May 26, 1953 D. W. COFFIN 2,639,544

TOY ENGINE KIT

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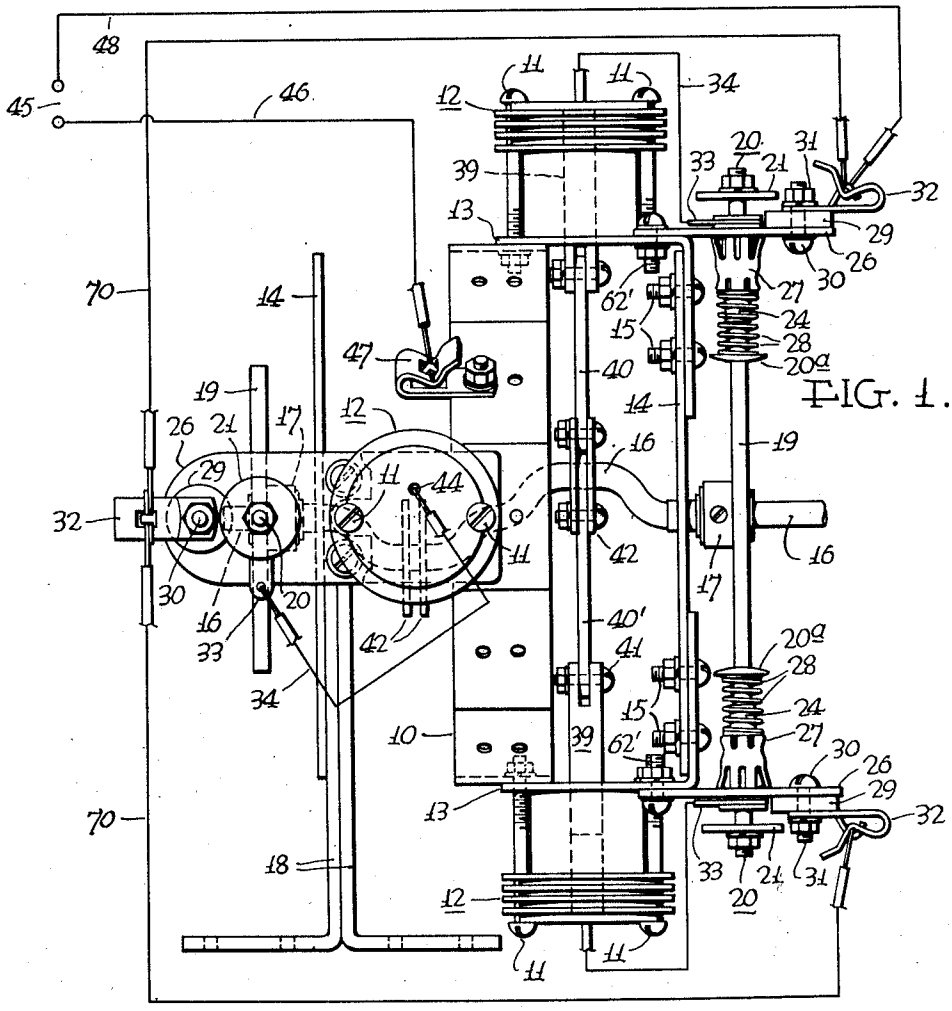


FIG. 1.

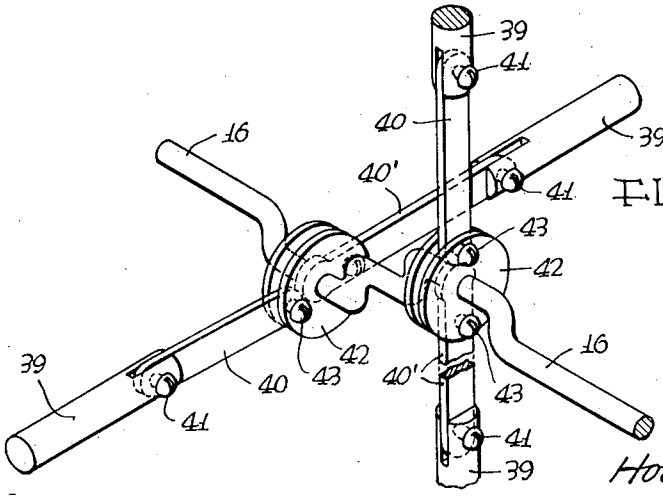


FIG. 4.

