

(51) International Patent Classification:
B30B 1/26 (2006.01) *B21J 9/18* (2006.01)(21) International Application Number:
PCT/TR2018/050680(22) International Filing Date:
12 November 2018 (12.11.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2018/16939 10 November 2018 (10.11.2018) TR(71) Applicant: **BES ISLETME ARGE VE MUHENDISLIK COZUMLERI SANAYI TICARET LIMITED SIRKETI** [TR/TR]; Uludag Universitesi Gorukle Kampusu Ulutek Teknoloji Gelistirme Bolgesi No:218, Gorukle, Bursa (TR).(72) Inventors: **SARIGOZ, Ahmet**; Nilüfer ORG. SAN. BÖLG. 118.Sok. No:10 T, 16340 Bursa (TR). **OCAL, Tahir**; Nilüfer ORG. SAN. BÖLG. 118.Sok. No:10, Bursa (TR).(74) Agent: **YAVUZ GÜLEÇ**; Elmas Patent A.S., Altunizade Mah. Kuşbakişi Cad. Aşuroğlu Sitesi, No:29 B Blok Kat:3, Altunizade Üsküdar/Istanbul (TR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: SLIDER MECHANISM WITH PENDULUM COORDINATION- IMA

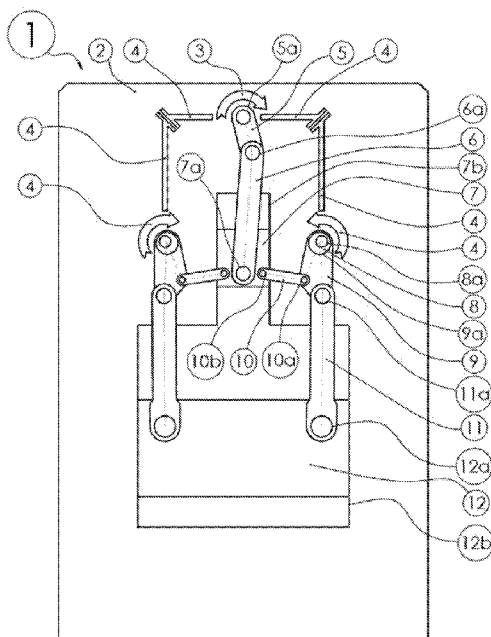


fig.1

(57) Abstract: The invention is about a Slider Mechanism With Pendulum Coordination (1) which is driven by rotary input, produce heavy duty force, and it is characterized in that; it comprises an input motor (3) coupled to a transmission unit (4) which outputs at several points, crank-1 (5) constrained to the frame (2) by a joint (5a), connection rod-1 (6) constrained to said crank-1 (5) by a joint (6a), ram-1 (7) constrained to said connection rod-1 (6) and frame (2) by joint (7a) and guideway bearing (7b), crank-2 (8) constrained to the frame (2) by a joint (8a), pendulum (9) constrained to said crank-2 (8) by a joint (9a), link (10) constrained to said pendulum (9) and ram-1 (7) by joints (10a, 10b), connection rod-2 (11) constrained to said pendulum (9) by a joint (11a), and ram-2 (12) constrained to said connection rod-2 (11) and frame (2) by joint (12a) and guideway bearing (12b). Although not mandatory, as illustrated in the figure, in the case of construction requirements, a transmission unit (4), crank-2 (8), pendulum (9), link (10), and connection rod-2 (11) can be applied as symmetric components.



Published:

- *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

SLIDER MECHANISM WITH PENDULUM COORDINATION – IMA

Technical Field

- 5 The invention is about all kinds of machines and mechanical structures which converts input rotary motion to the linear or rotational or any trajectory motion, and produces work through the output path.

The Prior Art

- 10 Reviews of previous techniques which are related to present invention and used in the same applications are as follows:

In the conventional slider - crank, and knuckle – joint mechanisms, in order to obtain the target value of stroke length, the ratio of the length (k) of the crank to that of connection rod (b) cannot be lowered than a certain value while the total length (k+b) which defines the size of the system is kept constant.

- 15 Target value of stroke length can be obtained in this way. In this instance, both the magnitude of produced payload force is too low, and its effective force is applied in a very short working regime at the end of the stroke. If high force output is targeted with the same mechanism constrains, crank length is kept too short compared to that of connection rod, but in this instance the resultant stroke is decreased dramatically. Namely, using conventional mechanisms, it is not possible to produce
20 both high magnitude of force and extended working regime at the end of the stroke. It is very difficult to control the position, speed, and force in these systems.

