March 20, 1928. 1,663,261

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ENGINE

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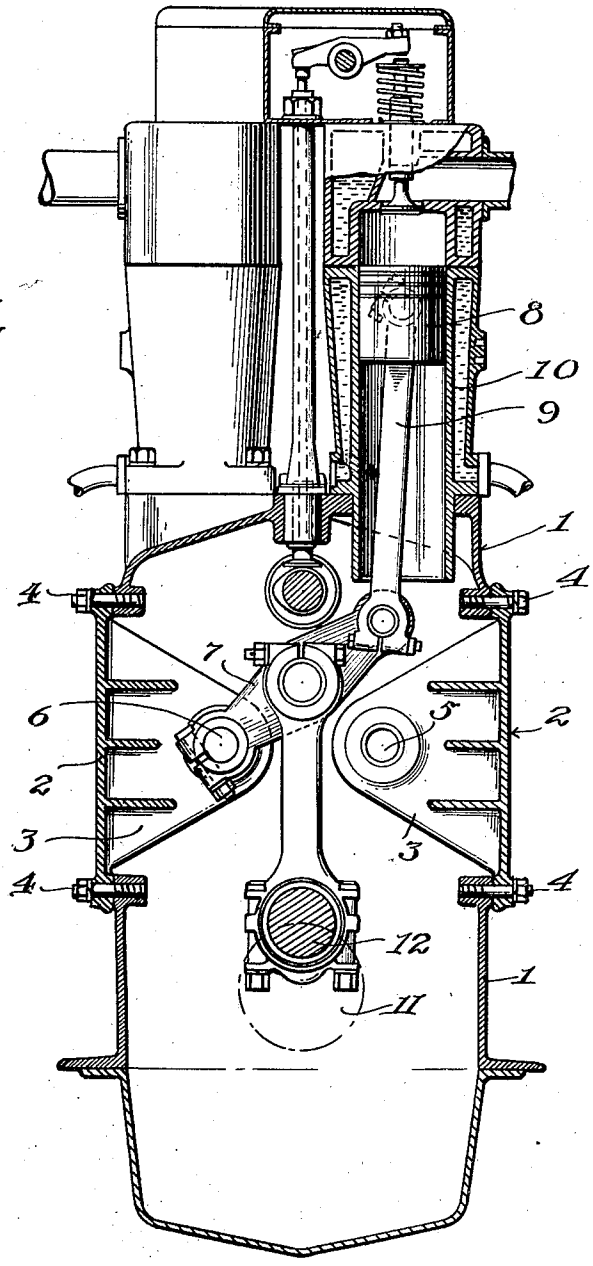
Fig. 1.



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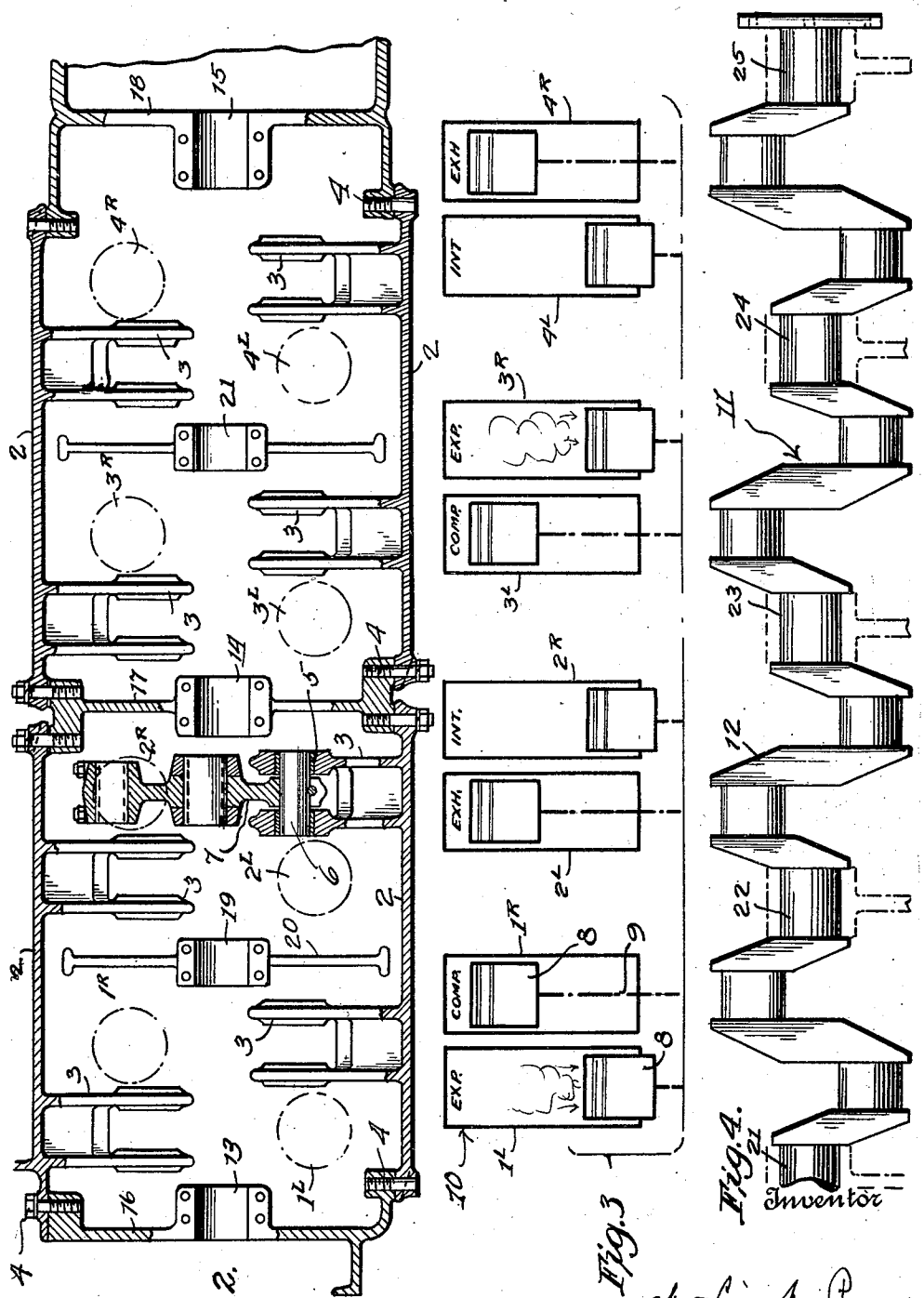

