

Nov. 18, 1924.

1,515,680

A. HENKELS

CODING AND DECODING MACHINE

Original Filed July 19, 1921

4 Sheets-Sheet 1

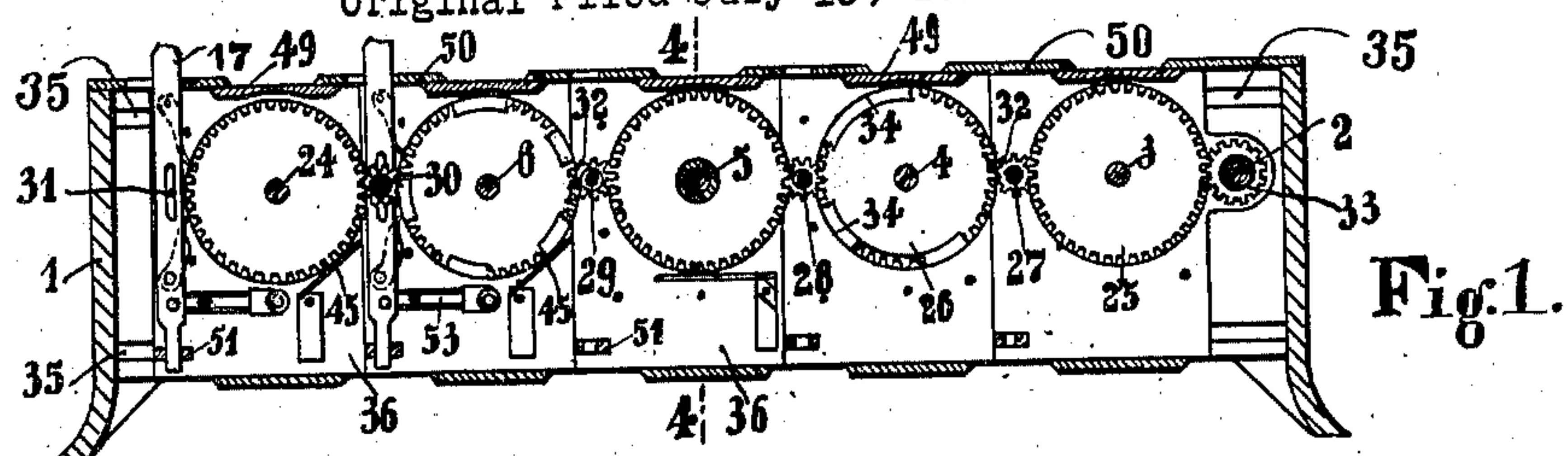


Fig. 2

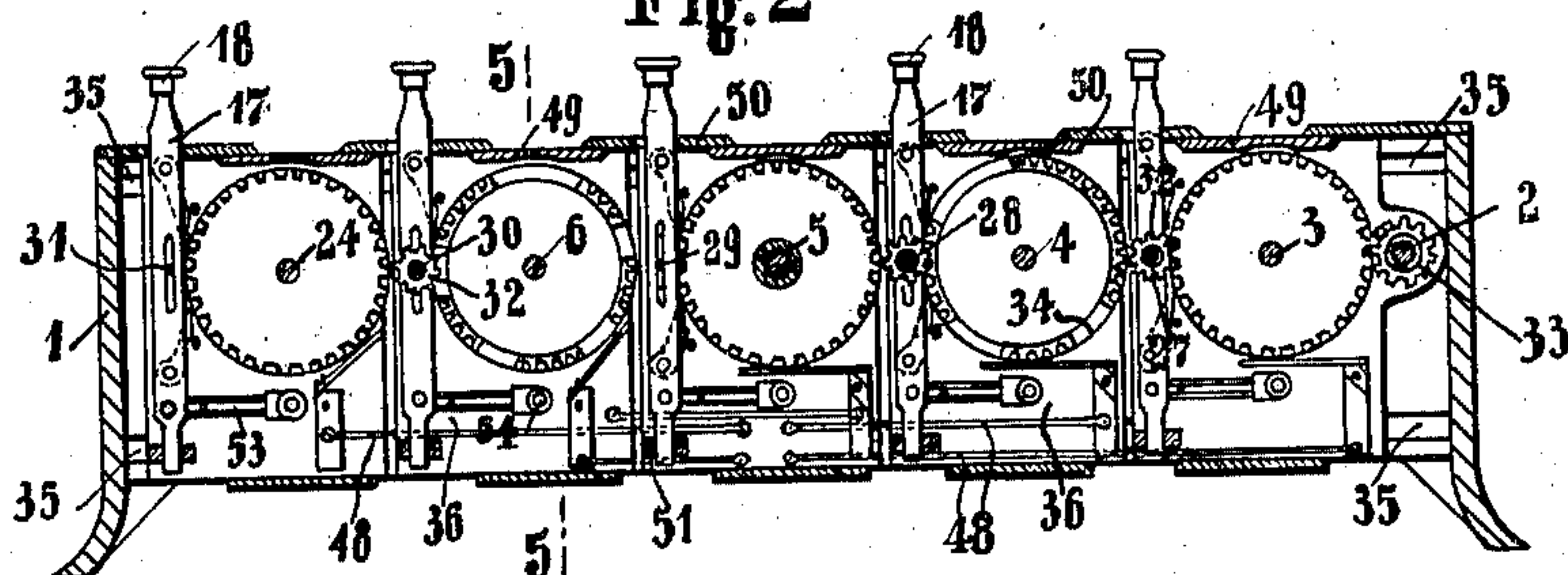
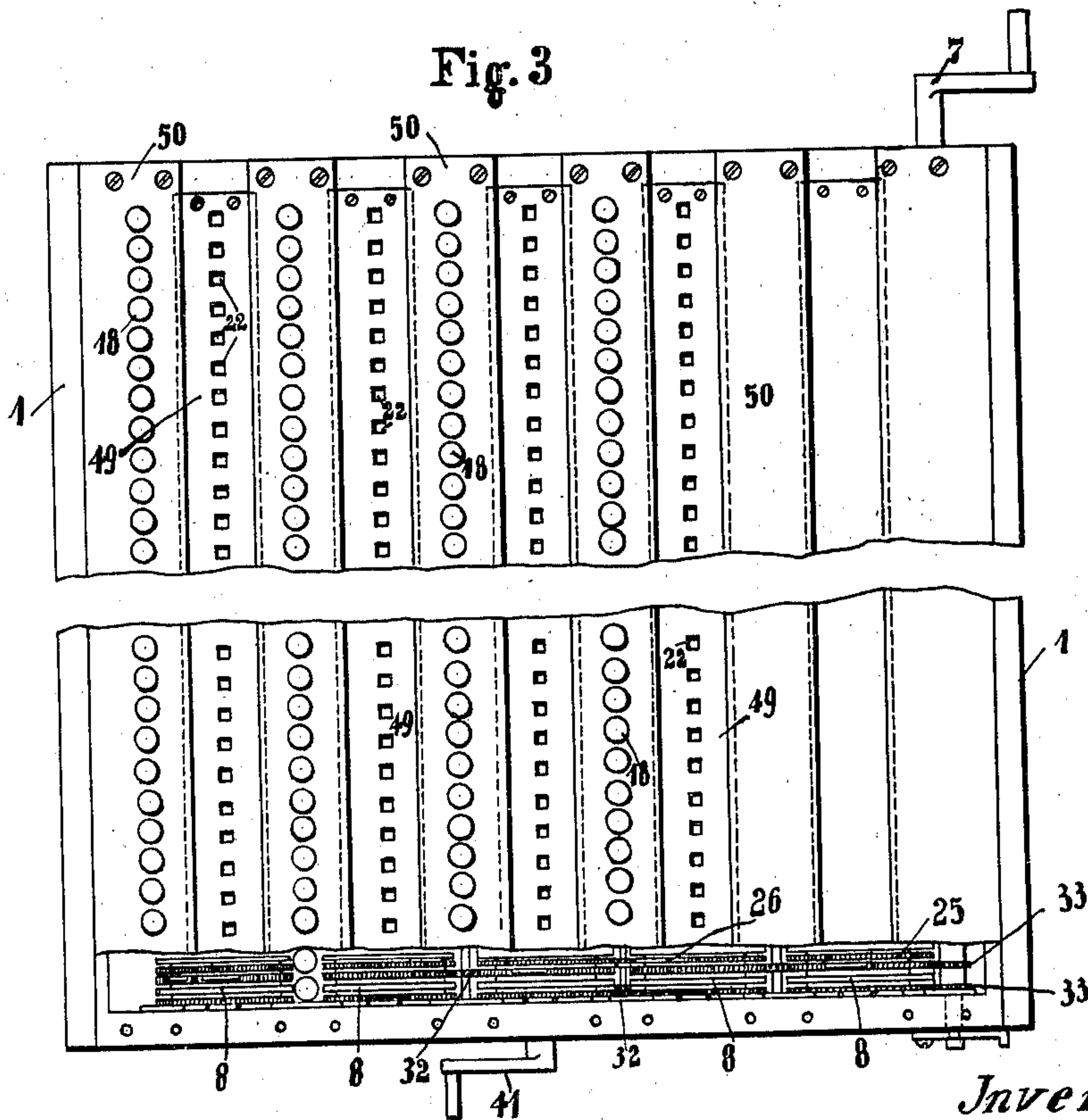


