United States Patent

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[33] **Germany**
[31] **P1,650,643.7**

[54] **MAGNETIC MOTION TRANSMITTING ARRANGEMENT**
14 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **335/306,** 99/329
[51] **Int. Cl.** **H01f 7/02**
[50] **Field of Search** ..... 99/329 (XR), (Inquired), (366); 335/207, 229, 230, 306

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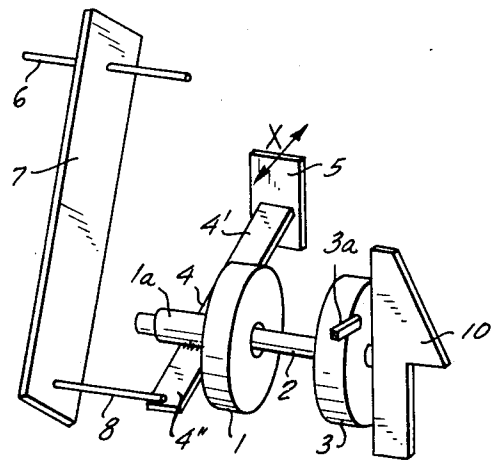
ABSTRACT: A motion transmitting arrangement wherein a first diametrically magnetized disc-shaped permanent magnet is movable axially toward a second disc-shaped permanent magnet, either in response to rotation of the second magnet from a first angular position in which the second magnet repels the first magnet to a second angular position in which the first magnet is attracted by the second magnet, or in response to introduction between the two magnets of a ferromagnetic member which is thereby magnetized and attracts the first magnet toward the second magnet. The arrangement can be used to release the carriage in a toaster in response to rotation of the second magnet or in response to displacement of the ferromagnetic member by a thermostat in the toasting chamber.