Fig. 2.

Fig. 3

Fig. 4.

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UNITED STATES PATENT OFFICE.

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ENGINE.

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The invention relates to engines and especially to that type of internal combustion engine shown and described in my United States Patent #1,384,343, granted July 12, 1921. The present invention is an improvement in the construction shown in that patent and consists in the arrangement of the cylinders and in the firing order thereof so as to insure a compact and well-balanced engine. The arrangement of cylinders and the firing order thereof, while shown in conjunction with the particular engine disclosed in the above mentioned patent, may be used in an engine with or without the power transmitting members shown in the said patent.

In the conventional engine, only one cylinder fires at a time. The result is that the crank shaft is twisted back and forth by the torsional strains creating vibrations which are annoying as well as detrimental to the engine. In the present construction, I propose to provide two banks or rows of cylinders and to explode the charges in a cylinder of each bank at the same time. When these cylinders are placed at a considerable distance apart, the torsional strains occur at two points on the crank shaft, which decreases the torsional vibrations to a minimum.

By such an arrangement of parts and the above mentioned firing order of the cylinders, an exceedingly compact and powerful engine may be constructed. To provide, for instance, eight cylinders, four in each bank, would have many advantages over an engine with four cylinders, each having double the capacity of one of the eight cylinders. The eight cylinder engine would be easier to cool on account of the increased radiating surface of the cylinders and by decreasing the torsional vibrations to a minimum, the arrangement is ideal.

By providing two banks of cylinders, the length of the engine is not materially increased, and by providing the cylinders in staggered relation, the breadth is no greater than if a single row of cylinders were employed.

With these ends in view, my improvements include elements, and combinations of elements which are illustrated in their preferred embodiment in the drawings accompanying this specification wherein:—

Figure 1 is a vertical view, partly in cross section, of the engine;

Fig. 2 is a plan sectional view showing the location of the cylinders in dotted outline and of the crank case and one power transmitting lever in full lines;

Fig. 3 is a diagram showing the firing order of the cylinders; and

Fig. 4 is a longitudinal view of the crank shaft.

The invention is shown herein as embodied in an engine employing eight cylinders, two banks being provided, each having four cylinders therein, although the principles thereof are in the main applicable to any even number of cylinders.

Referring more particularly to the drawings, 1 represents a crank case having inserts 2 consisting of rectangular plates carrying inwardly extending bifurcated supports 3. Suitable means, such as the bolts 4, are provided whereby the plates 2 may be suitably secured to the crank case 1. Aligned apertures 5 extend through the supports 3 and provide a bearing for a pin 6, which pin serves as a fulcrum point for a lever 7, which lever is at its other end connected to the piston 8 by means of a connecting rod or piston 9, which piston is slidable in a water jacketed cylinder 10.

