Dec. 23, 1941. C. A. KERKLING 2,267,033

METHOD OF MENDING CRACKED ENGINE BLOCKS AND THE LIKE

Filed Nov. 8, 1939 4 Sheets-Sheet 1

Fig. 1

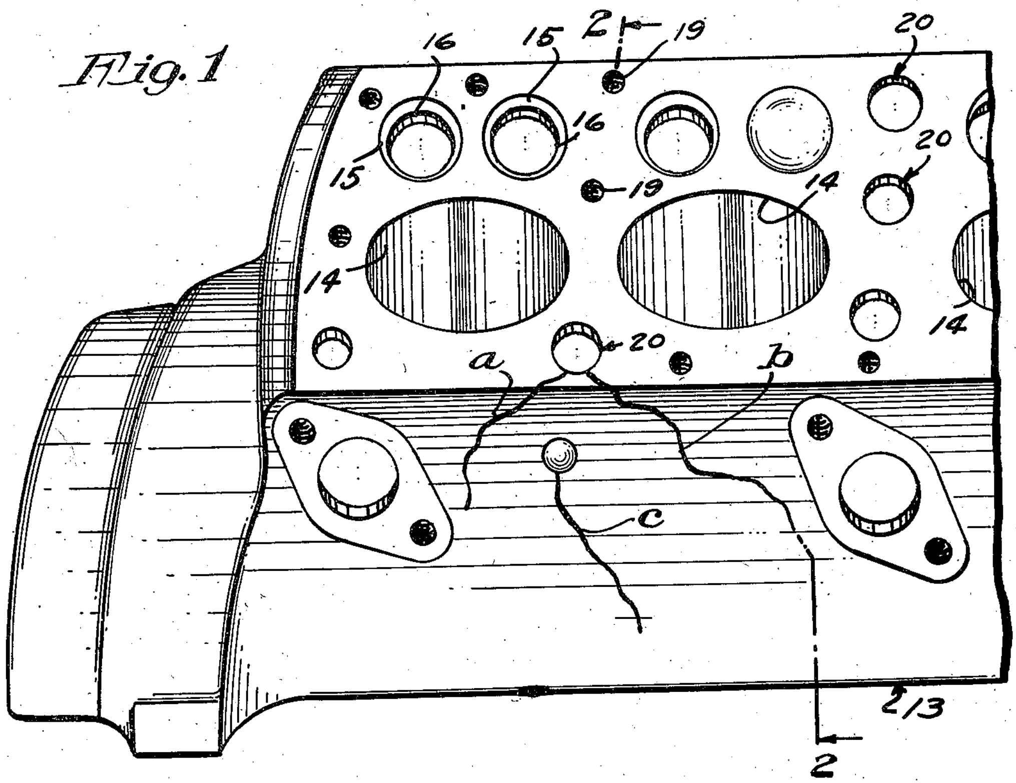
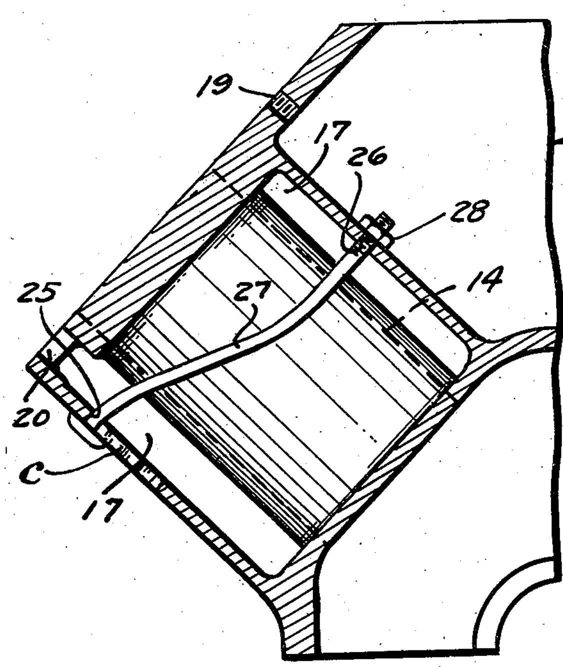


