J. OAKLEY.

PRODUCTION OF CONNECTING RODS AND SIMILAR MACHINE PARTS.

APPLICATION FILED MAY 29, 1920.

1,400,829. Patented Dec. 20, 1921.

Fig. 1.

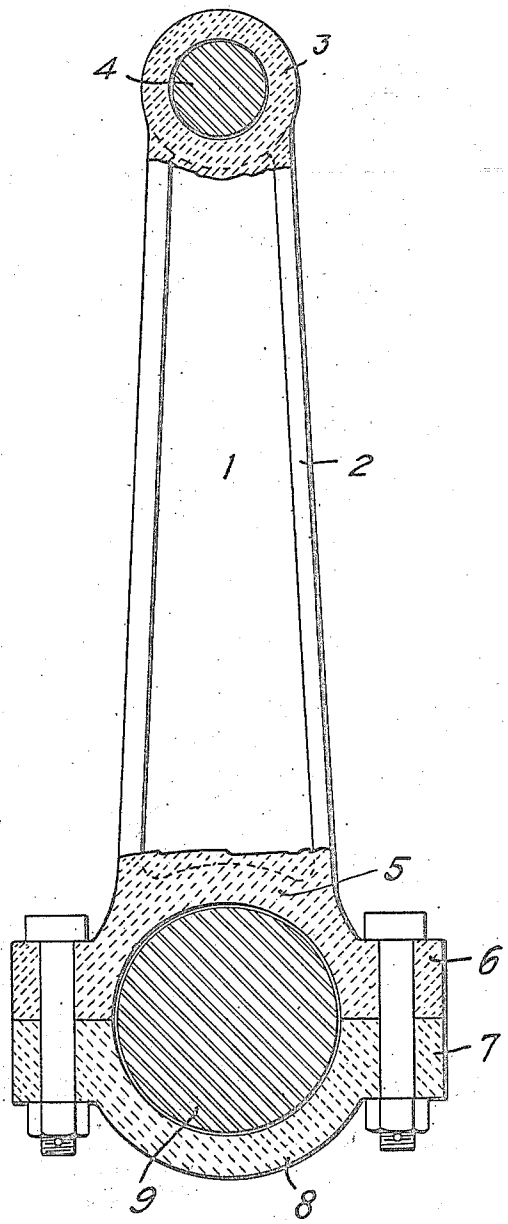
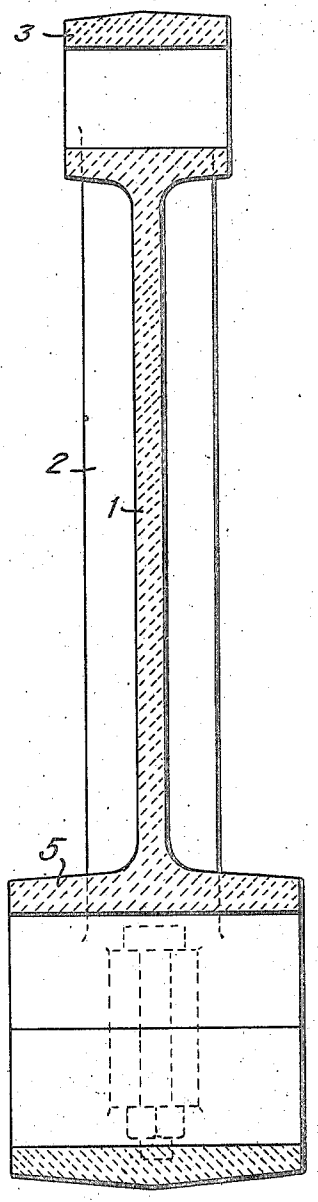


Fig. 2.



INVENTOR

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BY

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PRODUCTION OF CONNECTING-RODS AND SIMILAR MACHINE PARTS.

1,400,829. Specification of Letters Patent. Patented Dec. 20, 1921.

Application filed May 29, 1920. Serial No. 385,174.

To all whom it may concern:

Be it known that I, JOHN OAKLEY, a citizen of the Kingdom of Great Britain, and resident of Springfield, Massachusetts, have invented certain new and useful Improvements in the Production of Connecting-Rods and Similar Machine Parts, of which the following is a specification.

My invention provides an improved connecting rod or similar machine part having a rotary or oscillatory connection with adjacent parts of the machine and subjected to various strains in use, and is directed particularly to the connecting rods between the pistons and the cranks of an automobile or similar internal combustion engine; the improvement being in the composition of such rods and in their combination with other parts.