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FIG. 2.

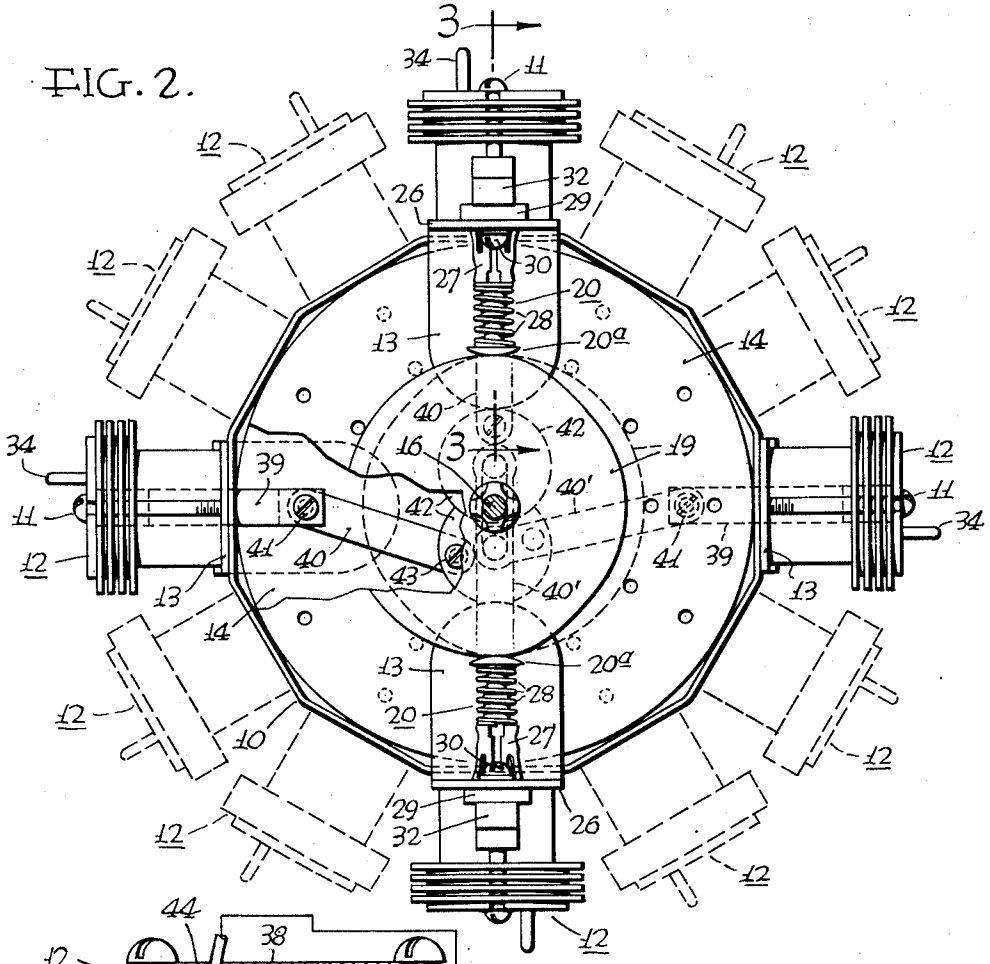
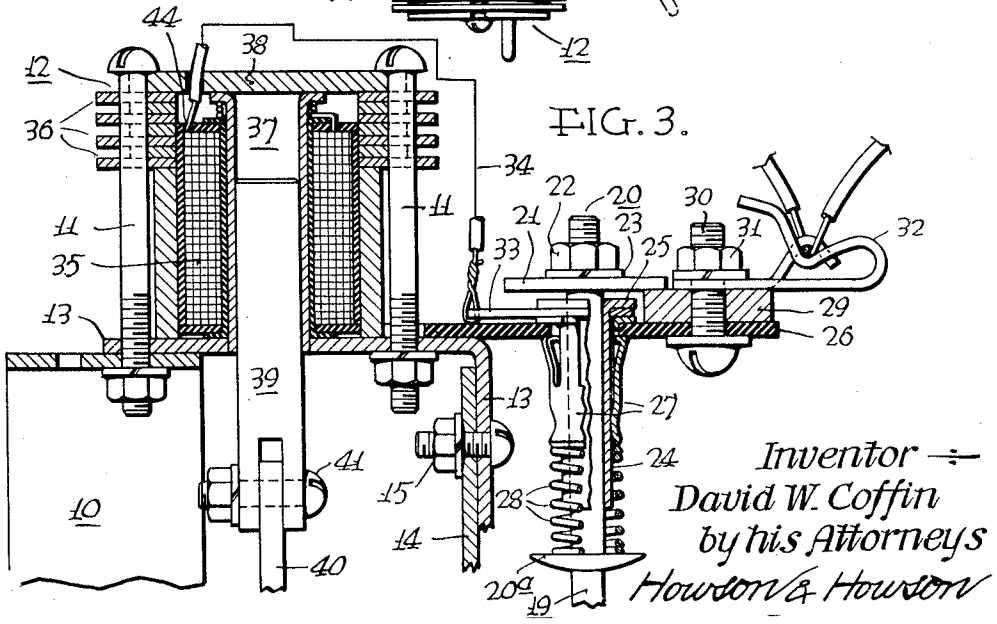