Fig. 3



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4 Sheets-Sheet 2

Fig. 4

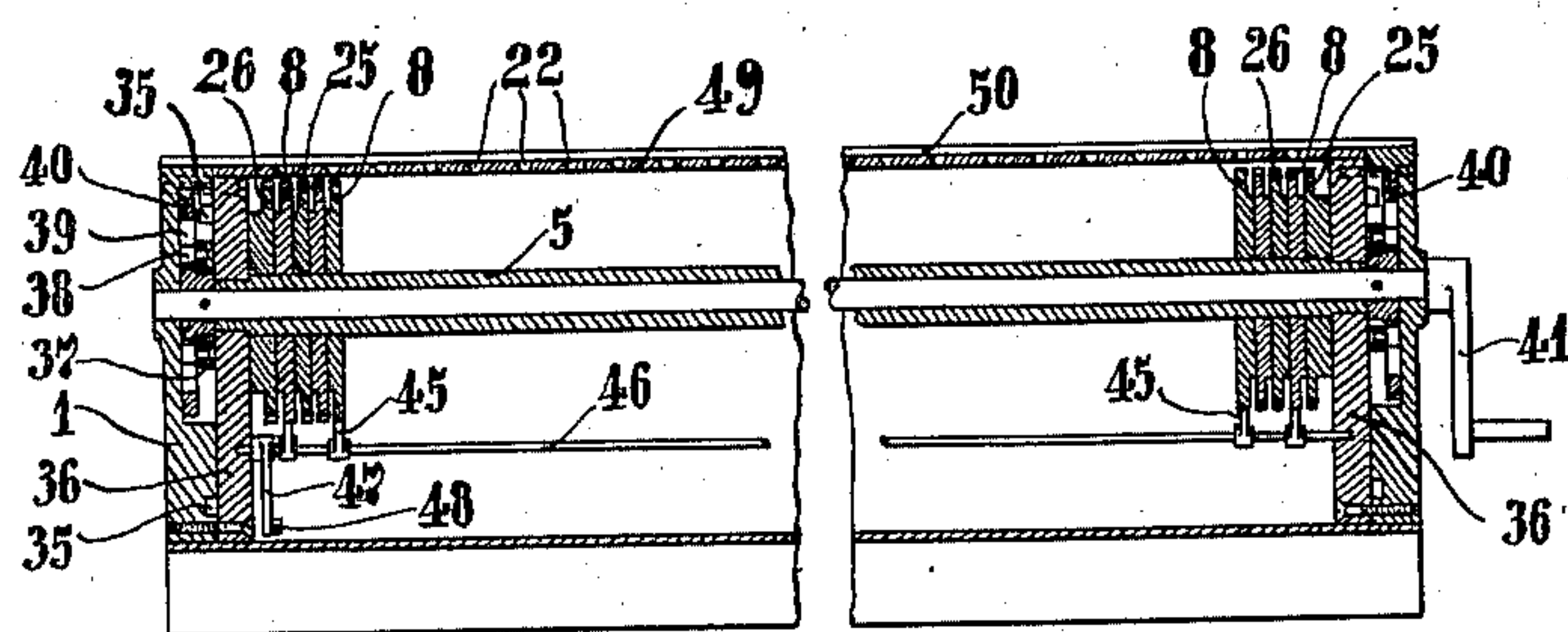
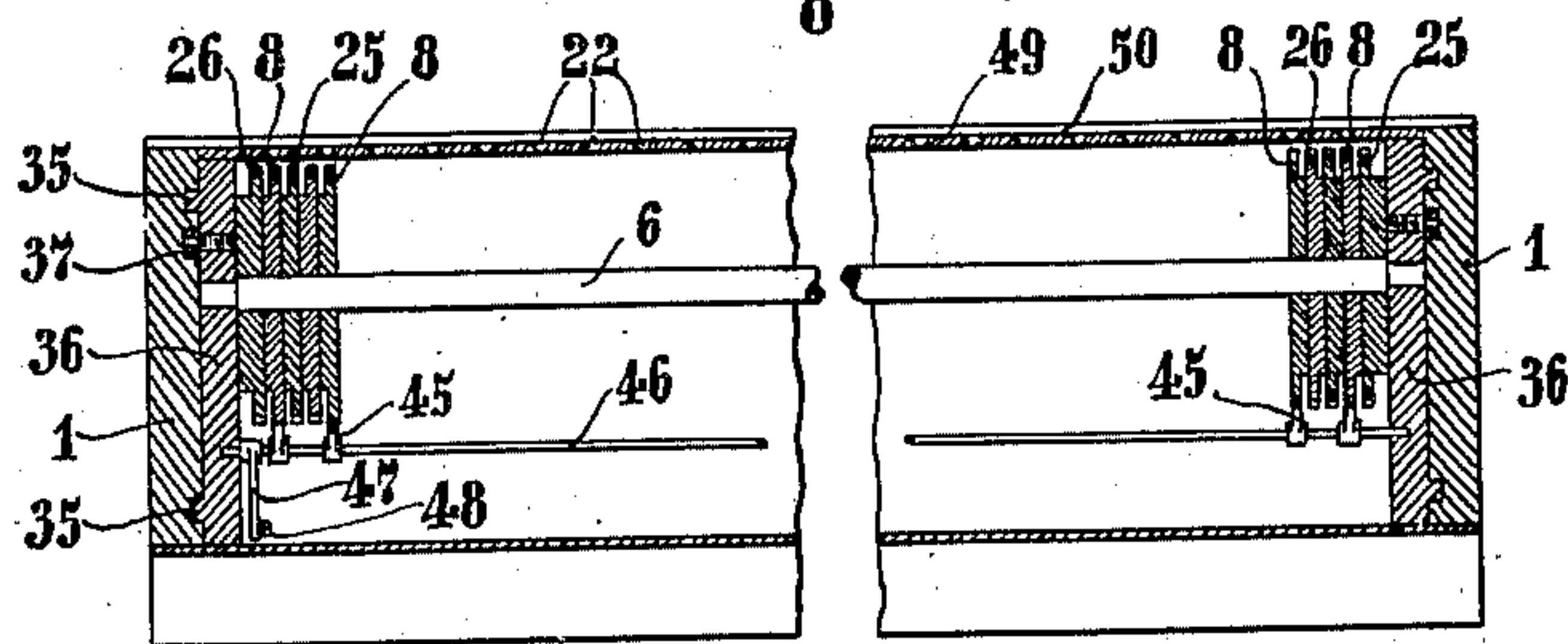