Fig. 2



Inventor
C. A. Kerkling
By his Attorneys
Merchant + Merchant

METHOD OF MENDING CRACKED ENGINE BLOCKS AND THE LIKE

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Fig. 3

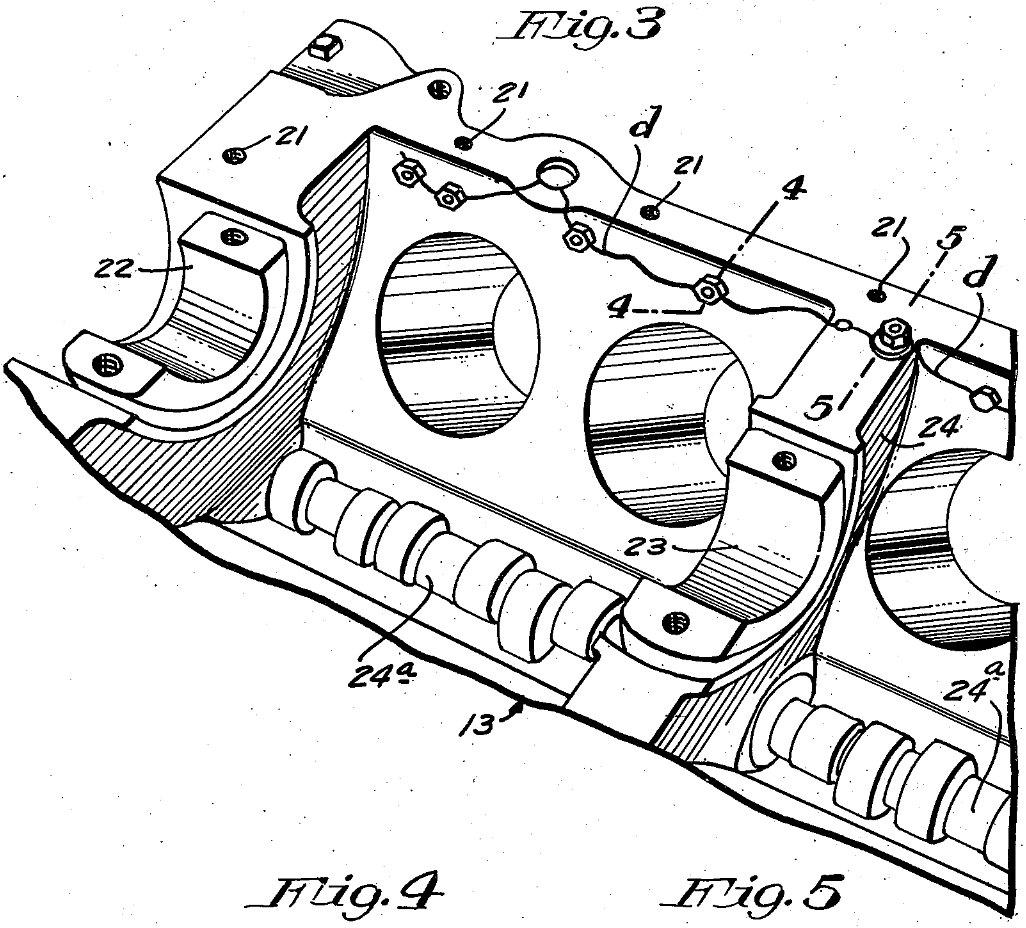


Fig. 4

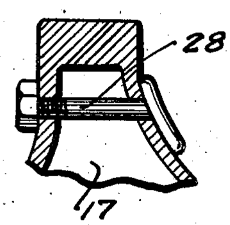
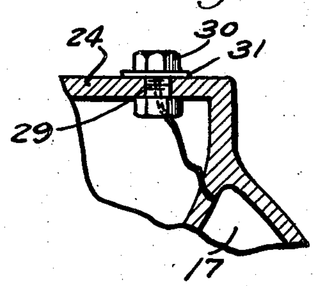