FIG. 3.



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FIG. 5.

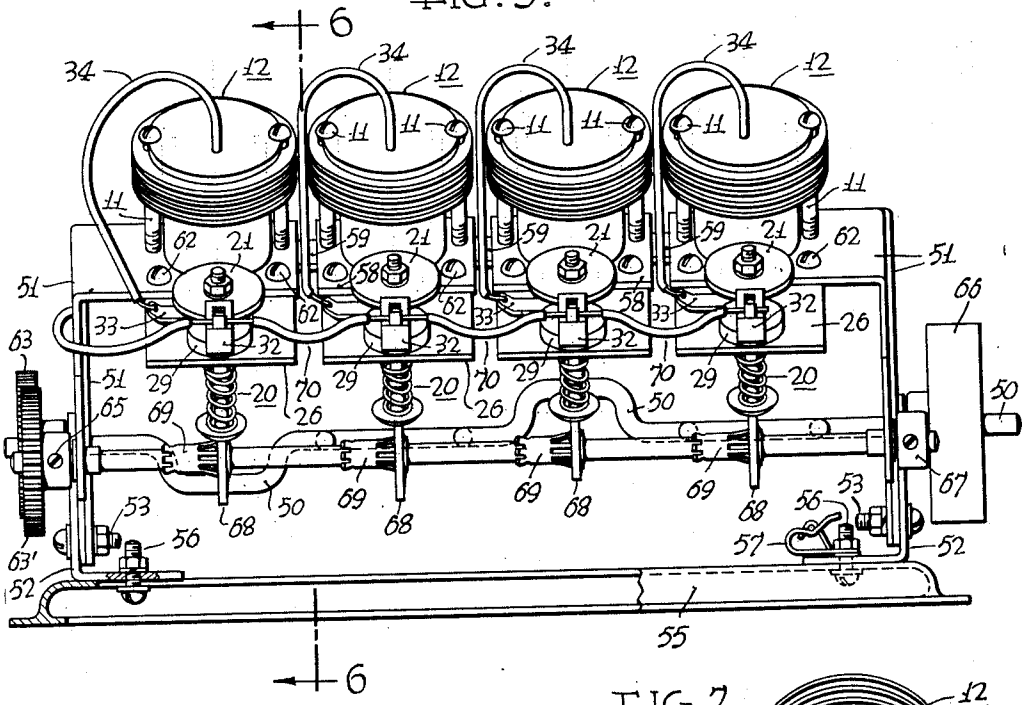


FIG. 7.

