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PISTON CONSTRUCTION

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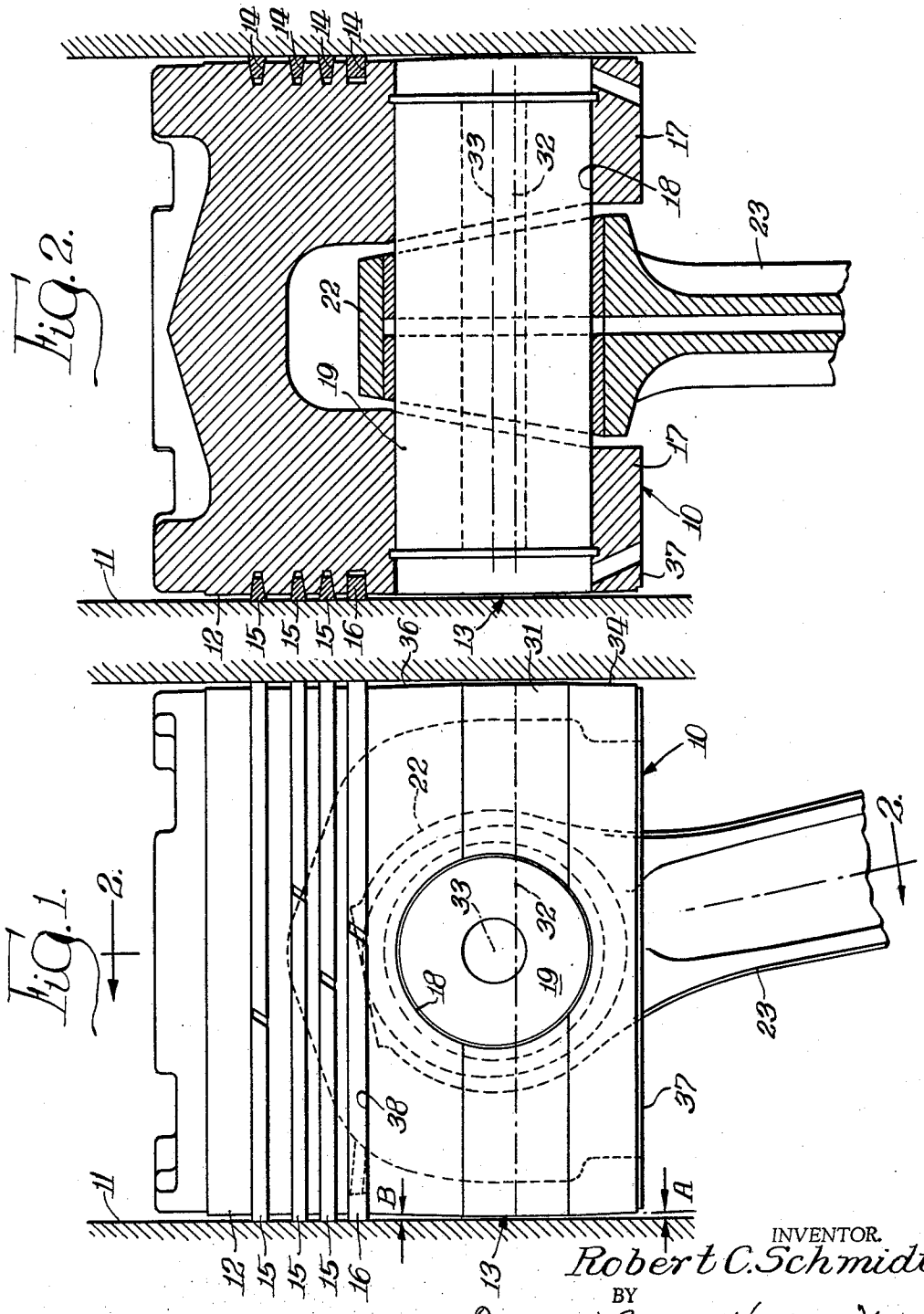

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PISTON CONSTRUCTION

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This invention relates to a piston, and more particularly to a piston for use in a multi-cyclinder internal combustion engine of the diesel type.

The general object of the invention is to provide an improved piston construction for use in a multi-cylinder internal combustion engine.

Another object is to provide an improved piston construction for use in an engine of the foregoing character, which permits a reduction in the over-all height and weight of the engine.

A further object is to provide an improved piston construction for use in an internal combustion engine of the diesel type which eliminates concentration of forces at the bottom of the skirt of the piston against the cylinder wall and consequently prevents scoring of the cylinder wall.

These and other objects will become apparent from the following detailed description and accompanying drawing in which:

FIGURE 1 is a side elevational view of a piston and a portion of a connecting rod, the former embodying the features of the present invention; and

FIG. 2 is a longitudinal sectional view taken along the line 2—2 of FIG. 1.