Fig. 5



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4 Sheets-Sheet 3

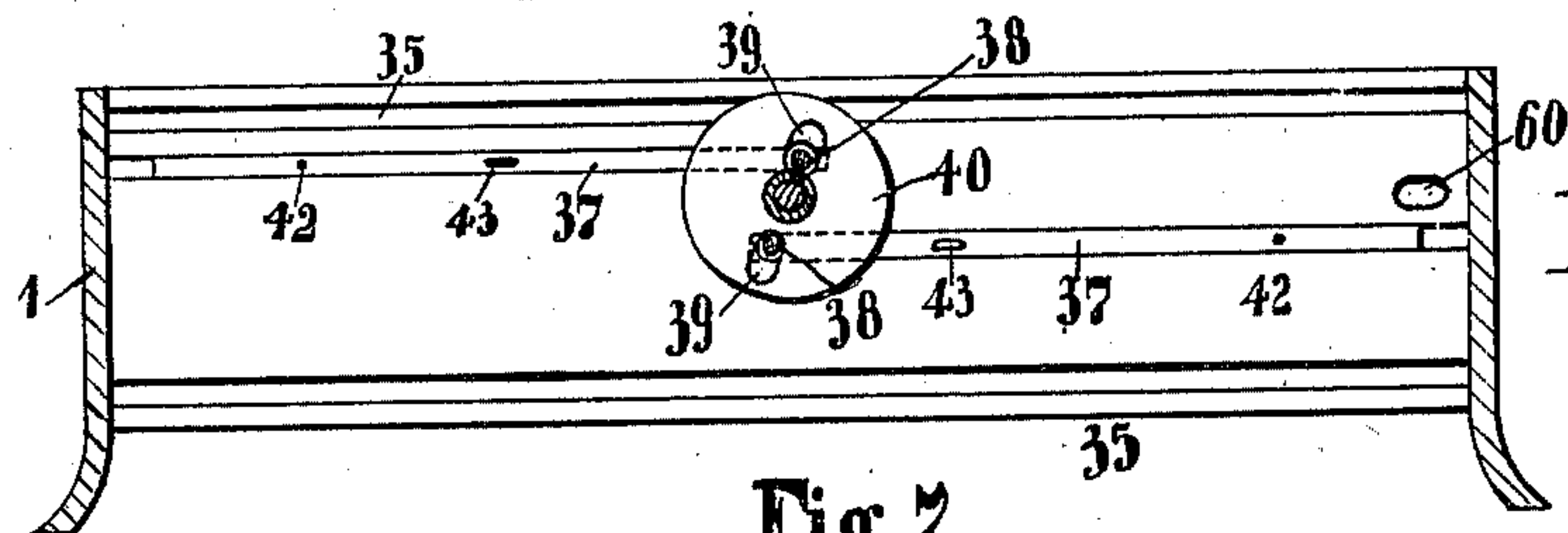


Fig. 6.