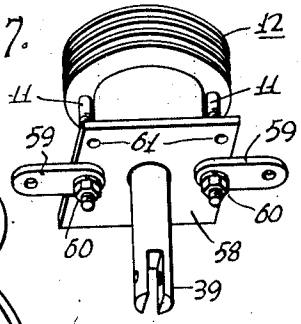
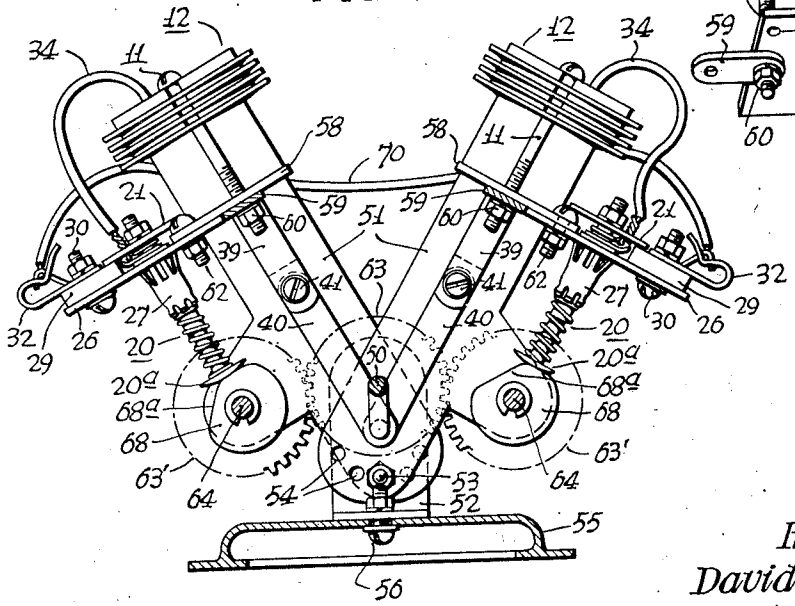


FIG. 6.



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TOY ENGINE KIT

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6 Claims. (Cl. 46—39)

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This invention relates to a toy electric engine and more particularly has to do with an educational assembly adapted to illustrate and teach principles of full size internal combustion engine theory.

The fundamental object of my invention is to provide in kit form, the essential pieces for assembly of imitation internal combustion engines which can be made to run electrically from the standard transformer supplied with mechanical toy sets or electric trains. For this purpose the usual toy electric motor is not satisfactory since the electric motor operates on entirely different principles than does the internal combustion engine and the appearance of such an electric motor cannot be made to simulate the appearance of an internal combustion engine.

A device of this nature must be extremely inexpensive yet workable. It must imitate as nearly as possible the appearance as well as the operation of the particular type of internal combustion engine intended to be copied. It must have a minimum number of parts from which a maximum number of engine types may be assembled within the skill of the average grade school boy. The parts must be inexpensively designed to teach the child as much as possible about the actuation of an internal combustion engine and they must be so arranged when assembled, that the cooperation of the working parts to affect the desired result is obvious. The toy must be completely safe in all respects. Last but not least, the engine must be capable of self-actuation when assembled, since this has the greatest appeal for the youngster.

For the above requirements I have selected a solenoid type of motor such as described in Radtke Patent No. 1,131,614, and Moodyman Patent No. 1,886,040. Such a motor can be made to simulate the appearance and operation of an internal combustion engine by placing the solenoid in the cylinder and using a reciprocating armature to portray the piston of an internal combustion engine. In this way the lead to the solenoid imitates the spark plug wire. Furthermore, the crankshaft, connecting rods, and frame may likewise be assembled and positioned to best educational advantage. While I am aware that solenoid engines of this general nature have been proposed to perform useful work, none of these devices have been intended for educational purposes, and an especially important feature of novelty in my construction resides in the "valve" and camshaft mechanism.