Fig. 5



Inventor
C. A. Kerkling
By his Attorneys
Merchant & Merchant

Dec. 23, 1941.   C. A. KERKLING   2,267,033

METHOD OF MENDING CRACKED ENGINE BLOCKS AND THE LIKE

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Fig. 6

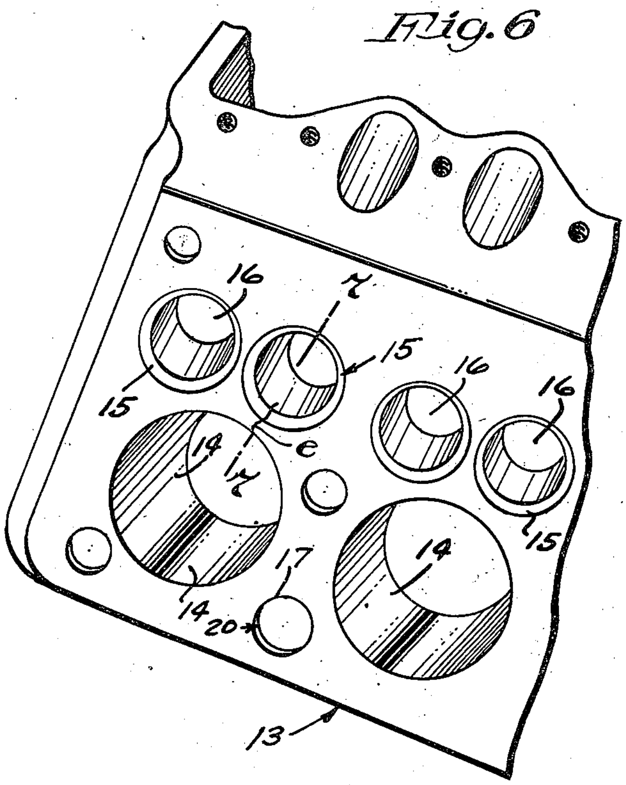


Fig. 7

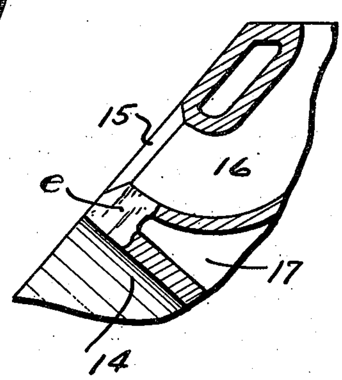
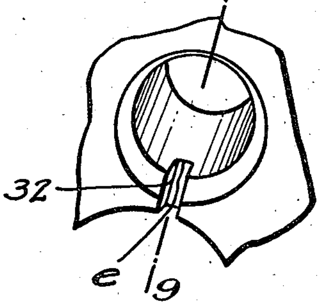


Fig. 8



Inventor
C. A. Kerkling
By his Attorneys
Merchant & Merchant

METHOD OF MENDING CRACKED ENGINE BLOCKS AND THE LIKE

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Fig. 9

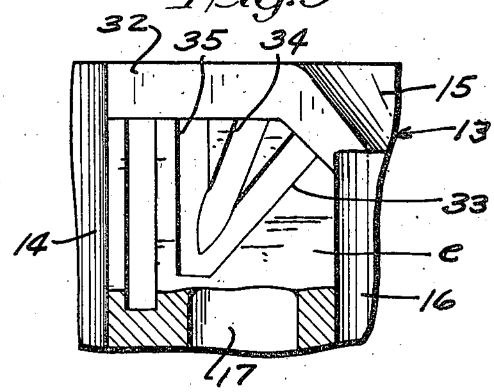


Fig. 10

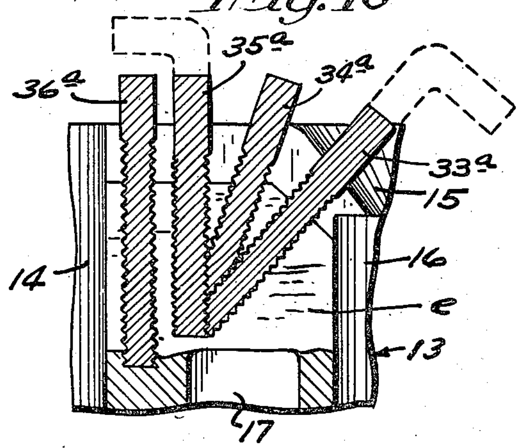


Fig. 11

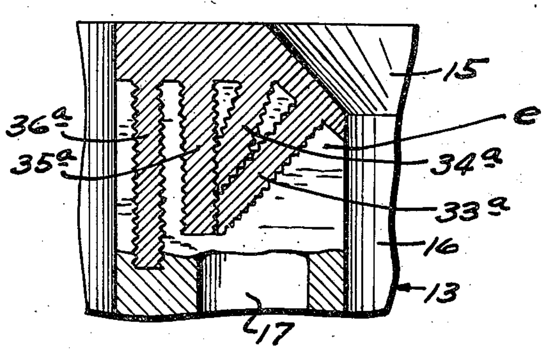
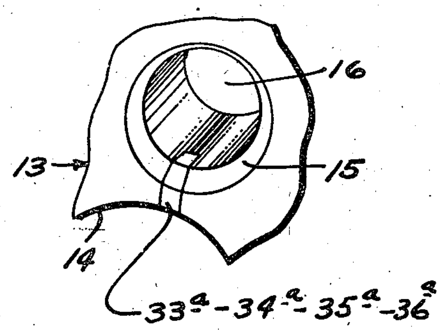