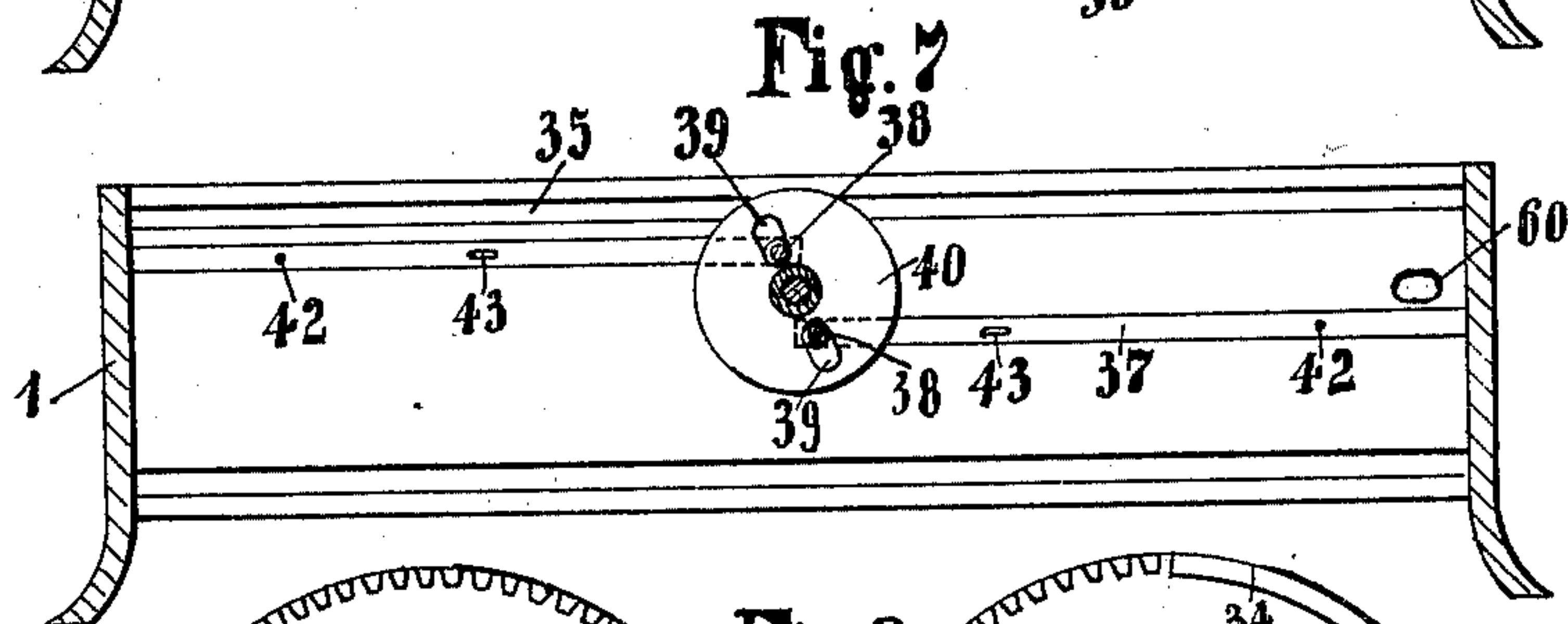


Fig. 7

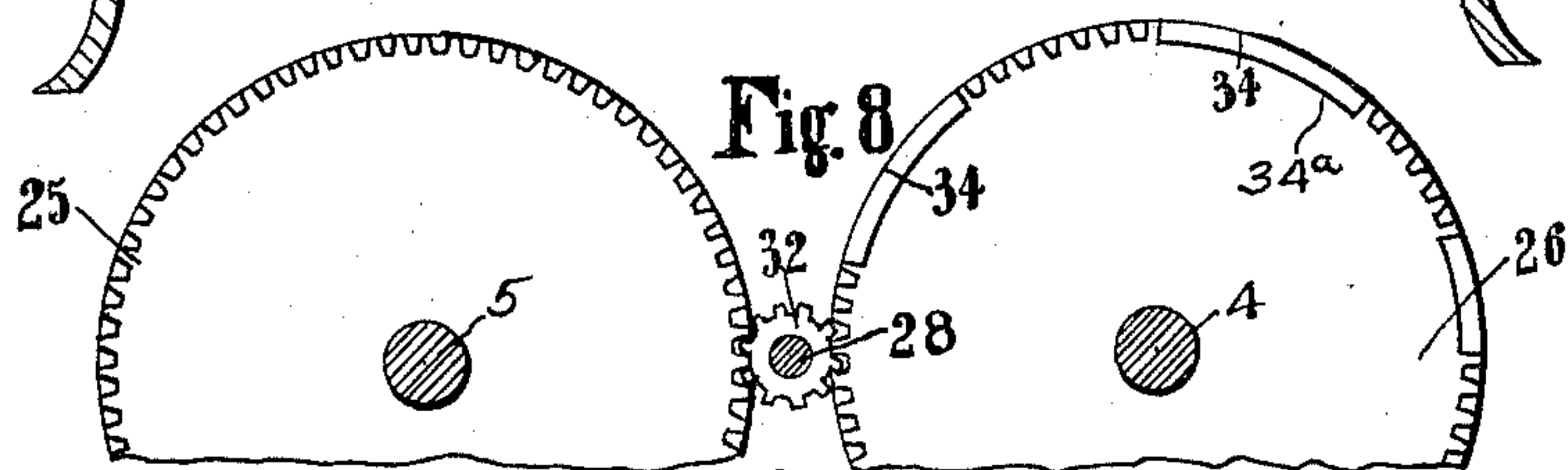


Fig. 8

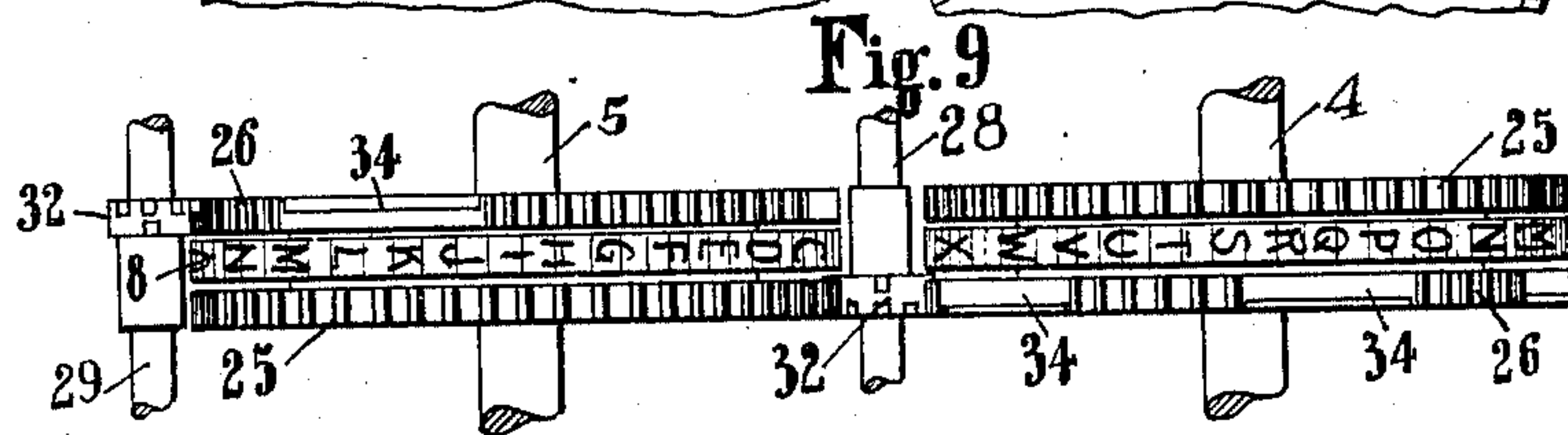


Fig. 9

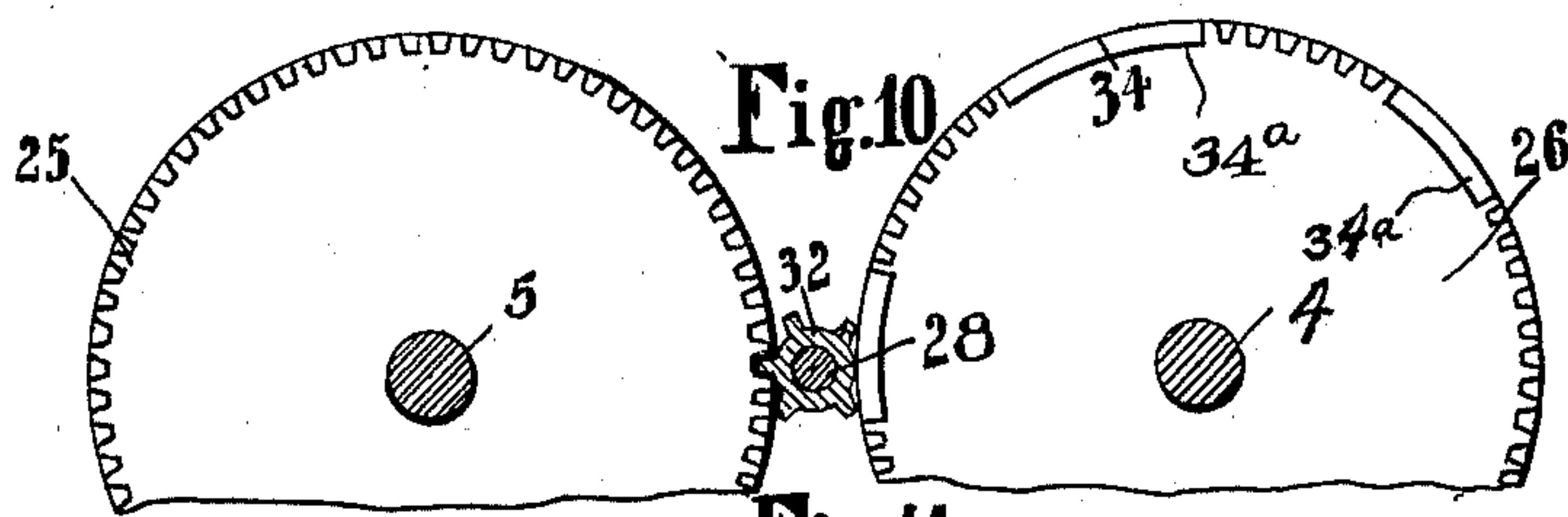


Fig. 10

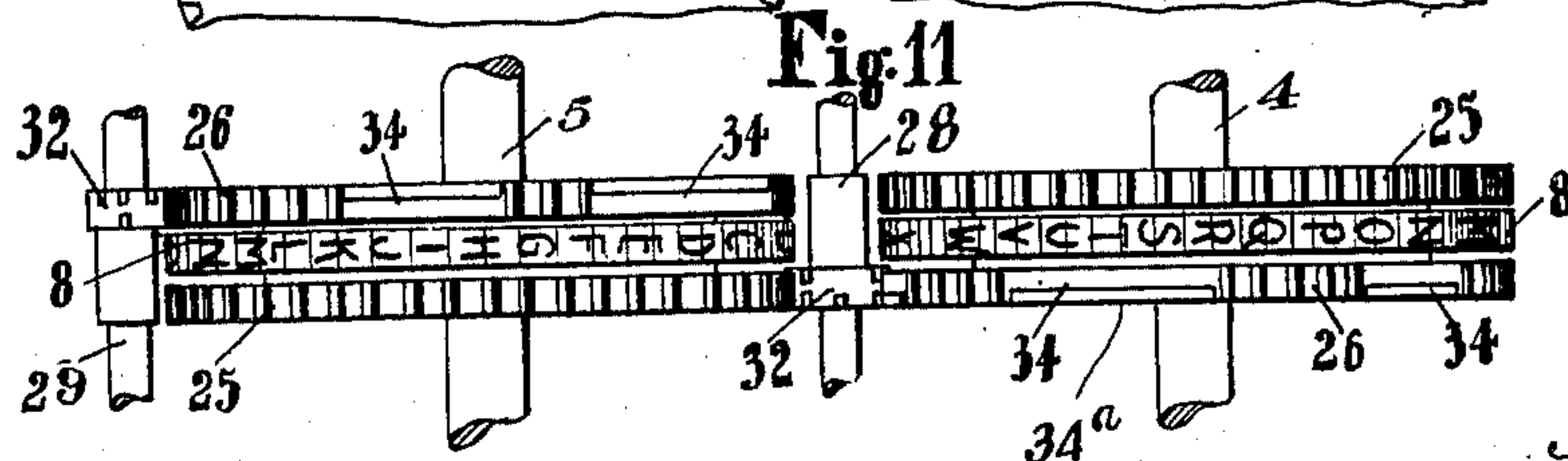


Fig. 11

Inventor;

Albert Henkels

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City.

UNITED STATES PATENT OFFICE.

ALBERT HENKELS, OF LANGERFELD, NEAR BARMEN, GERMANY.

CODING AND DECODING MACHINE.

Original application filed July 19, 1921, Serial No. 485,989. Divided and this application filed July 18, 1922. Serial No. 575,884.

To all whom it may concern:

Be it known that I, ALBERT HENKELS, a citizen of Germany, residing at Langerfeld, near Barmen, Germany, have invented certain new and useful Improvements in Coding and Decoding Machines (for which I have filed applications in Germany October 30, 1917, and September 26, 1919), of which the following is a specification.

This invention has reference to improvements in coding and decoding machines, and it is particularly intended to provide a practically infinite number of possible combinations in secret language with but one key word, and to reproduce entire words and sentences in a very easy and easily readable manner, the characters constituting the secret message being obtained in continuous rows, after the key word has been set, and being decoded and reconverted into open language in the same easy and simple manner. Among other additional objects my invention which is a division of my copending application for U. S. patent Serial No. 485,989 filed July 19, 1921, provides improved means of causing the engagement and disengagement of the several members of the operating means and of the carriers for the characters constituting the message or the key word, and of locking them in position, means being also provided to guard against the unauthorized decoding of the message. I also provide improved means of setting the several character bearing discs and it is also an object of my invention to so construct and arrange the engaging and disengaging and operating means that they may be operated by crank movement or similar means and with their operating parts confined within the interior of the machine casing. A further object of my invention is to provide means to still further increase the security and number of combinations to be obtained by so arranging and constructing the character bearing and operating members that each of the character bearing members which are arranged in coaxial series may be turned through different angles and I also provide means to guard against mistakes in the transcribing of the message by preventing any unintended actuation of the character discs and of the gear wheels or other instrumentalities operably connected thereto. Further objects and advantages

of my invention will appear from the drawings and as the specification proceeds.

For the better understanding of my invention I have illustrated the same on the accompanying drawings as embodied in a coding and decoding or ciphering machine having several series of coaxially arranged carriers for the type characters, but without restricting the invention to this particular form and arrangement.

In the drawings an arrangement preferably adapted for practical use is shown in Figures 1 and 2 in longitudinal section,

Fig. 1 showing the gear wheels in mesh with each other, whereas—

Fig. 2 represents the same gear wheels disengaged.

