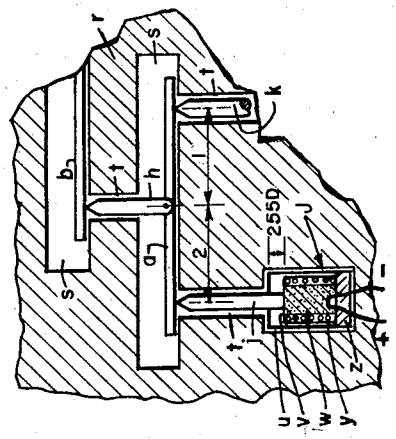


Fig. 2

INVENTOR.
George R. Keehn
BY John G. Moorhead

W. E. Thibodeau, A. W. Dew & J. B. Edgerton
ATTORNEYS

United States Patent Office 2,881,634 Patented Apr. 14, 1959

2,881,634

SETTING MECHANISM

George R. Keehn, Washington, D.C., and John Gerald Moorhead, Silver Spring, Md., assignors to the United States of America as represented by the Secretary of the Army

Application October 9, 1956, Serial No. 614,994

1 Claim. (Cl. 74—479)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to an instantaneous setting mechanism and more particularly to a device capable of effecting any desired linear displacement in integer unit steps.

A principal object of this invention is to transmit any desired linear displacement from a displacement source.

Another object of this invention is to transmit any desired linear displacement, in integer unit steps, from a plurality of displacement sources, proportional to the actuation of one, all or any combination of the sources.

A further object of this invention is to transmit any desired linear displacement, in integer unit steps, from a plurality of constant displacement sources, proportional to the actuation of one, all, or any combination of the sources.

A still further object of this invention is to provide novel structure in arriving at the above mentioned objects.

In general, this invention comprises a series of linear displacement-effecting members having equal displacements, and a system of displacement-transmitting members connected to the series of displacement-effecting members. The arrangement of the transmitting members relative to each other and to the displacement-effecting members is such that integer unit displacement output is performed by the transmitting system in response to actuation of any of the series of linear displacement-effecting members.

The specific nature of the invention as well as other objects, uses and advantages thereof will clearly appear from the following description and from the accompanying drawing, in which:

Figure 1 is a schematic diagram illustrating the invention.

Figure 2 is a fragmentary partial sectional view showing a possible structural embodiment of the invention.

Referring to the drawing, *a, b, c, d, e, f* and *g* denote horizontally disposed levers or members of progressively increased effective lengths based on the series $3x$, $7x$, $15x$, $31x$, $63x$, $127x$ and $255x$. This series can be expressed mathematically as $(2^n-1)x$. Letting x arbitrarily equal 1, and as illustrated in the drawing, relatively vertical members *h*, and *j, k, l, m, n, o, p*, and *q* disposed substantially perpendicular to horizontal members *a, b, c, d, e, f* and *g*, divide the latter into the ratio 1:2, 3:4, 7:8, 15:16, 31:32, 63:64, and 127:128, respectively. The ratio is matematically expressed as

$$\frac{(2^n-1)}{2^n}$$

The vertical members provide relatively frictionless and substantially point contacts or couplings with the horizontal members, as illustrated by arrows in Figure 1 and in detail in Figure 2. Members *h* are preferably equal in length, but as will be obvious can assume any length with a corresponding altering of spacing in the structure without hindering the functioning of the mechanism. Suitably secured to vertical members *j, k, l, m, n, o, p* and *q* are displacement-effecting means J, K, L, M, N, O, P and Q, respectively. These means preferably assume structure and function capable of producing equal displacements.

In Figure 2, the structure of a preferred embodiment of this invention is disclosed in fragmentary section and is representative of the structure of the entire preferred embodiment. A housing or casing *r* is conveniently provided with horizontal recesses *s* in which the horizontal members *a, b*, etc. may be located, and vertically extending channels or bores *t* in which the vertical members *h* and *j, k*, etc., may be disposed.

Each of the displacement-effecting means J, K, etc., can be an explosive motor assembly. The motor assembly is suitably and immovably mounted in a relatively enlarged bore portion of casing *r*, as shown. A preferred motor assembly may comprise a cylindrical barrel *u* having a bore in which a loosely fitted piston *v* is mounted for movement. Piston *v* contains an explosive squib *w* and coaxially mounts a biased spring *y* encased in relatively low melting point solder. Plug *z* conveniently closes one end of piston *v* and suitably seals the corresponding end of barrel *u*. The end of piston *v*, distal the end adjacent plug *z*, is spaced from the corresponding end of barrel *u* a fixed distance. For purposes of explanation of the embodiment shown in the drawing, it will be convenient—for reasons which will become apparent—to define this fixed distance as 255D, where D is an arbitrary unit of length. Barrel *u* may have an opening through which vertical member *j* may extend in abutting or secured relation with piston *v* substantially as shown.