A crank shaft 11, having cranks 12, is carried in the lower portion of the crank case 1, being supported by bearings 13, 14, and 15, which bearings are in turn carried by laterally extending portions 16, 17, and 18 of the crank case 1. Located midway between the bearings 13 and 14 is a bearing 19 carried by an upstanding portion 20 extending from the bottom of the crank case 1. A similar bearing 21 is provided intermediate the bearings 14 and 15, the crank shaft being provided with aligned bearing surfaces 21, 22, 23, 24, and 25, adapted to be carried in the bearings 13, 19, 14, 21, and 15, respectively.

The cylinders are arranged in two rows or banks, which banks extend longitudinally of the engine on the opposite sides of the perpendicular plane passing through the

axis of the crank shaft. The cylinders on the lefthand side of the engine are denoted by the reference characters 1^L, 2^L, 3^L, and 4^L, respectively, and those on the righthand side are denoted by the reference characters 1^R, 2^R, 3^R, and 4^R, respectively. A fulcrum support 3 is provided in the same transverse plane with each of the cylinders. It is to be noted that the cylinders of one bank are arranged in staggered relation with the cylinders of the other bank, any three adjacent cylinders, (two in one bank and one in the other bank) forming the vertices of a triangle.

Any one or more of these cylinders could be fired at any given time, but I have found that the torsional effects on the crank shaft are minimized or practically eliminated by firing the explosive charges in two cylinders simultaneously spaced a substantial distance apart.

In my preferred construction, the firing order of the cylinders is as follows:—

1^L and 3^R simultaneously;
3^L and 1^R simultaneously:
4^L and 2^R simultaneously; and
2^L and 4^R simultaneously.

It is to be noted that in the above mentioned firing order one of the cylinders in one bank explodes simultaneously with one of the cylinders in the other bank, and that these two cylinders are spaced apart by a distance at least equal to one-half the length of the crank shaft. At least two cylinders are interposed between the two cylinders that are firing. The above mentioned firing order is the one which I have found to be the best, but the essential point is that the two cylinders which fire simultaneously should be spaced apart longitudinally of the crank shaft by a considerable distance. If only six cylinders are used, I would recommend the following firing order:—

1^L and 2^R simultaneously;
1^R and 3^L simultaneously; and
2^L and 3^R simultaneously.

Referring to Fig. 4, it is to be noted that all of the cranks 12 of the crank shaft are in the same plane. Fig. 3 represents a diagram showing the order of the explosions. If Fig. 3 is taken in conjunction with Fig. 4, it will be seen that the pistons in Fig. 3 are directly above the respective cranks with which they would be connected in Fig. 4.

While I have shown my preferred construction by way of an example, it is obvious that many changes may be made in the specific structure herein shown without departing from the spirit of the invention. I, therefore, do not limit myself to the specific structure shown, except as I may limit myself in the following claims.

What I claim is:—

1. An engine having two rows of cylinders, the plane passing through the axes of the cylinders of one row being parallel to the plane passing through the axes of the cylinders in the other row and means for firing explosive charges in two of said cylinders simultaneously said last mentioned cylinders being spaced apart by a distance at least equal to one-half the length of the engine so that the engine is almost perfectly balanced.

2. An engine having two rows of cylinders, the cylinders of one row being arranged in staggered arrangement with relation to the cylinders of the other row and means for firing explosive charges in two of said cylinders simultaneously said last mentioned cylinders being spaced apart by a distance at least equal to one-half the length of the engine so that the engine is almost perfectly balanced.

3. An engine having two rows of cylinders, the cylinders of one row being arranged in staggered arrangement with relation to the cylinders of the other row, said cylinders having a firing order whereby the explosive charges in two of said cylinders are fired simultaneously said last mentioned cylinders being spaced apart by a distance at least equal to one-half the length of the engine so that the engine is almost perfectly balanced.

4. An engine having two rows of cylinders, the cylinders of one row being arranged in staggered arrangement with relation to the cylinders of the other row, said cylinders having a firing order whereby the explosive charges in one cylinder of each row are fired simultaneously the firing cylinders being spaced apart so that at least two cylinders are interposed between the cylinders that are firing whereby a balancing of the engine is obtained.

5. An engine having a plurality of cylinders in two banks, the plane passing through the axes of the cylinders of one bank being parallel to the plane passing through the axes of the other bank, pistons therein, a crank shaft, means operatively connecting said pistons and crank shaft, the firing order of said cylinders being such that the charges in two cylinders fire simultaneously, such firing cylinders being spaced apart by a distance equal to at least one-fourth the length of the crank shaft whereby the unbalanced vibrations of the engine are neutralized.

ALVAH LEIGH POWELL.