Patent research is done for conventional techniques. The patent, registration no CN102430681, mentions a pusher arm which can be integrated to a press, and which is actuated by a symmetric assembly of another link driven by two servo motors and connected to a second transmission link.

- 25 It is determined that, examined patent has no similarity with presented invention.

Description of the Invention

The object of the invention is bringing a new initiative in the field, compared to the systems used in conventional techniques.

- 30 Outputs of this mechanism: Long “rayting point”, high speed in approaching stroke, high force in work stroke (movement shift), precision and repeatability.

It has a unique motion kinematics that moves fast when approaching the workpiece and slowing down the system at the time of press, avoiding high inertial loads over the drive motor - thus not straining it. Does not require a large-size engine as a flywheel. For this reason, motor sizes are not
35 too much more than the amount of the work transferred on the workpiece. In this way, it is possible to operate the system using compact, economical, and easily available motors.

Another object of the invention is containing a kinematic structure which provides the possibility of independent power inputs to each of two cranks mentioned hereby. In this case, the transmission ratio and / or relation is between long crank and short crank is carried out by means of electronics and software.

- 5 Another object of the invention is containing a kinematic structure which provides direct application of one servo motor output of which is distributed to cranks by transmission unit, or one or two servo motors mechanically independently coupled to the cranks.

Another object of the invention is containing a kinematic structure which provides both high force and extended working stroke regime, compared to systems used in conventional techniques.

- 10 Another object of the invention is making use of long link arm which acts as a crank in rapid mode when extended stroke regime is introduced, whereas activating short link arm which acts as another crank in working mode when high force regime is introduced.

Direct drive: In contrast to other conventional presses, the movement between the motor and the ram is transmitted directly in this system. There is no heavy mass such as, large scale connecting
15 rod with gear system, pulley, flywheel, and etc. Drive mechanism is compact and simple. The moment of inertia lowered on the drive motor shaft is up too low compared to conventional presses. Does not require a large size drive system to act as a flywheel. For this reason, the motor sizes are not more than needed. This kinematic property of the invented mechanism provides effective and stable control during precise forming.

- 20 Advantages of the invention: Effective and stable control during precision forming is achieved. The energy (power) input is very low compared to conventional presses. No energy storage and / or system cooling required. It works more quietly. Breakdown, Failure, downtime and maintenance costs are minimum. It is environmentally friendly due to energy saving, and being powerful alternative to hydraulic systems. The investment cost is relatively low compared to the conventional presses
25 due to simplicity and small size input motor and power transmission means.

Another object of the invention is containing a kinematic structure which provides constrained movement of two cranks, namely long and short eccentrics, driven by one actuator motor, and power transmission in between these cranks is done by means of transmission units. The transmission ratio and / or relation in between long crank and short crank is done such that the force and speed output
30 characteristics at the end margin of the stroke (work regime) are met as per requirements of the modern approach; and this relation is adjustable – thus the machine is user friend for the operator.

The mode switch in these motion sequences is accomplished thanks to progressive action of longer and shorter cranks. When the long crank is moving, the shorter crank is stationary, and vice a versa. Another object of the invention is being integrated to any system which makes work through a linear
35 stroke - via converting rotary motion (which supply input torque, and produced by electric motor, manual movement, and etc.) to translational force.

Another object of the present invention is that it has a modular structure.

Another object of the present invention is that it is used standalone in specific application, as well as used as a subsystem a machine. For example, some of these applications are turret rotation and locking mechanisms; shutter locking mechanisms; squeezing and smashing machinery in food industry; automation lines in health industry; non-woven textile processing lines; woodworking machinery; marble machines; all kind of press fit and compression operations in automotive assembly lines; press brake, shear, punch, drawing presses, blanking presses, and etc. in sheet metal processing business; cold forging presses; plastic injection presses; rubber injection presses; PVC machines; construction equipment; textile machines; sewing machines; agricultural machinery; and etc.

The object of the invention is about a Slider Mechanism With Pendulum Coordination which is driven by a rotary input, and produce heavy duty force, and which fulfills the above-described purposes such that, it comprises an input actuator (such as motor) coupled to a transmission unit which outputs at several points, a crank constrained to the frame by a joint, a connection rod constrained to said crank by a joint, a ram constrained to said connection rod and frame by joint and guideway bearing, another crank constrained to the frame by a joint, a pendulum constrained to said crank by a joint, a link constrained to said pendulum and ram by joints, another connection rod constrained to said pendulum by a joint, and another ram constrained to said connection rod and frame by joint and guideway bearing.