A primary object therefore of the invention is

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to provide an educational toy engine which is simple to manufacture and which may be constructed by children.

A further object of the invention is to provide a toy of the type described which is self-propelled and illustrates to a maximum degree the various parts and functions of an internal cumbustion engine.

A still further object is to provide in a toy of the character described an imitation poppet valve which serves to make and break the electric circuit to the various cylinders.

A still further object is to provide in a toy of the class described, a straight cam shaft on which a cam adapted to operate the "valves" may be frictionally rotated so that the child is enabled to appreciate the effect of valve timing with respect to the piston and the crankshaft of an internal combustion engine.

Further objects will be apparent from the specification and drawings, in which:

Fig. 1 is a side elevation of a radial aircraft engine constructed with the elements of a kit in accordance with the invention and showing the electrical connections;

Fig. 2 is a front elevation of the structure of Fig. 1 with the front plate partially broken away to expose one connecting rod and with a greater number of cylinders shown in broken lines;

Fig. 3 is an enlarged sectional detail seen along the line 3, 3 of Fig. 2;

Fig. 4 is a perspective detail of the crankshaft of Figs. 1 and 2;

Fig. 5 is a side elevation of an eight cylinder type engine using the same cylinders and valve construction but a modified crankshaft, camshaft and frame;

Fig. 6 is a section as seen at 6, 6 of Fig. 5; and Fig. 7 is a perspective showing the bottom of one of the cylinders.

Throughout the detailed description of the drawings, it will be clearer to use internal combustion engine terminology in referring to parts on the toy engine that are intended to simulate or which have the same function as, the corresponding parts of an internal combustion engine. It must be emphasized that the novelty of my construction resides in the ingenious imitation of internal combustion engine theory for educational purposes, and in the provision of inexpensive parts for assembling such an engine rather than in the function of the engine itself. In other words, my contribution is to the educational toy art, not to the internal combustion engine nor the electric motor art.

Since a primary purpose of my invention is to supply a kit from which a wide variety of engine types may be assembled, I have selected the radial type of engine as best illustrating the variety of engine assemblies that can be made. It will be understood, however, that the vertical, in-line, horizontal, V and inverted types can be made up from the same kit of component parts.

Referring now more particularly to Figs. 1 and 2 of the drawings, a radial type engine may be constructed from a twelve-sided polygonal ring 10 which is provided with suitable punched holes to accommodate cylinder hold-down bolts 11 for cylinders 12, and angle brackets 13, 13. Side plates 14, 14 are attached to the brackets 13 by means of screws 15, 15 and together with the member 10 simulate the crankcase of a radial engine. A double-throw crankshaft 16 is journaled in side frames 14 and axially retained therein by means of collars 17, 17. A suitable bracket or supporting leg 18 may be bolted to either plate 14 so that the motor may be mounted on a base.

Fig. 2 shows in end elevation a four cylinder radial engine in which the cylinders are set at 90° apart. In broken lines, 8 additional cylinders are shown, any one or all of which may be added as an optional form. The radial assembly contemplates staggered cylinders when more than two cylinders are installed. Fig. 1 shows how the cylinders are arranged alternately on the flats on ring 10. The maximum number of flats provided in the present form is twelve so that two banks of staggered cylinders, six cylinders per bank may be provided. Obviously a larger ring may be supplied for a greater number of cylinders if desired.

The crankshaft 16 extends axially beyond plates 14 and carries, in the case of an assembly having more than one bank of cylinders, a fibre cam 19 at each end of the crankshaft. The radial engine cams 19 are of the same contour at each end of the crankshaft but in all forms the cam itself is made of a dielectric material such as Bakelite or fibre since one electrical lead is grounded to the frame.