In recent years, efforts have been made to reduce the size and weight of diesel engines in order to obtain wider use of such engines. Because of the large forces present in diesel engines, and particularly the forces acting on the pistons of the engine during the power stroke and tending to rotate the piston about its wrist pin, the pistons utilized in diesel engines have conventionally employed a so-called long skirt to prevent scoring of the the cylinder wall. Such an arrangement produces a force system that tends to cause the piston to engage the cylinder wall more or less throughout the length of the piston skirt. While the long skirt piston is satisfactory from the force and wear standpoint, such a design results in a relatively large sized engine and consequently a heavier engine for the power developed.

The use of a short skirt piston in a diesel-type internal combustion engine would permit a substantial reduction in the over-all height and consequently the weight of the engine. With a piston having a straight skirt, the skirt tends to engage the cylinder wall at the lower edge of the skirt due to the tendency of the forces on the wrist pin to rotate the piston about the wrist pin axis, and with a short straight skirt, the force system is such as would tilt the piston so that only the lower edge of the skirt would engage the cylinder wall and excessive wear at this point and scoring of the cylinder wall would result. Moreover, with the lower edge of the skirt contacting the cylinder wall, oil would be scraped off the wall, thus increasing the tendency of score the cylinder wall.

The piston construction of the present invention achieves the desired engine height and weight reduction in that it employs a novel short skirt construction and also avoids any concentration of forces. To this end, the skirt portion of the piston is constructed so as to distribute the forces of the piston against the cylinder wall over a substantial area of contact rather than merely an edge contact. The unit stress on the cylinder wall is thus decreased, thereby reducing the tendency of the piston to score the cylinder wall. Thus, the skirt of the present piston comprises upper and lower inwardly tapered end

portions and an intermediate straight portion, the angle of taper of the upper and lower portions being greater than the greatest angle of inclination of the piston in relation to the associated cylinder wall.

In addition to the tapered upper and lower end portions of the skirt, a novel relationship between the diameter of the wrist pin bore and the straight portion of the skirt is contemplated, the latter having an axial length such as to fall within the transverse projection of the wrist pin bore. Such relationship provides a force system which reduces the tendency of the piston to tilt and contact the cylinder wall only at an edge. Instead, the piston engages the cylinder wall substantially throughout the area of the straight intermediate portion. Consequently, the forces are distributed over such area and result in a low unit stress, thereby avoiding chance of scoring the cylinder wall. With this construction, the skirt may be made only long enough to provide support for the wrist pin.

In FIGS. 1 and 2, a piston construction embodying the features of the present invention and indicated generally at **10** is illustrated. The piston **10** in the present instance is shown operably disposed in a cylinder having a cylinder wall **11**. The piston **10** comprises a crown **12** and skirt **13**. The crown **12** is provided with one or more piston ring grooves, four such grooves **14** being shown. In the present instance, the upper grooves are shown as shaped to receive rings **15** of the keystone type and the lower groove receives an oil ring **16**. The skirt **13** includes interior bosses **17** having a transverse bore **18** therethrough adapted to receive a wrist pin **19**. The wrist pin **19** serves to connect the piston **10** to the upper end, indicated at **22**, of an associated connecting rod **23** connected to the crankshaft (not shown) of the engine.

During the power stroke of the piston, the force due to combustion in the cylinder is exerted axially downwardly on the piston and is opposed by the reaction force of the crankshaft exerted through the connecting rod **23** on the wrist pin **19**. Because of the angular position of the crankshaft during such power stroke, the connecting rod **23** moves to a position angularly related to the axis of the cylinder, as illustrated in FIG. 1. By such angular relationship, the force exerted on the wrist pin **19** has a transverse component tending to force the piston **10** against the cylinder wall **11**, at one side thereof.

It is, of course, advantageous to utilize a piston having a short skirt in that such a piston permits a reduction in the over-all height and weight of the engine. The shortened skirt permits the use of a shorter connecting rod and the latter need be only of such length as to provide clearance between the lower end of the skirt and the counterweights of the crankshaft.

With a piston having a short straight skirt, that is, a piston in which the skirt is substantially cylindrical, an unfavorable force system is developed during the power stroke of the piston, which tends to cause the latter to tilt about its wrist pin axis, so that the latter contacts the cylinder wall at the upper and lower edges of the piston. The transverse component of the connecting rod reaction force is thus concentrated at a very small area of contact approaching a line contact. Consequently, large unit stresses are developed where the piston contacts the cylinder wall, so that excessive wear occurs at this point and the cylinder wall may become scored.