Brief Description of the Drawings

Figure: Schematic view of the Slider Mechanism With Pendulum Coordination (presented invention)

Reference Numbers

No	Explanation
1	Slider Mechanism With Pendulum Coordination
2	Frame
3	Input motor
4	Transmission unit
5	Crank-1
5a	Joint
6	Connection rod-1
6a	Joint
7	Ram-1
7a	Joint

7b	Guideway bearing
8	Crank-2
8a	Joint
9	Pendulum
9a	Joint
10	Link
10a	Joint
10b	Joint
11	Connection rod-2
11a	Joint
12	Ram-2
12a	Joint
12b	Guideway bearing

Detailed Description of the Invention

5 The invention is about Slider Mechanism With Pendulum Coordination (1) which is driven by rotary input, produce heavy duty force, and it is characterized in that; it comprises an input motor (3) coupled to a transmission unit (4) which outputs at several points, crank-1 (5) constrained to the frame (2) by a joint (5a), connection rod-1 (6) constrained to said crank-1 (5) by a joint (6a), ram-1 (7) constrained to said connection rod-1 (6) and frame (2) by joint (7a) and guideway bearing (7b),
 10 crank-2 (8) constrained to the frame (2) by a joint (8a), pendulum (9) constrained to said crank-2 (8) by a joint (9a), link (10) constrained to said pendulum (9) and ram-1 (7) by joints (10a, 10b), connection rod-2 (11) constrained to said pendulum (9) by a joint (11a), and ram-2 (12) constrained to said connection rod-2 (11) and frame (2) by joint (12a) and guideway bearing (12b). Although not mandatory, as illustrated in the figure, in the case of construction requirements, a transmission unit
 15 (4), crank-2 (8), pendulum (9), link (10), and connection rod-2 (11) can be applied as symmetric components.

Basically, crank-1 (5) - connection rod-1 (6) – ram-1 (7) line is a sub actuator, and crank-2 (8) is another sub actuator. These are extra mechanism members that prepare convenient motion / force input scenario for “pendulum – link” couple which is the core of this invention. Namely, motion /
 20 position regimes of axis of joints (9a) and (10b) define the motion / position at the output of the mechanism at ram-2 (12). Crank-1 (5) - connection rod-1 (6) – ram-1 (7) line define the motion / position regimes of axis of joint and (10b), and crank-2 (8) defines that of joint (9a). In the other words, alternative actuators or structures (such as linear piston - cylinder) can be used in order to define the motion / position regimes of axis of joints (9a) and (10b).

Pendulum coordination feature will be explained in detail. Consider "vector 10a10b" which passes through axis of joint (10a) and joint (10b); "vector 8a12a" which passes through joint (8a) and joint (12a); and another "vector 7b5a" which collinear with tangent line intersecting trajectory of guideway path (7b) at joint (10b). The dimensioning of the mechanism is done such that, at the rating point zone (working zone) of the stroke of ram-2 (12); joint (10b) is in quasi static equilibrium state; the angle between vector 8a12a and vector 10a10b is close to 90 degrees; also the angle between vector 10a10b and vector 7b5a is close to 90 degrees; and the distance between the axis of joint (11a) and the projection line of vector 10a10b is very close to zero. In this state, the resultant moment on pendulum (9) produced by reaction force at joint (11a) coming from ram-2 (12) is very low, thus, balancing force on link (10) is very low. As a result, two advantages come together; component of reaction force (equilibrium load) at joint (10b) in direction of vector 7b5a is too low due to two reasons; first, the force flowing through link (10) is very low, and second, this force is essentially supported mainly by guideway bearing (7b) on which link (10) is more or less perpendicular. Said equilibrium load being low minimizes the power needed for preventing rotation of pendulum (9) during working phase at rayting point zone, and it is very easy for said sub actuator of "crank-1 (5) - connection rod-1 (6) – ram-1 (7) line" described above. Even, at this state, the angle between vector 10a10b and vector 7b5a (which is close to 90 degrees) can be operated so that, when magnitude of reaction force exceeds predefined limit, said sub actuator of "crank-1 (5) - connection rod-1 (6) – ram-1 (7) line" may retract; and in this way the whole machine is protected against overload. Due to these advantages, this invention is called as "..... pendulum coordination....."