The valve construction, more clearly shown in Fig. 3, comprises a long, button-head rivet 20 which is turned down at one end to provide a shoulder for washer 21 retained thereon by means of nut 22 and lock washer 23. The valve guide 24 is outwardly flanged at 25 and is retained in dielectric bracket 26 by means of a spring collar 27. The valve spring 28 abuts the end of collar 27, and the head 20*a* of valve 20. The valve seat 29 is an electrical conductor and is retained on member 26 by means of screw 30 and nut 31 which also retains spring binding post 32. Electrical contact to the valve is made through an elongated washer 33 to which is attached insulated wire 34. It will thus be apparent that when the "valve" or rivet 20 is closed, the electrical circuit is closed between the clip 32 and wire 34 whereas when the valve is raised by means of cam 19, the circuit is open. The washer 21 actually simulates the head of the conventional poppet valve, and the assembly of the valve guide 27, as well as the valve spring 28 is roughly similar to internal combustion engine practice. Each valve assembly is identical and the valves are used in all types of engines so that it is unnecessary to describe them in connection with other forms.

Each cylinder 12 has a coil or solenoid 35 axially positioned therein and is provided with imitation cooling fins 36. The cylinder wall 37 is retained in the assembly by means of cylinder head 38 and cylinder bolts 11. The piston 39, which acts as the armature for solenoid 35, is pivotally attached to connecting rod 40 by means of wrist pin 41, and to bearing plate 42 by means of crank pin 43 (Fig. 4). Additional holes in bearing plate 42 may be provided to accommodate added cylinders and connecting rods. In order to insure correct timing of the pistons, one of the connecting rods 40' may be elongated to surround the crankshaft 16, thus preventing relative movement of the bearing plate 42 with respect to connecting rod 40'.

Insulated wire 34 is connected to the solenoid 35 at 44 (Fig. 3) and extends through the top of the cylinder head 38 to imitate a spark plug. A convenient source 45 of electrical current (Fig. 1) may be the usual 6–12 volt transformer. One lead from the transformer is grounded to the frame 10 through lead 46 and spring binding post 47, whereas the other lead 48 is connected to the binding post 32 for each cylinder as shown in Fig. 1.

Figs. 5–7 illustrate a V-type engine which may be assembled from the same cylinders 12 and valve assemblies 20, 20. There are eight cylinders shown in the engine of Figs. 5 and 6 and for this purpose a four-throw crankshaft 50 is journaled in end frames 51, 51. The end frames 51 are in turn bolted to angle brackets 52, 52 by means of bolts 53, 53 and a plurality of holes 54 in each one of the end frames permits limited variation of the angle enclosed between the cylinder banks. Brackets 52 are mounted upon a slotted base 55 by means of bolts 56, one of which also accommodates the spring binding post 57 for the ground connection.

Brackets 51, 51 directly support the end cylinders 12, 12 in each bank by means of cylinder bolts 11 whereas intermediate cylinders 12, 12 are mounted on plates 58, 58 (Fig. 7) which are longitudinally connected to brackets 51 of adjoining plates 58 by means of links 59, 59. The links are mounted on cylinder bolts 11 under plate 58 by means of nuts 60. Plates 58 are also provided with a pair of apertures 61 adjacent one edge in which the valve members 26, 26 are mounted by means of bolts 62, 62.

Crankshaft 50 is provided at one end with a timing gear 63 which meshes with camshaft timing gears 63', 63' mounted on camshafts 64, 64 by means of set screws 65. The opposite end of crankshaft 50 carries a flywheel 66 to provide smooth operation for the engine and also to simulate full scale practice. The camshafts 64 are straight and are axially retained in the frames 51 by means of collar 67 and are provided with a plurality of cams 68, 68 having flats 68*a*. The cams 68 are of a dielectric material such as fibre and are resiliently pressed onto spring sleeves 69 with sufficient force to prevent relative rotation of the cams and the camshaft during engine operation, but at the same time enable the cams to be individually timed during assembly of the engine by rotating the sleeves 69 with respect to each camshaft 63.

The construction and operation of the connecting rods 40, 40' may be identical to that shown in Fig. 4, but in the preferred embodiment bearing plate 42 is omitted, which in turn dispenses with the necessity of the elongated connecting rod 40'. It will be understood that the construction of Fig. 4 corresponds generally to conventional internal combustion engine practice in which a master connecting rod is journaled on

the crank throw but the other connecting rods are journaled to the master rod.