Fig. 3 is a plan view,

Fig. 4 is a transverse section on the line 4—4 of Figure 2.

Fig. 5 is a similar section on the line 5—5 of Figure 1.

Figs. 6 and 7 disclose the cutting-in and -out devices respectively, of the gear mechanism in two different positions, whereas—

Figs. 8 to 11 show the gear mechanism of several type discs, one behind the other, in side elevation and top view, in two different angular positions of the wheels, respectively.

Figs. 12 and 13 are a longitudinal section through part of the machine, as also a plan view from above, respectively, with the operating mechanism disengaged.

Fig. 14 represents the progressive connection or adjustment, of the type carriers or discs.

In the drawing, 1 indicates the casing of the machine, in which the shaft 2 and five spindles 3, 4, 5, 6 and 24 are arranged in parallel relationship, one behind the other. The shaft 2 serves as the driving shaft; at its one end protruding from the casing through the slot 60, it carries the hand-crank 7, whereas on each of the spindles 3, 4, 5, 6 and 24 an equal number of type carriers or discs 8 have been arranged in such a manner as to turn loosely on the spindles, but immovable laterally. Each disc is rigidly connected to two gear wheels 25, 26 one of which (25) is provided with a full toothed spur-rim whereas the other one, 26, has an interrupted toothed spur rim, i. e. one provided with irregular groups of teeth. The full and the interrupted gear wheels

fixed to the discs 8 placed one behind the other, are alternately arranged relatively to each other on their respective axles or spindles, so that for instance, on spindle 3 the full spur gears 25 are placed to the right, and the interrupted gear wheels 26 to the left of the discs 8. On the spindle 4, however, the interrupted gear wheels are placed to the right and the full gear wheels to the left of the discs 8, and so on. In this way, one full gear wheel will always be opposite an interrupted one. The gear wheels are not in direct mesh with each other but are coupled by means of pinions or ratchet wheels 32 mounted rotatably on the intermediate spindles 27, 28, 29, 30, 31 but in such a manner that they cannot be shifted laterally. The pinions placed one behind the other in the longitudinal direction of the machine are arranged alternately to the right and the left of the discs, so that the interrupted gear wheels on spindle 3 are coupled to the full gear wheels on spindle 4, the interrupted gear wheels on spindle 4, however, to the full gear wheels on spindle 5, and so on. Gear wheels 33 mounted on the driving shaft 2 mesh with the full gear wheels on the spindle 3. When the crank shaft 2 is turned, the gear wheels 33 drive the full gear wheels 25 of the discs 8 on the spindle 3 which, in turn, by means of their interrupted gear wheels 26, drive the full gear wheels of the discs 8 on the spindle 4, and so on. In this manner, not only each of the discs 8 placed on a common spindle side by side is turned through a different angle, but also all discs arranged one behind the other, will be subject to a different angular motion. As only the discs on the spindles 4, 5, 6 and 24 serve for transcribing the message, while the discs on spindle 3 are used in setting the pass-word, i. e. to change the initial position of the interrupted gear wheels of these discs, the latter discs may also be turned in common through the same angular distance. Therefore, there is no absolute necessity of providing the gear wheel 33 with interruptions in order to produce the initial setting of the train of gearing, but the wheel 33 may be fitted with full spur rims as represented in Figs. 1 and 2, but it is obvious that my invention will also include those instrumentalities in which a mutilated or interrupted gear as a driving means is mounted on the axle 2.

During the turning of the discs with the object of transcribing the sequence of letters or signs set on the machine, into secret cypher or vice versa, the pinions 32 are to serve at the same time for locking the driven full gear wheels 25 and therewith also the discs 8 in their respective positions, whenever the pinions 32 by virtue of the interruptions in the toothed rims of the driving gear wheels 26 are out of mesh with the

latter, i. e. when the driving gear wheels are running idle. To this effect one half of the face of the pinions 32 is provided with a full number of teeth, whereas on the other half of the face, each second tooth has been removed. (Figs. 8-11). This means that these pinions are provided, so to say, with two rows of teeth corresponding with one another as regards the position of the teeth, one of which possesses only half as many teeth as the other. At the places where the toothed rims of the driving gear wheels 26 are interrupted, segments 34 have been provided, connecting the groups of teeth, and forming a continuation of the addendum circle. These segments extend over the part of the face of the tooth opposite that half of the pinion 32 which possesses only half the number of teeth. As long as one group of teeth of the driving wheels is in operation (Figs. 8 and 9) both toothed rims of the pinion mesh with the driving wheel 26, as also with driven wheel 25. While the driving wheel 26 is running idle, i. e. when the pinion is placed opposite an interruption in the toothed rim of the latter, the segment connecting the groups of teeth of the driving wheel engages the gap provided on one half of the pinion by omitting every tooth (Figs. 10 and 11); thereby the pinion is prevented from turning. As, however, the pinion meshes permanently with the neighbouring full gear wheel, this latter is likewise locked together with its respective discs, while the driving wheel is running idle, whereby mistakes in the transcription of a sequence of letters or signs due to an unintentional movement of one of the discs, are effectively guarded against. Moreover, the locking of the pinions assures at all times the correct re-engagement of the gear teeth of the interrupted wheels, both during the forward movement of the latter as also during the reverse rotation.

The disengagement of the members of the train of gear wheel mechanism may be effected by any suitable means, preferably by changing the position of these members relatively to each other. As one form of embodiment of this part of my invention I have here shown this disengagement and engagement to be effected transversely with relation to the spindles 3, 4, 5, 6, 24 in a novel manner allowing the various series of gears and type to be moved consecutively and independently of each other. To this effect the spindles 3, 4, 5, 6, 24 are each supported, not in the walls of the casing, but in carriages comprising pairs of laterally disposed cheeks 36 which are guided in two grooves 35 provided in the longitudinal walls of the casing 1. These cheeks 36 carry at the same time the spindles 27, 28, 29, 30 and 31, the arrangement being such that