In operation, the explosive motor assembly J may be fired by any suitable means, as for example, by passing current through a filament in a manner illustrated in Figure 2. This current detonates the squib *w* which generates sufficient heat to melt the low melting point lead encasing spring *y*. Consequently, the spring *y* which is suitably biased against plug *z* and piston *v*, will urge piston *v* through the displacement 255D. Accordingly, vertical member *j* is longitudinally displaced 255D. As will be apparent the corresponding end of horizontal member *a* will be raised, and member *h*, suitably hinged to member *a*, will thus be longitudinally displaced causing the corresponding end of member *b* to be raised. The end of member *a* adjacent member *k* will be substantially unaffected by this firing of motor J. It can be seen that upon firing a particular motor, as for example, motor J, a series of calculated movements occur imparting a definite final output displacement indicated in the direction of and at the enlarged arrow in Figure 1.

The bores and recesses in casing *r* are of sufficient relative size to insure linear longitudinal movement of the vertical members and still permit the desired movement of the horizontal members. The raising of the horizontal members will alter the point of contact of the vertical members with the horizontal members, but this will result in negligible gross error in view of the contemplated minute overall displacements of the mechanism. Hinged connections are preferably not employed because of the undesirable torques that may develop. The vertical members *h* and *j, k*, etc. may be rectangular in cross section with suitably designed recesses *s*.

As stated the respective lengths of the horizontal members *a, b*, etc. follow the series $3x$, $7x$, $15x$, $31x$, $(2^n-1)x$. The horizontal members are then proportioned to lengths approximating the series $2x$, $4x$, $8x$, $16x$, 2^nx, and x, $3x$, $7x$, $15x$, $(2^n-1)x$. This relative proportionment of parts of the mechanism is preferable since integer unit output displacements are obtained with motors having equal displacements. In the particular mechanism described integer unit output displacements of zero to 255D are possible.

The horizontal and vertical members are so designed that the output rod is pushed through a displacement called the output displacement. If motor J is fired, the output displacement is D; if only motor K is fired, the output displacement is 2D; and correspondingly, for the other successive motors fired individually the output displacements will be 4D, 8D, 16D, 32D, 64D, and 128D, respectively. All of the motors, or none, or any combination of them can be fired simultaneously or at different times if desired, to give any output displacement desired with D as a unit from zero to 255D. Firing all motors will result in an output displacement of 255D; firing all the motors except J will impart an output displacement of 254D, and firing only motors J and K will give a 3D output displacement. By mathematical structural analysis the combination of motors that will give the desired displacement can be obtained. In principle, as many motors could be added as desired with a corresponding increase in horizontal and vertical members.

Altering the stroke or displacement for individual motors and lengthening or shortening individual horizontal members may result in many variations of output displacement. By predetermined calculations and design many output displacements can be effected to produce many desirable results.

The motors, are illustrated as being in line, but it will be obvious that the necessary motor displacement can be obtained by placing the motors in several stepped rows or in a circle.

The mechanism of this invention can be applied to setting various timing devices. Various machines and instruments such as computers can also utilize the mechanism and principles of this invention.

Numerous motors employing electromagnets or fluid pressure or compressed air can be used without departing from the spirit of this invention.

This application is a companion application of application S. N. 616,580 filed October 17, 1956, now Patent No. 2,825,237 by the joint inventors of this application.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

We claim:

A setting mechanism for obtaining a predetermined displacement of an output lever, said mechanism comprising: a casing; a series of stepped ascending horizontal recesses having first and second ends in said casing, each recess being in overlapping relation with respect to a lower recess; a series of first vertical channels connecting the first end of each recess with the recess immediately below; a series of stepped, ascending flat levers, each lever positioned to fulcrum in a recess, the first and second ends of each lever being adjacent first and second ends of a recess; each lever positioned in overlapping relation with the lever immediately below; a first series of vertical rods, each vertical rod disposed for vertical movement in each of said first channels, one end of each rod of said first series being pivotly connected to a lever at a predetermined distance along the length thereof, and the other end of said first series of rods contacting the first end of a corresponding overlapping lever; a series of bores in said casing positioned below the lowermost recess of said series, a series of second vertical channels, each channel of the second series connecting a bore with said second end of a recess, a second series of vertical rods in said series of second vertical channels, one end of each rod of said second series contacting said second end of a lever; a piston slidable in each bore, the other end of each rod of said second series connected to said piston, an explosive in each bore adapted to drive its respective piston a predetermined distance when the explosive is fired, said levers being of such length and said first series of rods being so positioned relative to said series of levers that a predetermined displacement of the uppermost output lever of said series is attained by selectively exploding the explosives in said bores.

References Cited in the file of this patent

UNITED STATES PATENTS

1,517,681	Lucey	Dec. 2, 1924
2,179,822	Imm	Nov. 14, 1939
2,481,648	Dehn	Sept. 13, 1949
2,498,309	Svoboda	Feb. 21, 1950

FOREIGN PATENTS

682,998	Great Britain	Nov. 19, 1952

OTHER REFERENCES

Publication, Product Eng. (page 122), September 1949.