Motion of the input means (3) can be produced via manual or by motor or additional lever rotated by linear actuators. The range of motion, full lap or start and end points can be in any angular position.

The transmission unit (4) between the input motor (3) and crank-1 (5), and crank-2 (8) can be characterized in various structures, namely gear box, belt and pulley, rack and pinion, cam and slot, and etc. The relation between speed and torque (or force) inputs and outputs of the transmission unit (4) can be either linear or nonlinear. Speed and torque (or force) outputs on crank-1 (5) can be either the same or different from said outputs on crank-2 (8). Instead of applying the transmission unit (4) between crank-1 (5) and crank-2 (8), independent additional motor can be applied on crank-2 (8)

Crank-1 (5) is free to turn 360 degrees. Depending on the input motion, it either oscillates within the range of start and end angles or completes the full turn. It converts the torque applied by the input means to force and transfers to the connection rod-1 (6) through the joint (6a).

Connection rod-1 (6) is a two-force-member, and free from any moment accept inertial effects. One end joint (6a) oscillates depending on the movement of crank-1 (5), and the other end joint (7a) reciprocates in the trajectory of guideway bearing (7b). It transmits the force directly to ram-1 (7) through joint (7a).

5

Ram-1 (7) moves in the trajectory of guideway bearing (7b), and pushes and pulls end joint (10b) accordingly. The profile of guideway bearing (7b) does not need to be linear, it can be in arc, spline, or in any form.

10 Link (10) is a two-force-member, and free from any moment accept inertial effects. One end joint (10a) moves depending on the motion of ram-1 (7), and the other end joint (10b) oscillates in depending on the rotation of pendulum (9) around joint (9a). Link (10) make pendulum (9) rotate around joint (9a). Joint (9a) can be either stationary or mobile performing pure rotation around joint (8a) depending on the movement of crank-2 (8). Link (10) not need to be constructed from rigid
15 material. It can be flexible material; or composed of more than one part such as linear actuator including cylinder - piston powered by any means; or composed of bolt and nut couple; thus, the length of the link (10) can be self-aligning and / or adjustable via changing relative position of joint (10a) with respect to joint (10b). In this way, additional precaution can be built against overload danger of the reaction forces coming from ram-2 (12) such that in the case of excessive loads, the
20 length of link (10) self-aligns automatically.

Crank-2 (8) is free to turn 360 degrees. Depending on the input motion, it either oscillates within the range of angles or completes the rotation. It converts the torque applied by the input means to force and transfers to pendulum (9) through the joint (9a). Crank-2 (8) make joint (10a) of pendulum (9) rotate around joint (10b). Joint (10b) can be either stationary, or move in trajectory of guideway (7b)
25 depending on the movement of ram-1 (7).

Pendulum (9) performs combined motion depending on the movement of axis joint (9a) and joint (10a). Either of joint (9a) and joint (10b) can be stationary or mobile depending on the motion of subsequent mechanism members connected to them. Then, resultant motion and force is
30 transmitted to connection rod-2 (11) through joint (11a).

Connection rod-2 (11) is a two-force-member, and free from any moment accept inertial effects. One end joint (11a) oscillates in course of movement of pendulum (9), and the other end joint (12a) reciprocates in the trajectory of guideway bearing (12b). It transmits the force directly to ram-2 (12)
35 through joint (12a).

Ram-2 (12) moves in the trajectory of guideway bearing (12b), and position and force output (push and pull) of the whole mechanism is performed at the bottom edge of the ram-2 (12). The profile of guideway bearing (12b) does not need to be linear, it can be in arc, spline, or in any form.

- 5 Alternatively, motion input may be transferred to connection rod-1 (6) by motor frame connected on crank-1 (5). In the same sense, motion input may be transferred to pendulum (9) by motor frame connected on crank-2 (8). That is, the motor and / or transfer unit frames can be mounted on crank-1 (5) and crank-2 (8), moving with them. The issue is the relative motion between crank-1 (5) and connection rod-1 (6); and between crank-2 (8) and pendulum (9).