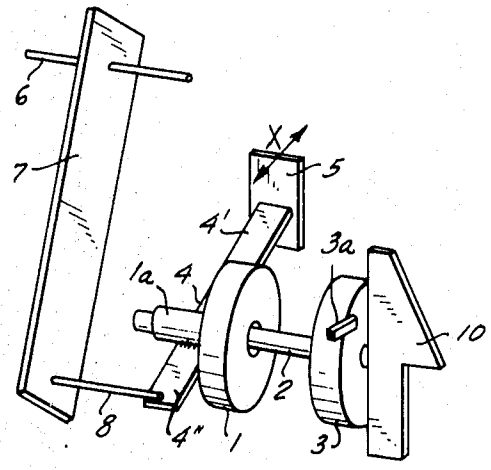


FIG. 1

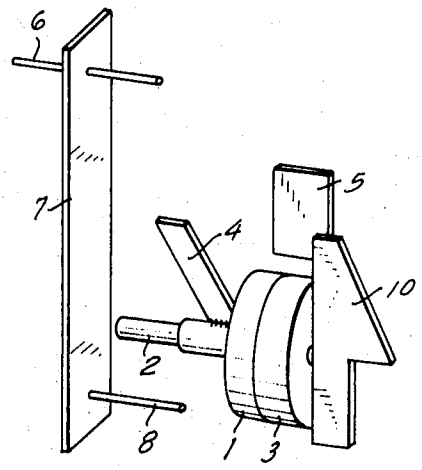


FIG. 2

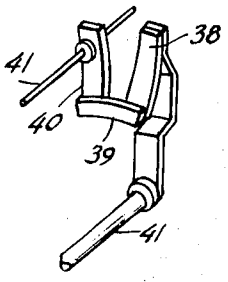


FIG. 6

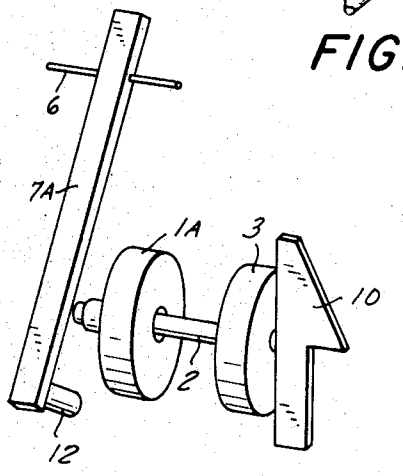


FIG. 3

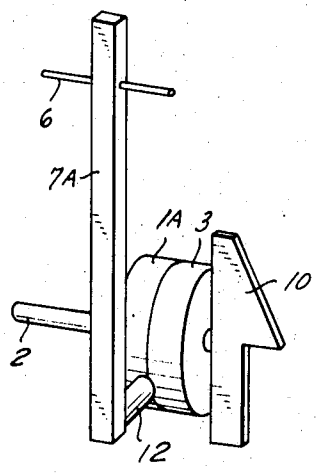


FIG. 4

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FIG. 5a

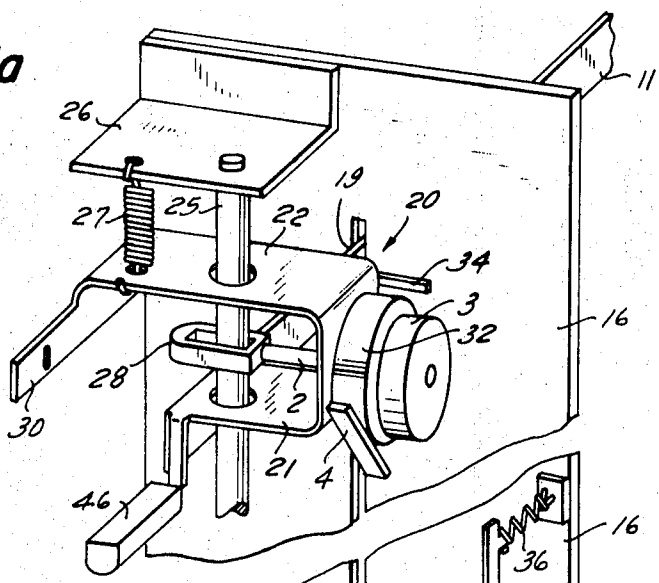
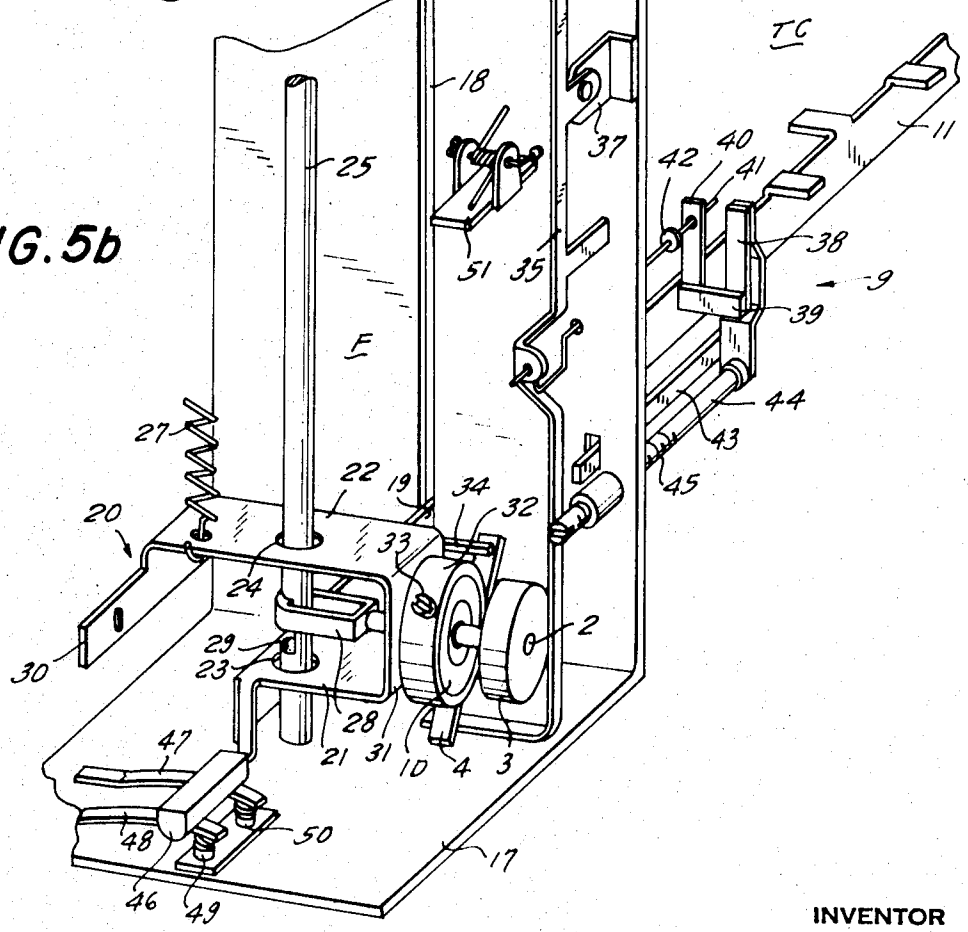