each one of the spindles 3, 4, 5, 6, 24 is attached to one pair of cheeks, together with the spindles 27, 28, 29, 30 and 31 located behind the former. Except for the cheeks carrying the spindles 5 and 29 which are held in a fixed position on the walls of the casing each pair of cheeks is connected rigidly together by means of the spindles, as also by a number of transverse tie-rods 54, 55, 58, 58^a, thus forming a sliding frame or carriage which may be moved in longitudinal direction of the casing in such a way as to allow the sets of gears to be brought out of engagement by shifting the pairs of cheeks in opposite directions. This shifting of the pairs of cheeks is effected by the aid of two slide rods 37, guided in grooves or slots in one of the longitudinal walls of the casing (Figs. 4, 5, 6 and 7). The innermost ends of these slide rods carry rollers 38 which engage in radial slots of a crank or eccentric disc 40 supported along the wall of the casing. This disc 40 may be turned by means of a hand crank 41 connected thereto. The slide rods are provided with holes 42 and with longitudinal slots 43 which engage with studs 44 (Fig. 12) provided on the sliding cheeks. The studs of the cheeks carrying the spindles 4 and 6 engage the slots 43; the studs of the cheeks carrying the spindles 3 and 24, however, engage the holes 42. If the disc 40 is turned in counter-clockwise direction (Fig. 7), the two pairs of cheeks containing the spindles 3—27 and 24—31 are carried along first, and after the latter have moved through a certain distance, the pairs of cheeks containing the spindles 4—28 and 6—30 are carried along, i. e. the pairs of spindles located in front and behind the fixed spindles 5—29 are moved away from this latter pair of spindles as also from each other in opposite directions. In this manner all pinions 32 have been brought out of engagement with the full gear wheels 25 placed behind, thus uncoupling the discs 8 located one behind the other. (Fig. 6.) The coupling-up of the system of gears is effected by rotation of the disc 40 in the opposite direction, whereby the spindles are moved in the opposite manner to what had been done before, until all gear wheels are again in mesh. The driving shaft 2 may likewise be supported in a carriage or a pair of cheeks which may slide in longitudinal direction inside the casing 1. However, it may also be supported in the pair of cheeks carrying the spindles 3 and 27, as represented on the drawing, the unclutching of its gear wheels from the gears 25 of the spindles 3 being in this case effected by a movement of the driving shaft 2 in axial direction.

For preventing an unintentional turning of the type discs whilst the gear wheels are unclutched, the discs 8 are locked by means

of springs 45, pressing against them from below. (Figs. 2, 4, 5 and 12.) The springs 45 are preferably fastened to shafts 46 resting in the respective pair of cheeks 36 and carrying each one control lever 47, one end of which is acted upon by a push-rod 48, the other end being attached to the casing 1. The arrangement of the push rods 48 in this case is such that during the movement of the pairs of cheeks with the object of uncoupling the system of gears, the springs 45 are pressed against the type-discs 8 by turning the shafts 46 (Figs. 4 and 5). During the opposite movement of the cheeks with the object of re-engaging the system of gears, however, these springs are moved away from the discs 8, i. e. put out of action.

The windows 22 are provided in the rails 49 connecting the pairs of cheeks 36 on top, these rails taking part in the movement of the spindles. Owing to the arrangement of the intermediate gear wheels 32 it is possible to make the type discs 8 as large as, or even larger than the gear wheels 25, 26 in order that the types may be placed close below the windows, so that the type or letter which happens to be on top directly below the window. For closing the spaces remaining between the rails 49 covering strips 50 extending over the edges of the rails 49, have been provided which are fastened to the walls of the casing 1 in such a way as not to impede the movement of the rails 49 during the connection and disengagement of the system of gears.

For rotating any individual type disc 8 in order to set the pass-word and the message to be transmitted, keys 17 have been provided which have push buttons 18 fitted to the tops. In the embodiment shown by way of example the lower, off-set ends of these keys may be guided in vertical holes provided in flat ears or bars 51, connecting the cheeks 36, 36 of each pair of cheeks, whereas they are guided on top, on the spindles 27, 28, 29, 30, 31 by means of longitudinal slots 52. In order to permit of turning the type discs 8 backward as well as forward, the keys 17 may be provided with two pawls 19 and 19^a arranged in opposite directions relatively to one another, one of which (19) engages the full gear wheels 25 from the top, the other one from below. The keys 17 may be pressed down or raised by means of the buttons 18. As a rule they are kept midway between the top and bottom position by means of a two-legged spring 53 attached to a rod 54 connecting the two cheeks 36, 36 and supported in its intermediate position by a rod 55 inasmuch as the legs of the spring 53 press from above and below against a stud 56 attached to the key 17. The shifting pawls 19 and 19^a, which may be acted upon by

springs 57, 57^a are to be locked in the intermediate position of the key 17 by means of transverse rods 58, 58^a so that in this position they cannot engage the teeth of the gears 25. If, however, the key is raised, pawl 19 will be kept out of engagement with the teeth of gear 25 by the rod 58, while pawl 19^a will slide over the rod 58^a into engagement with the teeth of gear 25, which will be moved clockwise by an amount limited by the slot 52 engaging the rod 27, the slot being of such a length as to allow the pawl to move the wheel by one space of the row of type around the circumference of the wheel. If, now, the key 17 be depressed, the pawl 19 will slide under the rod 58 into engagement with gear wheel 25, while pawl 19^a is held out of engagement with gear wheel 25 by the rod 58^a. The wheel 25 is thus moved counter-clockwise, its movement again being limited by the engagement of the slot 52 and rod 27 to an amount equal to one space on the typewheel. A separate operating device is provided for each type disc.

The operation of the device is substantially effected as follows: After the system of gear wheels has been uncoupled in the manner already described, the discs 8 on the spindle 3 are first adjusted for the pass-word selected, whereupon on the spindles 4, 5, 6, 24 the plain-language message to be transcribed, is set. After the system of gears has been brought back into mutual engagement, the crank 7 is given a pre-arranged number of turns, thus effecting the conversion of the plain language message into secret code. The deciphering or decoding by the receiver of the message is effected by means of a similar machine, the operator first disengaging the system of gear wheels in the same manner as the sender of the message, then setting his wheel 3 to the pre-arranged key-word and turning the other type discs 8 so as to obtain the code message received by him. He then operates the crank 7 a prearranged number of times in the reverse direction whereupon the message in open language will appear on the disc corresponding to the spindles 4, 5, 6, 24. As the crank shaft 2 carries full gear wheels, a distinct initial position of the crank shaft is not required; only the number of turns of the crank and the pass-word need previously be arranged for. The greatest possible degree of security against unauthorized deciphering of the message is obtained in this machine, inasmuch as by the adjustment of another pass-word on the discs 8 of the spindle 3 the initial position of the driving gear wheels 26 on this spindle may be changed in any desired manner, whereby, in combination with the selection of a different number of turns of the crank, an infinite number of variations is rendered pos-

sible. The arrangement of the types or letter signs may be the same on all the discs, inasmuch as the discs located one behind the other on the same shaft may also be turned each through a different angle.

It is obvious that this invention is not confined to the arrangements illustrated by way of example. There are many other combinations possible in which this invention may be carried into effect without departing from the spirit of my invention. More especially, the machine may be provided with a printing device in order to permit of printing the message directly in plain language, as also in cipher-code, as may be desired.

I wish it to be understood that I am not restricted to the particular arrangement of the spindles 2 and 3 with their respective gears as starting members but may arrange these and equivalent motion imparting means in other sections and portions of the machine and connect them with any of the type-carriers and motion imparting members and I may provide other modifications and change in accordance with the exigencies of the particular manner of utilization of the invention and to suit the convenience of the user.