10

Various modes of mechanism motions will be explained:

- One mode is that crank-1 (5) turns fully or oscillates, and crank-2 (8) is stationary (does not move). In this case, pendulum (9) performs pure rotation around joint (9a) depending on push and pull effect of link (10) which is moved by ram-1 (7). The motion output at ram-2 (12) is relatively fast, and force output is relatively low. Because, crank-1 (5) length is considered to be longer than that of crank-2 (8). Because the crank-1 (5) is predicted to be longer than the crank-2 (8).

15

- One another mode is that crank-1 (5) is stationary (does not move), and crank-2 (8) turns fully or oscillates. It means that ram-1 (7) is stationary. In this case, joint (10a) of pendulum (9) performs pure rotation around joint (10b). The motion output at ram-2 (12) is relatively slow, and force output is relatively high.

20

- One another mode is that both of crank-1 (5) and crank-2 (8) turn fully or oscillate regularly in steady state. Each of these motions may be also in any mathematical function. In this case, combined motion is transferred to pendulum (9). The magnitude of speed and force output at ram-2 (12) depends on the motion functions of the crank-1 (5) and crank-2 (8) and the relation in between.

25

- One another mode is that, crank-1 (5) moves fast, and slows down around bottom death center of ram-1 (7) (quasi-static). Crank-2 (8) is stationary (or quasi-static) while ram-1 (7) is moving fast far from bottom death center, and starts rotation when ram-1 (7) is in quasi-static regime around bottom death center. In this case, since joint (10b) is quasi static, joint (10a) performs pure rotation. The force transmitted to ram-2 (11) through pendulum (9) is basically produced by crank-2 (8). As the length of crank-2 (8) is too short, the fore output is too high. Thus, motion output at ram-2 (12) is relatively slow, and force output is relatively high.

30

- One another mode is that ram-1 (7) is locked at bottom death center via a pin movement, gravitational forces, frictional forces, spring forces, hydraulics, pneumatics, electrical devices or etc., and crank-2 (8) turns fully or oscillates. In this case, joint (10a) of pendulum (9) performs pure rotation

35

around joint (10b). The motion output at ram-2 (12) is relatively slow, and force output is relatively high. The force transmitted to ram-2 (11) through pendulum (9) is basically produced by crank-2 (8). As the length of crank-2 (8) is too short, the fore output is too high. Thus, motion output at ram-2 (12) is relatively slow, and force output is relatively high.

CLAIMS

1. The invention is about Slider Mechanism With Pendulum Coordination (1) which is driven by rotary input, and produce heavy duty force, and it is characterized in that; it comprises;
- **pendulum (9)** which is constrained by a joint (9a) and joint (10a) as positions and forces input features internally, and output position and force features at joint (11a),
 - **connection rod-2 (11)** constrained to said pendulum (9) by joint (11a),
 - **ram-2 (12)** constrained to said connection rod-2 (11) and frame (2) by joint (12a) and guideway bearing (12b),
 - **crank-2 (8)** constrained to the frame (2) by a joint (8a), and to said pendulum (9) at by a joint (9a),
 - **link (10)** constrained to said pendulum (9) at joint (10a),
 - **ram-1 (7)** constrained to said link (10) by joint (10b), and to frame (2) by guideway bearing (7b),
 - **connection rod-1 (6)** constrained to said ram-1 (7) by joint (7a),
 - **crank-1 (5)** constrained to said connection rod-1 (6) by joint (6a), and to the frame (2) by joint (5a),
 - **transmission unit (4)** which outputs at several points (i.e. crank-1 (5), and crank-2(8))
 - **an input motor (3)** coupled to said transmission unit (4).
2. The mechanical system (1) according to claim-1, characterized in that components crank-1 (5) - connection rod-1 (6) – ram-1 (7) line is a as a sub actuator; and this sub actuator can be replaced by alternative actuators or structures (such as linear piston – cylinder, belt and pulley, rack and pinion, cam and slot, and etc.) in order to define the motion / position regime of axis of joint (10b).
3. The mechanical system (1) according to claim-1, and 2, characterized in that crank-2 (8) is a sub actuator; and this sub actuator can be replaced by alternative actuators or structures (such as linear piston – cylinder, belt and pulley, rack and pinion, cam and slot, and etc.) in order to define the motion / position regime of axis of joint (9a).
4. The mechanical system (1) according to claim-1, 2, and 3, characterized in that anyone or all of said connection rod-2 (11), crank-2 (8), link (10), connection rod-1 (6), and crank-1 (5) has (have) eccentric link form.
5. The mechanical system (1) according to claim-1, 2, and 3, characterized in that, motion of the input means (3) can be produced via manual or by motor or additional lever rotated by linear actuators, and the range of motion, full lap or start and end points can be in any angular position.
6. The mechanical system (1) according to claim-1, 2, and 3, characterized in that, transmission unit (4) between the input motor (3) and crank-1 (5), and crank-2 (8) can be in various structures, namely