FIG. 5b



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MAGNETIC MOTION TRANSMITTING ARRANGEMENT

BACKGROUND OF THE INVENTION

The present invention relates to motion transmitting or switching arrangements in general, and more particularly to improvements in magnetic motion transmitting arrangements which can be utilized in toasters, cameras, business machines and/or for many other purposes. Still more particularly, the invention relates to improvements in motion transmitting arrangements of the type which can store energy and release such energy at a desired time to thereby initiate or effect movements of one or more parts.

SUMMARY OF THE INVENTION

One of the objects of my invention is to provide a motion transmitting arrangement which need not be powered by electric current, which can store desired amounts of energy, which can be readily operated to store energy, which can release such energy in response to direct or indirect transmission of actuating signals, and which can be designed as a highly sensitive or as a rugged, long-lasting assembly adapted to be used in areas which are maintained at any one of a wide range of temperatures.

Another object of the invention is to provide a compact motion transmitting arrangement which comprises a small number of simple parts, which can be built into or combined with a wide variety of machines, apparatus or instruments, and which can stand repeated and frequent use with a minimum of wear.

The improved motion transmitting arrangement comprises a first magnet (preferably a disc-shaped diametrically magnetized permanent magnet) which is movable axially between first and second positions and is guided in such a way that the orientation of its poles remains unchanged during movement between the two positions, a second magnet at least a portion of which is movable between a repelling position in which the poles of the second magnet face the poles of the first magnet and the second magnet thereby causes the first magnet to move to and to remain in first position and an attracting position in which the second magnet causes the first magnet to move to second position. The aforementioned portion of the second magnet may constitute a second disc-shaped diametrically magnetized permanent magnet which is rotatable between repelling and attracting positions. Alternatively, the second magnet may further comprise a fixed disc-shaped diametrically magnetized permanent magnet which is held against rotation and the aforementioned portion of the second magnet then constitutes a strip or a like member of ferromagnetic material which is movable between the two permanent magnets to thereby attract the first magnet to second position. If the second magnet is a disc-shaped permanent magnet, it can be rotated by an actuating lever or by a further permanent magnet, for example, in response to heating of a thermostat to a predetermined temperature.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved motion transmitting arrangement itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompany drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a magnetic motion transmitting arrangement which embodies one form of my invention, the second magnet being shown in repelling position;

FIG. 2 is a similar perspective view but showing the second magnet in attracting position;

FIG. 3 is a perspective view of a second motion transmitting arrangement with the second magnet shown in repelling position;

FIG. 4 illustrates the arrangement of FIG. 3 but with the second magnet in attracting position;

FIG. 5*a* is a fragmentary perspective sectional view of a toaster which is provided with a motion transmitting arrangement of the type shown in FIGS. 1 and 2 and wherein such arrangement serves to release the carriage for bread slices when the toasting operation is completed;

FIG. 5*b* is a similar fragmentary perspective sectional view of a larger portion of the toaster, with the motion transmitting arrangement shown in operative position in which the carriage assumes its lower end position in the toasting chamber; and