The spring binding post 57 serves as the ground terminal corresponding to binding post 47 and it will be understood that the connections 70 are made in substantially the same way that the electrical connections of Fig. 1 are shown. Obviously, a smaller number of cylinders may be assembled by sliding frames 51, 51 longitudinally closer together and the same base member may be advantageously used for a vertical engine assembly as well.

It will thus be understood that the primary purpose of the invention is to provide an additional construction kit from which over sixty different types of engines can be assembled depending upon the number and arrangement of the cylinders. For the purpose of clarity, only illustrative engine forms have been shown herewith, but the ability to assemble a wide variety of engine forms from a minimum number of parts and to provide an operating engine is an important feature of the invention. Special emphasis is directed to the dielectric cams and the ability to adjust the cams on the cam shaft or the crankshaft, as the case may be. The poppet type of valve which electrically performs a function similar to the poppet valve of an internal combustion engine is a distinct feature of novelty in such a construction toy.

I claim:

1. A construction toy kit comprising a plurality of imitation internal combustion engine parts from which a variety of imitation internal combustion engine types may be assembled, said kit including imitation engine cylinders; a solenoid contained within each imitation cylinder; a a sleeve axially mounted within each solenoid to form an imitation cylinder wall therein; a plurality of armatures to imitate internal combustion engine pistons, one of said armatures to be mounted within each of said imitation cylinder walls for reciprocation therein; a plurality of brackets for mounting said imitation cylinders, solenoids, and cylinder walls; an open frame on which said brackets and the parts assembled thereon may be removably mounted for assembling said parts to simulate an internal combustion engine; a plurality of dielectric cams to simulate the valve-actuating cams of an internal combustion engine; a plurality of dielectric brackets to be mounted on said frame, one adjacent each of said imitation engine cylinders; a plurality of imitation poppet valves, one to be mounted on each of said last-mentioned brackets adjacent one of said imitation cylinders and to be reciprocated by said dielectric cams, each of said imitation poppet valves including an electrical conducting portion; an imitation crankshaft to be journaled in said frame and to be connected to said armatures to be rotated by said armatures as they reciprocate within said imitation cylinder walls, rotation of said crankshaft rotating said dielectric cams to cause reciprocation of said imitation poppet valves; and spaced electrical contacts to be connected to a source of electrical energy and to said solenoids and to be opened and closed by the conducting portions of said imitation poppet valves as said imitation poppet valves are reciprocated by said dielectric cams to effect alternate actuation of said solenoids to simulate alternate operation of the cylinders and pistons of an internal combustion engine.

2. A construction toy kit comprising a plurality of knock-down imitation internal combustion engine parts from which an imitation internal combustion engine may be assembled, said kit including an open framework to simulate an engine crankcase; at least one imitation internal combustion engine cylinder to be mounted on said framework; a solenoid contained within each of said cylinders; an imitation cylinder head for each of said imitation cylinders; means for attaching and detaching each imitation cylinder, solenoid, and cylinder head to said framework; an armature reciprocable in the bore of each solenoid to simulate the piston of an internal combustion engine; an imitation crankshaft to be journaled in said framework and to be connected to each armature, said imitation crankshaft having crank portions each in alignment with the bore of at least one of the solenoids when said imitation crankshaft is journaled in said framework; an imitation connecting rod to be pivotally secured to each armature and to a crank portion of said imitation crankshaft, said imitation connecting rods being clearly visible and accessible through said framework when the imitation engine is assembled; means for attaching and detaching said imitation connecting rods one to each of said armatures and to the crank portions of said crankshaft; an imitation poppet valve to be slidably and visibly mounted on said framework adjacent each imitation engine cylinder mounted thereon; a valve spring for each of said imitation poppet valves simulating the valve springs of an internal combustion engine; cam means operated by said imitation crankshaft for reciprocating said imitation poppet valves in timed relation to rotation of said imitation crankshaft; electrical contacts to be operated by reciprocation of each imitation poppet valve to energize and de-energize said solenoids to cause said armatures to simulate the operation of the pistons of an internal combustion engine, each of said contacts to be included in an electrical circuit; and electrical connections from each of said contacts to one of said solenoids, said connections being controlled by said imitation poppet valves and passing through said imitation cylinder heads to simulate the appearance of the spark plug of an internal combustion engine.