gear box, belt and pulley, rack and pinion, cam and slot, and etc.; the relation between speed and torque (or force) inputs and outputs of the transmission unit (4) can be either linear or nonlinear; and speed and torque (or force) outputs on crank-1 (5) can be either the same or different from said outputs on crank-2 (8).

5

7. The mechanical system (1) according to claim-1, 2, and 3, characterized in that, instead of applying the transmission unit (4) between crank-1 (5) and crank-2 (8), independent additional motor can be applied on crank-2 (8).

10 8. The mechanical system (1) according to claim-1, 2, 3 and 5, characterized in that, motion input may be transferred to connection rod-1 (6) by motor frame connected on crank-1 (5).

9. The mechanical system (1) according to claim-1, 2, 3 and 5, characterized in that, motion input may be transferred to pendulum (9) by motor frame connected on crank-2 (8).

15

10. The mechanical system (1) according to claim-1, 2, and 3, characterized in that, the profile of guideway bearing (7b) is in line, or arc, or spline, or any form.

11. The mechanical system (1) according to claim-1, 2, and 3, characterized in that, the profile of
20 guideway bearing (12b) is in line, or arc, or spline, or any form.

12. The invention is about a method of producing high force and extended working stroke - via rotary drive, characterized that it comprises turning fully or oscillating both of crank-1 (5) and crank-2 (8) at the same time as per a certain mathematical relation in between; as a result, moving axis of joint
25 (10b) and joint (9a) simultaneously as per mathematical relation in between; thus, applying combined motion on pendulum (9).

13. The method according to claim-12, characterized in that it comprises rotating crank-1 (5) fast in the region far from bottom death center of ram-1 (7), in the meantime making crank-2 (8) not move;
30 slowing down crank-1 (5) around bottom death center of ram-1 (7), in the meantime rotating crank-2 (8) the full turn or oscillate; thus moving axis of joint (10b) the while joint (9a) is quasi-static, and followed by moving axis of joint (9a) the while joint (10b) is quasi-static.

14. The method according to claim-12, and 13, characterized in that, dimensioning of the mechanism
35 is done such that, at the rating point zone (working zone) of the stroke of ram-2 (12); joint (10b) is in quasi static equilibrium state; the angle between link (10) and guideway bearing (7b) is close to 90 degrees; and the angle between link (10) and connection rod-2 (11) is close to 90 degrees also; and

resultant magnitude of moment which pushes pendulum (9) to rotate is minimum; thus effort for keeping joint (10b) in quasi static equilibrium state is too less.

15. The method according to claim-12, 13 and 14, characterized in that, link (10) not need to be constructed from rigid material; in order to building additional precaution for overload danger of the reaction forces coming from ram-2 (12); alternatively it can be flexible material; or composed of more than one part such as linear actuator including cylinder - piston powered by any means; or composed of bolt and nut couple; thus, the length of the link (10) can be self-aligning and / or adjustable via changing relative position of joint (10a) with respect to joint (10b);

16. The method according to claim-12, 13, 14 and 15, characterized in that it comprises, blocking ram-1 (7) (thus locking axis of joint (10b)) at bottom death center via break of the motor, a pin movement, gravitational forces, frictional forces, spring forces, hydraulics, pneumatics, electrical devices, and etc., and turning fully or oscillating crank-2 (8) (thus moving the axis of joint (9a)).

17. The method according to claim-12 characterized in that it comprises turning fully or oscillating crank-1 (5), and making crank-2 (8) not move (Thus, moving the axis of joint (10b), and fixing the axis of joint (9a))

18. The method according to claim-12 characterized in that it comprises turning fully or oscillating crank-2 (8), and making crank-1 (5) not move (Thus, moving the axis of joint (9a), and fixing the axis of joint (10b))

19. The method according to claim-12, 13, 14, 15, 16, 17 and 18, characterized in that, speed and torque (or force) outputs on crank-1 (5) can be either the same or different from said outputs on crank-2 (8).