I claim:

1. In a coding and decoding machine in combination, a plurality of supporting axles, series of coaxially spaced type carriers, loosely and rotatably mounted on said axles, driving means on both sides of said type carriers and adapted for operably connecting the adjacent series of carriers, means on the driving means of one side of alternating series of type carriers for intermittently interrupting the rotation of some of the carriers, and means of displacing the individual series relatively to each other.

2. In a coding and decoding machine in combination, a plurality of supporting axles, substantially parallelly spaced from each other, series of coaxially spaced type carrying discs, loosely and rotatably mounted on said axles, driving means on both sides of said discs, and connected thereto, intermediate driving means between the adjacent series of discs, and in operative engagement with the first mentioned driving means, and motion interrupting portions on the driving means of one side of alternating series of type discs, and on the intermediate driving members, and means of displacing the individual series of discs relatively to each other.

3. In a coding and decoding machine in combination, a plurality of supporting axles, series of coaxially spaced type carriers, loosely and rotatably mounted on said axles, driving means on both sides of said carriers, and connected thereto, and adapted for operably connecting the adjacent series of type carriers, means on the driving means of one

side of alternating series of type carriers for intermittently interrupting the rotation of some of said carriers, sliding frames for individually mounting said series of carriers, and cam motion actuated bars operably connected to said frames.

4. In a coding and decoding machine in combination, a plurality of supporting axles, series of coaxially spaced type carrying discs, loosely and rotatably mounted on said axles, driving means on both sides of said discs, and operably connected thereto, and adapted for operably connecting the adjacent series of type discs, means on the driving means of one side of alternating series of type discs for intermittently interrupting the rotation of some of the discs, oppositely displaceable push rods, sliding carriages for individually mounting said series of discs, and connected to said push rods, and spring actuated setting means operably engageable with the individual type carrying discs.

5. In a coding and decoding machine in combination, a plurality of supporting axles, series of co-axially spaced type carriers loosely and rotatably mounted on said axles, driving means on both sides of said carriers, and operably connected thereto and adapted for operably connecting the adjacent series of carriers, means on the driving means of one side of alternating series of type carriers for intermittently interrupting the rotation of some of the carriers, oppositely displaceable push rods, and means of mounting the series of carriers on said push rods, setting means adapted for operative engagement with said carriers, and spring actuated displaceable locking and controlling levers engageable with said carrier driving means.

6. In a coding and decoding machine in combination, a plurality of supporting axles, substantially parallelly spaced, series of co-axially spaced type carriers rotatably mounted on said axles, driving means on both sides of said carriers, and connected thereto, intermediate driving means between the adjacent series of carriers and in operative engagement with the first mentioned driving means, and motion interrupting portions on the driving means of one side of alternating series of type carriers, and on the intermediate driving means, oppositely displaceable push rods, substantially cam actuating operating means for said push rods, sliding frames for individually mounting said series of carriers, and connected to said push rods, spring actuated setting means operably engageable with the individual type carriers, and spring actuated locking and controlling levers, operatively connected to said frames and engageable with said type carriers and adapted to lock said type carriers in their relative positions.

7. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, two gear wheels, one on each side, fixed to each type carrier, one of the gear wheels of each pair having an interrupted rim of teeth on its circumference, normal wheels on one spindle facing interrupted wheels on the adjacent spindle, a pinion intermediate adjacent pairs of gear wheels, a double rim of teeth on said pinion, one being normal, the other one lacking every second tooth, plain segments of half breadth filling the gaps of the interrupted gear wheel rims and means for throwing the gear wheels on said spindles in and out of gear, respectively, with one another and with said driving shaft wheels.

8. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, two gear wheels, one on each side, fixed to each type carrier, one of the gear wheels of each pair having an interrupted rim of teeth on its circumference, normal wheels on one spindle facing interrupted wheels on the adjacent spindle, a pinion intermediate adjacent pairs of gear wheels, a double rim of teeth on said pinion, one being normal, the other one lacking every second tooth, plain segments of half breadth filling the gaps of the interrupted gear wheel rims and slides displaceable transversely to and forming bearings for said spindles.

9. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, two gear wheels, one on each side, fixed to each type carrier, one of the gear wheels of each pair having an interrupted rim of teeth on its circumference, normal wheels on one spindle facing interrupted wheels on the adjacent spindle, a pinion intermediate adjacent pairs of gear wheels, a double rim of teeth on said pinion, one being normal, the other one lacking every second tooth, plain segments of half breadth filling the gaps of the interrupted gear wheel rims, slides displaceable transversely to and forming bearings for said spindles and a crank disc operatively connected with said slides.

10. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, two gear wheels, one on each side, fixed to each type carrier, one of the gear wheels of each pair having an interrupted rim of teeth on its circumference, normal wheels on one spindle facing interrupted wheels on the adjacent spindle, a pinion intermediate adjacent pairs of gear wheels, a

double rim of teeth on said pinion, one being normal, the other one lacking every second tooth, plain segments of half breadth filling the gaps of the interrupted gear wheel rims, slides displaceable transversely to and forming bearings for said spindles, a crank disc and connecting rods connecting said crank disc with said slides.

11. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, two gear wheels, one on each side, fixed to each type carrier, one of the gear wheels of each pair having an interrupted rim of teeth on its circumference, normal wheels on one spindle facing interrupted wheels on the adjacent spindle, a pinion intermediate adjacent pairs of gear wheels, a double rim of teeth on said pinion, one being normal, the other one lacking every second tooth, plain segments of half breadth filling the gaps of the interrupted gear wheel rims, slides displaceable transversely to and forming bearings for said spindles and windows associated with said slides so as to participate in their displacement and adapted to register with said type carriers.

12. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one

another, gear wheels fixed to said type carriers and gear wheels fixed to said driving shaft, some of said gear wheels having an interrupted rim of teeth on their circumferences, means for throwing the gear wheels on said spindles in and out of gear, respectively, with one another and with said driving shaft wheels, a bar adjacent to and adapted to be displaced transversely to the spindle of each type carrier and two pawls on each bar adapted to turn said type carrier in different directions.

13. In a device of the kind described in combination, a driving shaft, a plurality of type carrier spindles, type carriers loosely disposed on said spindles in line with one another, gear wheels fixed to said type carriers and gear wheels fixed to said driving shaft, some of said gear wheels having an interrupted rim of teeth on their circumferences, means for throwing the gear wheels on said spindles in and out of gear, respectively, with one another and with said driving shaft wheels, a brake spring for each type carrier, a lever connected with each spring and a shaft connecting the levers of each row of type carriers, said shaft being operatively connected with said throwing out means.

In testimony whereof I affix my signature.

ALBERT HENKEES.