3. A construction toy kit in accordance with claim 2 in which the framework is polygonal and in which one of the said imitation cylinders and associated parts is assembled on each of the flat sides of said framework to thus simulate a radial type internal combustion engine.

4. A construction toy kit in accordance with claim 2 in which the connections from said contacts to said solenoids pass through the imitation poppet valves when said valves are in positions simulating the closed positions of the poppet valves of an internal combustion engine to thus energize said solenoids to cause movement of said armatures in one direction, and wherein said imitation poppet valves when in positions simulating the open positions of the poppet valves of an internal combustion engine de-energize said solenoids to permit said armatures to be moved in the opposite direction.

5. A construction toy kit comprising a plurality of knock-down imitation internal combustion engine parts from which an imitation internal combustion engine may be assembled, said kit including an open framework; a plurality of imitation internal combustion cylinders to be detachably mounted on said framework; a plurality of

solenoids, one contained within each imitation cylinder; means for selectively attaching and detaching said cylinders to the framework; a plurality of imitation internal combustion engine pistons, one to be mounted within the bore of each solenoid for axial reciprocation therein; a dielectric cam to be journaled in said framework to imitate the valve actuating cam of an internal combustion engine; a plurality of imitation poppet valves, one to be slidably mounted on said framework adjacent one of the imitation internal combustion engine cylinders to be reciprocated by said cam, said imitation poppet valves each including an electric make and break mechanism, to be connected in an electric circuit connected to a source of electrical energy; electrical connections between the make and break mechanism of each imitation poppet valve and its adjacent imitation engine cylinder and connected to the solenoid therein; and means including a crankshaft rotated by reciprocation of said imitation pistons for rotating the dielectric cam in timed relation to movement of the imitation pistons, said cams actuating said imitation poppet valves and said electric make and break mechanism alternately to energize and de-energize said solenoids.

6. A construction toy kit comprising a plurality of knock-down imitation internal combustion engine parts from which an imitation internal combustion engine may be assembled, said kit including a plurality of imitation internal combustion engine cylinders; a plurality of angle brackets; means including screws and perforated plates for connecting the angle brackets to form an open framework; means for mounting said imitation internal combustion engine cylinders on said framework; a plurality of solenoids one within each of said imitation internal combustion engine cylinders; a plurality of armatures, one reciprocable within the bore of each of said imitation internal combustion engine cylinders to simulate the pistons of an internal combustion engine; an imitation crankshaft to be journaled in said framework; imitation connecting rods

each having one end connected to one of said armatures and its other end to be connected to said crankshaft; means including screws and circular bearing plates for connecting said other ends of said connecting rods to said crankshaft; a cam operatively connected to said crankshaft to imitate the valve actuating cam of an internal combustion engine; a plurality of imitation poppet valves each mounted on said framework adjacent one of said imitation internal combustion engine cylinders and each having a head slidably mounted in the framework and actuated by said cam to simulate the operation of a poppet valve of an internal combustion engine; a source of electrical energy for actuating said imitation internal combustion engine; and electrical connections between said source of electrical energy and the solenoid within each of said imitation cylinders, one of said connections leading through the imitation poppet valve operatively associated with each imitation cylinder and being made and broken by said associated imitation valve as said imitation valve is moved by said cam to simulate closed and simulated open positions, respectively, said imitation valve when in simulated closed position closing said connection and supplying electrical energy to its associated solenoid to energize the same and when in simulated open position, opening said connection and breaking the supply of electrical energy to said associated solenoid to de-energize the same.

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