FIG. 6 is a perspective view of the thermostat in the toaster of FIGS. 5*a* and 5*b*.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a magnetic switching or motion transmitting arrangement which comprises a first magnet 3 fixed to a guide shaft 2 for reciprocatory movement therewith between a first position and a second position (shown in FIG. 2) in which the magnet 3 is respectively more distant from and nearer to a second permanent magnet 1. The maximum distance between the magnets 1, 3 is determined by a stop 3*a*. Each of the magnets 1, 3 is a disc and each thereof is magnetized diametrically. When the magnet 1 is held in the angular position of FIG. 1, like poles of the magnets 1, 3 face each other so that the magnet 1 repels the magnet 3 and maintains it in abutment with the stop 3*a*. This is the repelling position of the magnet 1.

The magnet 1 has a hub 1*a* which is rotatable on the guide shaft 2 and is affixed to a two-armed lever 4. The arm 4′ of the lever 4 abuts against a preferably adjustable arresting or blocking member 5, the adjustment controlling the sensibility of release, and the arm 4″ abuts as indicated by the arrow X in FIG. 1, against a pin or post 8 provided on an actuating lever 7 which is turnable on a pivot pin 6. The actuating lever 7 is turnable in a counterclockwise direction from the position shown in FIG. 1 to that shown in FIG. 2 whereby its post 8 turns the lever 4 and the magnet 1 so that the latter assumes the attracting position shown in FIG. 2. The lever 7 can be turned by a thermostat, such as the thermostat 9 shown in FIG. 5*b*. When the magnet 1 is turned to the position shown in FIG. 2, the position of its poles with reference to the poles of the axially movable magnet 3 is changed to such an extent that the magnet 3 is attracted and moves with the guide shaft 2 to assume the second position shown in FIG. 2. The magnet 3 carries an operating element, here shown as a hook or catch 10, which can release a spring-biased carriage or platform 11 (FIG. 5*b*) serving to support a slice of bread in the chamber TC of a toaster. When the magnet 3 is caused to assume the second position of FIG. 2, the catch 10 releases for example, the carriage 11 so that the latter can rise abruptly to lift the toasted slice so that it can be gripped by fingers.

The operation is as follows:

When held in the repelling position of FIG. 1, the second magnet 1 repels the magnet 3 so that the latter bears against the stop 3*a* and the catch 10 engages and holds the carriage 11 in the lower end position. Like poles of the magnets 1, 3 are then located opposite each other. The arm 4″ of the lever 4 is located near the post 8 which is held in the angular position of FIG. 1 whereby the blocking member 5 arrests the magnet 1 in or close to a dead center or neutral position. The magnets 1, 3 then constitute an energy storing device. If the thermostat 9 thereupon pivots the actuating lever 7 in a counterclockwise direction so that the pin 8 moves to the position shown in FIG. 2, the magnet 1 also turns in a counterclockwise direction and the position of its poles with reference to the poles of the magnet 3 is changed so that the latter is attracted and slides with the guide shaft 2 toward the position shown in FIG. 2 in which it can but need not abut against the magnet 1. It is clear that a second stop can be provided to arrest the magnet 3 in a second position in which this magnet remains spaced from the magnet 1. As the magnet 3 travels toward the position shown in FIG. 2, its catch 10 releases the carriage 11 so that the latter moves to upper end position and exposes the toasted slice.

When the user wishes to toast a fresh slice of bread or other foodstuff, the levers 4, 7 are returned to the positions shown in FIG. 1 whereby the magnet 1 repels the magnet 3 and the latter returns into abutment with the stop 3*a* without changing the orientation of its poles.

As stated before, the magnet 1 normally assumes a neutral or dead center position in which its poles face like poles of the magnet 3. In order to insure that the magnet 1 remains in such unstable neutral position, the arrangement of FIGS. 1 and 2 comprises the lever 4 which blocks movement of the magnet 1 in one direction beyond such neutral position. The force necessary to turn the magnet 1 to the attracting position of FIG. 2 is rather small so that a thermostat 9 can readily furnish the force needed to turn the actuating lever 7. The improved arrangement is operative without necessitating a connection with a source of electrical energy so that it can be used in many instances and situations where the electrical energy is not available. Moreover, and since it requires no wiring or electrical insulation, it can be installed at a fraction of the cost of presently known electrically operated motion transmitting and energy storing arrangements. The dimensions of the permanent magnets determine the magnitude of force which is necessary to turn the magnet 1 from the position of FIG. 1 to that shown in FIG. 2. Thus, and depending on the desired use of the motion transmitting arrangement, such force can be selected at will so that the magnet 3 can be shifted in response to exertion of a very small force or in response to exertion of a rather substantial force.