For many years aluminum and alloys thereof have been used to a greater or less extent, but no such alloy has been thought to be adapted for use in the making of connecting rods and the like, having the necessary physical qualities to make a connecting rod which should be strong enough to stand the shocks and strains of use and which could be readily machined to the accuracy required in practice. I have found that there are certain alloys of aluminum which by an appropriate method of manufacture and treatment can be made into connecting rods which will have the durability and strength of steel and will be very much lighter with little or no increase in cost of the finished article, taking into consideration the great saving in the cost of cutting or machining.

I have found also that such metal is peculiarly useful in that it can be used without babbitting its bearings on the wrist pin and crank pin, being itself a good bearing metal with a higher resistance to abrasion than ordinary Babbitt metal. These qualities make such a connecting rod greatly desired for automobiles where lightness is of importance in proportion of strength. The connecting rods in automobiles are subjected at each operation to a downward blow at their upper ends from the sudden expansion in their cylinders and to an upward blow from the crank pins against the resistance of the gas to be compressed, and being of considerable length they are liable also to the bending strain on a columnar structure. Thus they have to be made strong and of a considerable cross-section, so that a reduction in the unit weight of the metal employed means a considerable reduction in the total weight. When we add the comparatively frictionless bearing quality of the metal it will be seen that connecting rods thereof are considerably superior to those of steel. A specific example of the composition and method of manufacture which I prefer is the following.

An alloy is used consisting of aluminum 94%, magnesium 0.5% and the balance chromium, manganese and copper in varying proportions. The chromium is less important than the other ingredients, but is useful in producing a good polished wearing surface. This alloy is cast into ingots, worked as by rolling or forging into billets and then cut and further forged, preferably drop-forged, into blanks. Such forging or otherwise working of the metal increases its tensile strength (which measures its resistance to bending) as, for example, from 27,000 pounds per square inch to 36,000 or as high as 40,000 pounds.

The forged blanks are then heated to a temperature approximating 500 to 525 degrees centigrade and then quenched. It is found that this heat treatment increases the physical qualities very substantially. For example, alloy having beforehand an ultimate tensile strength of 36,000 pounds per square inch, will have its strength increased to 55,000 or 60,000. The elastic limit will be raised from 25,000 pounds per square inch, to 36,000, the elongation from 2 to 20% and the reduction of area under strain from 6 to 40%. There is thus produced a metal having the strength of steel with the comparatively frictionless quality of good bearing metal and a weight very much less than either of these metals,—about one-third as great in fact.

The heat treatment is not completely effective at once. It requires an aging of the metal for a period of one to five days in order to bring it to the desired physical characteristics. I prefer after the heat treatment to again forge or press the blank and then to machine it along the faces which require to be accurately or nicely finished, in which operation I include the boring of the ends to fit their pins. The aging of the metal after the heat treatment serves also to bring it to a condition in which it machines or cuts better than before. The machining may be done before the aging is

complete but it can be done better afterward. The ease with which the metal can be machined is an important consideration in economy of the product. Although the metal itself costs several times as much as steel, yet the machining operations on a connecting rod will cost so much more for steel than for this improved alloy as to bring the total cost of manufacture of the alloy connecting rod to a point which makes it a commercial competitor of a steel rod.

There are considerable variations possible in the composition of the aluminum alloy and in the proportions of the components. The important thing is to use such an alloy as will be capable of transformation by hea treatment into a metal of comparativel high strength and elastic limit, though it consists chiefly of aluminum and weighs little more than aluminum.

The aluminum alloys above referred to and the heat treatment thereof have been known for a number of years, examples of the same being described in Wilm Patents No. 1,130,785 filed in 1911 and 1,261,987 filed in 1912. They have not been used however, for connecting rods or any similar machine parts, although throughout this period numerous efforts have been made especially in the automobile industry to lighten the engine and to cheapen it by a reduction in the cost of bearings.

I have found by experiment that the connecting rods for such engines made as above described have not only the known qualities of lightness and strength but also a quite unexpected resistance to bending under the shock of compressive strains and a resistance to abrasion and a smoothness or lack of friction which make them not only practicable but very much superior to connecting rods of steel; and the economy involved in machining operations has been unexpectedly great and sufficient to make them a commercial success.

Another feature of unexpected but considerable importance is the silence with which they work in engagement with the pins at either end. It is a common criticism of automobile engines, that, especially after a short period of use, the wear of the pins or of their bearings in the connecting rods causes a tapping in the engine. With my improved connecting rods the noise of engagement of the parts is very greatly less than with other metals.

The best results have been obtained with an excessive working of the alloy in making the billet or the blank, and the alloy referred to lends itself advantageously to such operations. For example, in the making of the connecting rods referred to I have rolled and forged the metal down to one-third or one-fourth of the original cross-section. This has produced a dense, tough, fibrous structure excellently adapted for use in connecting rods and similar parts and well capable of being cut readily by ordinary steel cutters which could not possibly be used for cutting hardened steel.