20. The method according to claim-12, 13, 14, 15, 16, 17, 18 and 19, characterized in that, crank-1 (5) and crank-2 (8) either oscillate within the range of start and end angles or complete the full turn depending on the input motions.

21. The method according to claim-12, 13, 14, 15, 16, 17, 18, 19 and 20, characterized in that, in the case of construction requirements, a transmission unit (4), crank-2 (8), pendulum (9), link (10), and connection rod-2 (11) can be applied as symmetric components, as illustrated in the figure.

1/1

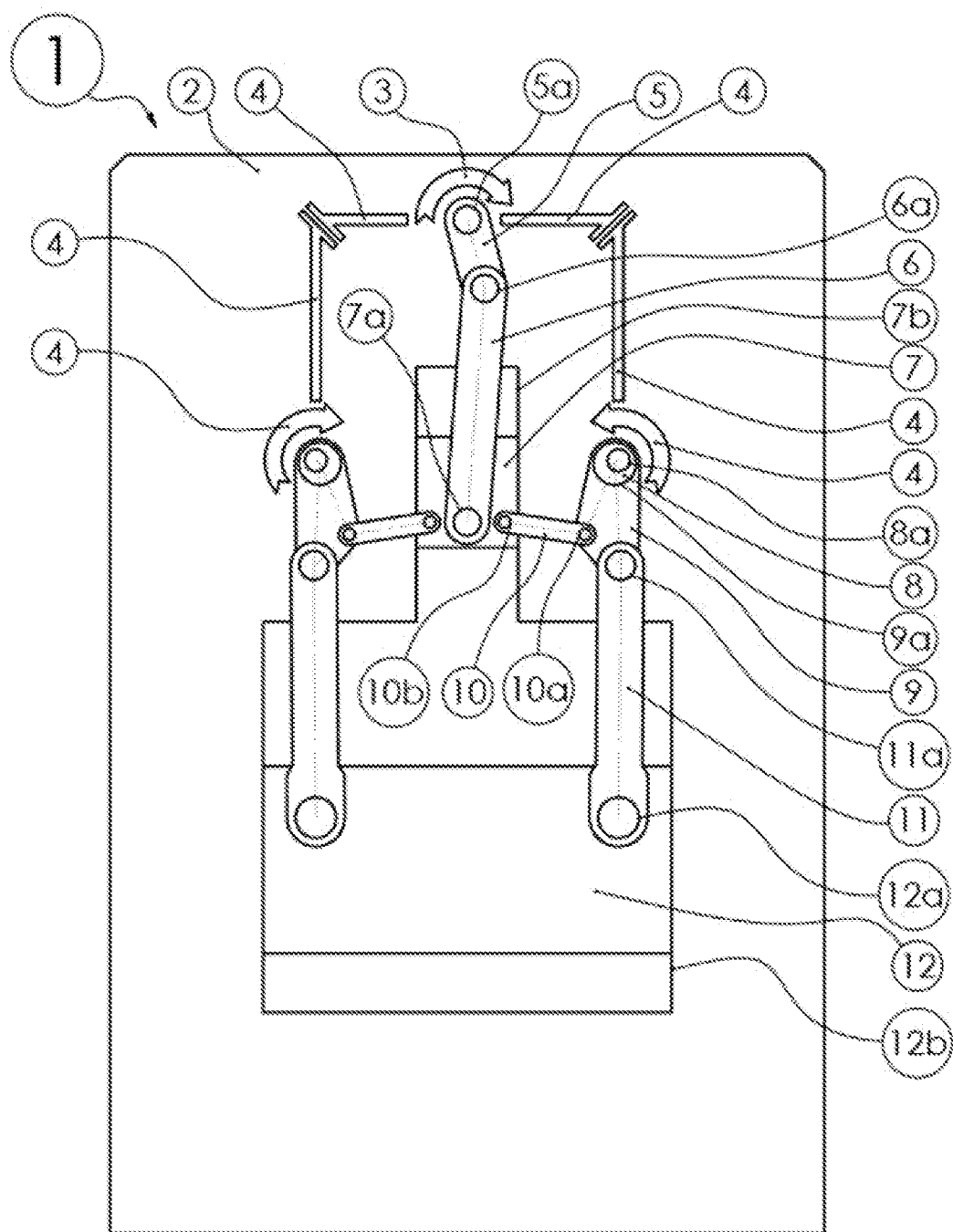


fig.1