FIGS. 3 and 4 illustrate a second motion transmitting arrangement wherein the first magnet 3 is mounted and configurated in the same way as described in connection with FIGS. 1 and 2. The second magnet again comprises a rotary permanent magnet 1A and the actuating means further comprises a permanent magnet 12 mounted on the free arm of the actuating lever 7A which is turnable on the pivot pin 6 in the same way and by the same means as described in connection with the lever 7. The permanent magnet 12 is a bar which is magnetized in such a way that it causes the permanent magnet 1A to turn in a clockwise or counterclockwise direction when the actuating lever 7A is pivoted to the position shown in FIG. 4. This causes the second magnet 1A to attract the first magnet 3 so that the latter moves to the second position shown in FIG. 4 and its catch 10 releases the carriage 11 of the toaster. The arrangement is preferably such that the bar magnet 12 need not touch the permanent magnet 1A in order to move the latter to the angular position shown in FIG. 4. When the magnet 1A is held in the angular position shown in FIG. 3, such position is closed to or coincides with a neutral or dead center position.

One mode of utilizing the improved motion transmitting arrangement is shown in FIGS. 5*a*, 5*b* and 6. These illustrations show a portion of a toaster which embodies the arrangement shown in FIGS. 1 and 2. The housing of the toaster comprises a frame member or wall 16 which separates the toasting or heating chamber TC from a compartment F serving to accommodate the motion transmitting arrangement and certain other components of the toaster. The thermostat 9 is accommodated in the chamber TC and this chamber also accommodates the aforementioned carriage 11 for bread slices and the reflectors and heating elements (not shown) which influence the thermostat.

The wall 16 preferably consists of nonmagnetizable material and its lower part is bent over at right angles to form a foot or base 17. The upright portion of the wall 16 is formed with an elongated vertical slot 18 for a narrow arm 19 which extends between the chamber TC and compartment F and is provided at one end with a slide 20 movable up and down in the compartment. The other end of the arm 19 constitutes or carries the aforementioned carriage or platform 11 for bread slices. The slide 20 comprises two parallel horizontal panels 21, 22 located above each other and provided with registering holes 23, 24 for an upright or column 25 along with the slide can move up and down between the upper end position shown in FIG. 5*a* and the lower end position shown in FIG. 5*b*. The ends of the column 25 are mounted in the base 17 and in a horizontal bracket 26 affixed to the upper end of the wall 16. A helical contraction spring 27 is connected between the bracket 26 and slide 20 so that the latter tends to move upwardly and to assume the end position shown in FIG. 5*a*. When the slide 20 is moved to the lower end position shown in FIG. 5*b*, a yoke or catch 28 snaps into a notch or recess 29 in the column 25 to thereby arrest the slide 20 and carriage 11 in such position. The spring 27 then stores energy and is ready to move the carriage 11 upwardly as soon as the yoke 28 is caused to leave the notch 29. The means for moving the slide 20 downwardly against the opposition of the spring 27 comprises a handle 30 which is provided on the top panel 22 and extends outwardly through a slot in the housing of the toaster. Such handle is preferably provided with a sleeve or knob, not shown.