To avoid the foregoing difficulties, the present piston **10** utilizes a skirt **13** constructed so that it does not contact the cylinder wall at the lower edge of the skirt, but instead, contacts the wall only along a generally cylindrical or straight wall portion intermediate of its length. To this end, the skirt **13** comprises a generally cylindrical or straight wall portion **31** positioned intermediate the ends of the skirt and within the transverse projection of the wrist pin bore **18**. The axial center line, indicated at **32**

in FIG. 1, of the straight portion 31 in this instance is disposed somewhat below the center, indicated at 33 (FIGS. 1 and 2), of the wrist pin 19. The skirt 13 of the present piston has a length only sufficient to provide enough material in the bosses 17 to support the wrist pin 19. To insure that no part of the skirt other than the straight portion 31 contacts the cylinder wall 11, the lower and upper portions of the skirt, indicated at 34 and 36, respectively, below and above the straight portion 31, are relieved in order to provide clearance from the cylinder wall for these portions. Such relieved portions 34 and 36 in this instance are tapered inwardly from the straight intermediate portion 31, the upper tapered portion 36 preferably being somewhat longer than the lower tapered portion 34. The angles of taper indicated at A and B in FIG. 1, respectively, of the portions 34 and 36, are greater than the greatest angle of inclination to which the piston 10 may be tilted in relation to the cylinder wall 11. This angle of inclination is quite small and consequently the angles A and B may also be small. For purposes of illustration, the angles A and B have been exaggerated in FIGS. 1 and 2. With the straight intermediate portion 31 disposed so as to lie within the transverse projection of the wrist pin bore 18 and preferably with the axial center line 32 thereof disposed close to the center 33 of the wrist pin 19, the reaction of the cylinder wall is generally aligned with the transverse component of the force exerted on the wrist pin 19 by the connecting rod. Moreover, such reaction is distributed over a substantial area, rather than merely on a line of contact, so that the unit stress is materially reduced.

The total length of the skirt 13 is desirably as short as practical and preferably has a length only sufficient to provide enough material for the bosses 17 to support the wrist pin 19. Thus, the lower end, indicated at 37, of the skirt 13 is disposed below the wrist pin bore 18 a sufficient distance to provide enough metal in the bosses 17 and the upper end, indicated at 38, of the skirt 13 is located so as to space the wrist pin bore 18 below the lowermost piston ring groove 14 so that the groove is complete.

It will thus be appreciated that the novel skirt construction employed in the piston 10 of the present invention results in a piston of reduced size and a connecting rod of shorter length, both of which permit reduction of the overall height and weight of the engine. Moreover, the present piston construction reduces any tendency of the piston to score the cylinder wall, both from the fact the forces are not concentrated at a line, and also because better lubrication is obtained. Thus, the inwardly tapered portions 34 and 36 avoid a scraping action on the oil film on the cylinder wall, and the oil film is maintained on the cylinder wall. The better lubrication permits use of a piston having less clearance from the cylinder wall with a consequent reduction in noise of operation.

I claim:

1. A piston comprising a crown and skirt, said crown having at least one groove therearound adapted to receive a ring and said skirt having a bore therethrough adapted to receive a connecting rod wrist pin, said skirt having a straight intermediate portion and upper and lower end portions tapered inwardly from said intermediate portion, said straight portion being axially positioned within the transverse projection of said wrist pin bore, the taper of said end portions being such that the side thrust from the connecting rod is confined to and distributed over said straight portion.

2. A piston according to claim 1, in which said straight portion has an axial length less than the diameter of said wrist pin bore.

3. A piston according to claim 1, in which the axial center of said straight portion is disposed below the center of said wrist pin bore.

4. A piston according to claim 1, in which the angle of taper of said upper and lower portions is greater than the greatest angle of inclination of said piston in relation to its associated cylinder wall.

5. A piston according to claim 1, in which said skirt has a length only sufficient to provide support for said wrist pin.

6. A piston according to claim 1, in which said skirt has wrist pin bosses formed therein for supporting said wrist pin, and the lower end of said skirt is located substantially at the bottom of said bosses.

7. A piston according to claim 6, in which the upper end of said skirt has a length only sufficient to provide support for said wrist pin and to space said wrist pin bore below said groove.

8. A piston comprising a crown and skirt, said crown having at least one groove therearound adapted to receive a ring and said skirt having a bore therethrough adapted to receive a wrist pin, said skirt having a straight intermediate portion and end portions tapered inwardly from said intermediate portion, said skirt also having wrist pin bosses formed therein, the bottom edge of the lower portion of said skirt being located substantially at the lowermost portion of said bosses.

9. A piston according to claim 8, in which the upper end of said skirt has a length only sufficient to provide support for said wrist pin and to space said wrist pin bore below said groove.

10. A piston according to claim 9, in which the length of said straight portion is less than the diameter of said wrist pin bore.

11. A piston according to claim 9, in which the angle of taper of said upper and lower end portions is greater than the greatest angle of inclination of said piston in relation to its associated cylinder wall.

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