The accompanying drawings illustrate a connecting rod made in accordance with my invention, Figure 1 being a side elevation with the ends in section and Fig. 2 being a transverse longitudinal section.

The connecting rod is formed with the usual web 1 and flanges 2 and boss 3 at its upper end apertured to receive the wrist pin 4 connected to the piston of the engine. At its lower end is a larger boss 5 with flanges 6 for attachment to the flanges 7 of a cap 8, the boss and cap being bored to provide a circular opening for the crank 9.

The pins 4 and 9 are indicated as of steel but they may be made of other metal and even of the same aluminum alloy as the connecting rod, it being a peculiarity of this alloy that the friction between two pieces of the same alloy is no greater than it is between this alloy and steel; contrary to the general rule that friction is greater between two pieces of the same metal than between two pieces of different metals.

The cap 8 is preferably made of the same aluminum alloy as the connecting rod proper, as indicated on the drawing, but this cap also may be made of other metals.

The hub 3 is bored to a close working fit for the pin 4, without the intermediation of the babbitt or bearing metal usually interposed between such parts in the better class of machines. I have found that with this aluminum alloy the bore can be made very exact and smooth and the bearing end of the rod can oscillate on the pin with the same ease as a well babbitted bearing. Any usual or suitable arrangement of oil grooves may be provided. The lower end of the rod has a similar bearing fit on the crank pin and permits the same smooth and easy rotation of one part with relation to the other. Even when the parts wear in use sufficiently to produce a slight play of the pins in their bearings, the contact of the pins with the rod of this alloy will be found to make less noise than in the case of most similar bearings.

In the manufacture of this connecting rod the rough forging will be of excessive size so as to permit the planing and boring to exact dimensions and finish on those faces where an exact fit or a smooth finish is desired; such for example as the end faces of the bosses 3 and 5 and the interior bores of these parts and preferably also the outer faces and edges of the flanges 2. For the cap 8 the interior bore and the bearings for the bolts and nuts and also the side edges, (right and left edges in Fig. 2) should be machined to an exact dimension. And the

meeting faces of the boss 5 and the cap 8 should also be finished exactly. All these machining operations are accomplished with the greatest ease with this aluminum alloy; and thereby a great saving in cost is effected as compared with similar operations on steel connecting rods.

An important advantage of the use of this connecting rod for engines is the extremely smooth and rapid acceleration and retardation of the engine and of the rapidly reciprocating parts thereof, owing to the lessened inertia and momentum by the great elimination of dead weight; such elimination being as high as 60 or 70 per cent. over connecting rods and similar reciprocating parts now commonly used.

Though I have described with great particularity of detail a specific design of connecting rod and a particular composition and method of manufacture, yet it will be understood that the design may be varied and the composition and methods described may be departed from by those skilled in the art without departure from the invention as defined in the following claims.

What I claim is:

1. A connecting rod or the like made of an aluminum alloy of the class described consisting mainly of aluminum so as to be approximately as light as this metal and which has been worked and heat-treated to increase its density, tensile strength and elastic limit.

2. A connecting rod or the like made of an aluminum alloy of the class described consisting mainly of aluminum so as to be approximately as light as this metal and which has been worked and heat-treated to increase its density, tensile strength and elastic limit, in combination with a pin having a bearing in one end of said rod and in direct contact therewith.

3. A connecting rod or the like made of an aluminum alloy of the class described consisting mainly of aluminum so as to be approximately as light as this metal and which has been worked and heat-treated to increase its density, tensile strength and elastic limit, in combination with a cap of the same alloy worked and heat treated in the same way, the contacting faces of the rod and cap respectively being machined to a perfect fit on each other.

4. A connecting rod or the like composed of an aluminum alloy of the class described, forged and heat-treated and then machined.

5. A connecting rod or the like composed of an alloy including aluminum, magnesium, manganese and copper and comprising about 94% aluminum and about 0.5% magnesium, which alloy has been subjected to excessive working and has been heated to a temperature approximating 500 to 525 degrees centigrade and then quenched and machined.

6. A connecting rod for connecting the pistons of internal combustion engines to the cranks thereof and having bearings at its ends for engagement with a wrist pin and a crank pin respectively, said connecting rod being made of an aluminum alloy of the class described consisting mainly of aluminum so as to be approximately as light as this metal and which has been worked and heat-treated to increase its density, tensile strength and elastic limit.

In witness whereof, I have hereunto signed my name.

JOHN OAKLEY.