The yoke 28 is rigid with the guide shaft 2 of the magnetic motion transmitting arrangement. The shaft 2 is fixed to the first magnet 3 which is reciprocable therewith between the second position shown in FIG. 5*a* and the first position shown in FIG. 5*b*. The shaft 2 is reciprocable axially in but cannot turn with reference to a bearing plate 31 which connects the panels 21, 22 of the slide 20. The second magnet 1D of the motion transmitting arrangement is rotatable on the shaft 2 and is surrounded by a supporting ring 32 affixed thereto by a radial screw 33 or analogous fastening means. The ring 32 replaces the hub 1*a* of FIG. 1 and is rigid with the lever 4 which normally bears against an arresting or blocking bar 34 on the slide 20 to thereby maintain the magnet 1D in repelling position. The actuating lever 7 of FIG. 1 is replaced by an actuating lever 35 which is fulcrumed on the wall 16, as at 37, and is biased in a counterclockwise direction by a spring 36. The lever 35 can turn in a clockwise direction in response to requisite heating of the thermostat 9 to thereby effect movement of the lever 4 to the position shown in FIG. 5*a*.

The thermostat 9 is mounted on the wall 16 and is located in the toasting chamber TC. It comprises three U-shaped bimetallic elements 38, 39, 40 (see also FIG. 6) which are deformed in response to heating to thereby shift a pushrod 41 which in turn can pivot the actuating lever 35. The pushrod 41 is formed with a flange 42. The elements 38, 39, 40 are mounted on an arm 44 which is stabilized by a rail 43. The arm 44 is threaded, as at 45, and is affixed to the wall 16 in such a way that the length of its portion in the chamber TC can be regulated for the purpose of determining the length of the interval during which a bread slice remains in the toasting chamber.

The electric circuit of the toaster comprises the aforementioned heating elements (not shown) and a master switch including fixed contacts 49, 50 and movable contacts 47, 48. A trip 46 of insulating material is mounted on the lower panel 21 of the slide 20 and closes the master switch by moving the contacts 47, 48 against the contacts 50, 49 in response to movement of the slide to the lower end position shown in FIG. 5*b*.

The wall 16 further supports a cocking member 51 which is biased by a torsion spring and serves to move the lever 4 to the position shown in FIG. 5*b* when the slide 20 is moved downwardly by way of the handle 30.

The operation of the structure shown in FIGS. 5*a*, 5*b* and 6 is as follows:

When the toaster is not in use, the slide 20 assumes the upper end position shown in FIG. 5*a*. The magnet 1D then attracts the magnet 3 so that the catch or yoke 28 is held in the left-hand end position and does not bear against the column 25. The spring 27 is strong enough to hold the arm 19 with the slide 20 and carriage 11 in such upper end position. If the user wishes to toast a slice of bread (not shown) or the like, such slice is placed onto the prongs of the carriage 11 and the handle 30 is pushed downwardly to move the slide 20 to the lower end position shown in FIG. 5*b*. The arm 4 moves past the cocking member 51 and turns the ring 32 with the magnet 1D so that the latter repels the magnet 1. Consequently, the magnet 1 moves the shaft 2 and the yoke 28 in a direction to the right, as viewed in FIG. 5*a*, so that the yoke 28 bears against

the peripheral surface of the column **25** and enters the notch **29** as soon as the slide **20** reaches its lower end position. The yoke **28** is a functional equivalent of the aforementioned catch **10** and cooperates with the column **25** to hold the carriage **11** in the lower end position of FIG. **5***b* for an interval of time which is determined by the selected axial position of the arm **44**. As the slide **20** approaches its lower end position, the trip **46** closes the master switch (contacts **47—50**) so that the circuit of the toaster is completed and the heating elements in the chamber TC toast the slice on the carriage **11**. When the interval determined by the setting of the arm **44** elapses, the bimetallic elements **38—40** of the thermostat **9** shift the rod **41** toward the actuating lever **35** against the opposition of the spring **36** to such an extent that the lever **4** is moved to the angular position shown in FIG. **5***a* whereby the magnet 1D turns with the lever **4** and attracts the magnet **3**. The latter moves the shaft **2** to the left so that the yoke **28** leaves the notch **29** and permits the spring **27** to contract. Thus, the slide **20** moves the carriage **11** upwardly and the freshly toasted slice can be removed from the chamber TC. As a rule, the movement of the magnet **3** toward the magnet 1D takes place suddenly and, as the slide **20** travels toward its upper end position, the trip **46** moves away from the contacts **47**, **48** so that the master switch opens and deenergizes the electric circuit of the toaster.

It is clear that the improved motion transmitting arrangement is susceptible of many modifications without departing from the spirit of my invention. It is also clear that such arrangement can be put to use in many other devices or apparatus. For example, the structure shown in FIGS. **1—2**, or **3—4** can be used in photographic apparatus (to actuate a shutter or the like), in calculating machines (to replace a relay) and/or elsewhere. Furthermore, two or more motion transmitting arrangements can be combined with each other or two or more such arrangements may be used to actuate several discrete movable parts of a machine, instrument or apparatus. Two or more motion transmitting arrangements can be assembled in series or in parallel. Also, the magnet **3** and/or the magnet **1**, 1A, 1B or 1D can be assembled of several magnets.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art.

I claim:

1. A magnetic motion transmitting arrangement comprising a pair of permanent magnets arranged along a common axis, one of said magnets being movable in direction of said common axis between a first position and a second position in which latter position said one magnet is spaced from the other a distance smaller than in said first position, and the other of said magnets being turnable about said axis between a repelling position maintaining said one magnet in said first position and an attracting position causing said one magnet to move from said first to said second position; and means cooperating with said other magnet for turning the same between said positions thereof and including a lever turnable about a second axis distant from said common axis.

2. A motion transmitting arrangement as defined in claim **2**, wherein said turning means further comprise a second lever fixed to said other magnet for turning therewith about said common axis and a transverse member fixed to said first-mentioned lever and engaging said second lever upon turning of said first lever about said second axis.

3. A motion transmitting arrangement as defined in claim **2**, wherein said second lever is a two-arm lever, one arm of said two-arm lever being adapted to be engaged by said transverse member, and including arresting means engaged by the other arm of said two-arm lever when said other magnet is in said repelling position.

4. A motion transmitting arrangement as defined in claim **1**, wherein said turning means further comprises a third magnet carried by said lever spaced from said second axis and movable during turning of said lever about said second axis between a pair of positions to thereby effect movement of said other magnet between said repelling and attracting positions.

5. A motion transmitting arrangement as defined in claim **1** and including catch means fixed to said one magnet for movement in axial direction therewith.

6. A magnetic motion transmitting arrangement comprising a first magnet movable between first and second positions; a second magnet movable between repelling and attracting positions in which said second magnet respectively maintains said first magnet in a first position at a first distance from said second magnet and causes said first magnet to move from said first to a second position in which the distance between said magnets is less than said first distance; and a carriage reciprocable along a longitudinal path between two positions, said first magnet being arranged to hold said carriage in one such end position in the first position thereof.

7. A magnetic motion transmitting arrangement comprising a first magnet movable between first and second positions; a second magnet movable between repelling and attracting positions in which said second magnet respectively maintains said first magnet in a first position at a first distance from said second magnet and causes said first magnet to move from said first to said second position in which the distance between said magnets is less than said first distance; and a carriage reciprocable between two positions, said first magnet being arranged to hold said carriage in one such end position in the first position thereof, said magnets and said carriage forming part of a toaster.

8. A motion transmitting arrangement as defined in claim **1**, wherein said magnets store energy and the poles of said other magnet facelike poles of said one magnet in the first position of said one magnet.

9. A motion transmitting arrangement as defined in claim **1**, wherein each of said magnets comprises at least one diametrically magnetized disc.

10. A motion transmitting arrangement as defined in claims **3**, wherein said arresting means is adjustable.

11. A motion transmitting arrangement as defined in claim **6**, further comprising thermostat means for moving said second magnet from repelling to attracting position.

12. A motion transmitting arrangement as defined in claim **11**, further comprising operating means connected with said first magnet and arranged to maintain the carriage in said one end position in the first position of said first magnet.

13. A motion transmitting arrangement as defined in claim **6**, further comprising cocking means for moving said second magnet to repelling position in response to movement of said carriage into said one end position thereof.

14. A motion transmitting arrangement as defined in claim **1**, further comprising guide means movable with said one magnet and arranged to hold the latter against a change in orientation of its poles during movement between said first and second positions.