Fig. 12



Inventor
C. A. Kerkling
By his Attorneys
Merchant & Merchant

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UNITED STATES PATENT OFFICE

2,267,033

METHOD OF MENDING CRACKED ENGINE BLOCKS AND THE LIKE

Clarence Antonio Kerkling, Bloomington, Ind.

Application November 8, 1939, Serial No. 303,468

1 Claim. (Cl. 29—156.4)

This invention relates to improved methods of mending cracked blocks of engines and the like, and more particularly to methods for mending cracks in blocks of internal combustion engines.

Every year there are thousands of expensive cylinder blocks from engines of automobiles, trucks, tractors, buses and the like, discarded because of cracks caused by freezing, by undue strain, or by rapid and uneven temperature changes. While, as indicated, some of these cracks are caused by undue strain, or rapid and uneven heating or cooling, the greatest percentage are in liquid cooling engines and are the result of freezing of the engines' cooling fluid.

Many different methods and products have been experimented with over a period of many years, in an attempt to make permanent repairs of such cracks, but such methods and products that have hereto been tried have in most instances proved unsuccessful and have therefore largely been abandoned.

Welding and brazing processes, while theoretically ideal, have not worked out well, and have largely been abandoned, due to troubles arising from localized high temperature heating of small sections of the engine block.

Another method which has been hereto extensively tried in an attempt to produce permanent repairs in cracked cylinder blocks, consists in filling the engine's cooling system with a liquid containing substance that will deposit on the walls of the crack, under seepage of the fluid therethrough; and eventually close the crack. However, such methods have largely failed to provide a permanent repair of cracked cylinder blocks for the following reasons, to wit:

A. The first reason for failure of such methods is the fact that cracks of any great magnitude usually weaken the wall structure on one or both sides of the crack to the extent that there is a continual relative vibration or movement set up between block portions on opposite sides of the crack under operating conditions, which results in either preventing the formation of a proper seal, or a dislodgement of a seal once made.

B. In the second place, in cases where the cracks are of material length, and particularly when the cracks are caused by freezing, the cracked wall is apt to be bulged so that the opening of the crack is quite wide, and in fact, too wide to permit of an efficient seal by the last described process.

C. A further reason for failure of such methods seems to be the absence of a primarily fluid sealing compound, which when hardened in the crack of the engine block, will have the necessary lasting and staying qualities.

This invention has as one of its objects, the provision of a liquid sealing product or compound, which when run through the engine's circulating system, will accumulate on the walls of the crack under seepage of the fluid through the crack, and seal up the crack; and which, when finally set, will have great tensile strength, will have expansion and contraction characteristics so closely corresponding to that of the engine block metal that a permanent seal will be made, at least in the absence of relative vibration between opposite walls of the crack.

Another important object of the invention is an improved method of sealing cracks in engine blocks through the use of primarily fluid sealing substances or compounds applied through the engine's cooling system. Unto this end, the improved methods herein defined in the claim include the step or steps of mechanically closing such cracks to a minimum and/or permanently restraining the opposite walls of the crack from relative vibration, so as to reduce the open area to a minimum before application of the fluid sealing substance and/or reduce to a minimum the stresses and strains applied to the subsequently formed seal during operation of the engine.

Among the various different types of cracks which have been successfully repaired through the use of the methods and product of this invention, the three which have been selected for the purpose of illustration herein are as follows:

1. Bulged cracks in the outer side walls of an engine block directly outward of the cylinder or cylinders thereof.
2. Cracks adjacent the base line of the block and running through its main bearing support.
3. Cracks through a valve seat and entering the fluid chamber and sometimes extending to an adjacent cylinder.

Both the improved methods and product hereof have proven highly successful in permanently repairing the above noted types and other types of cracks in engine cylinder blocks and are now being used commercially on a wide scale. The above and other objects and advantages of the invention will be made apparent in the following specification, claim, and appended drawings.

Referring to the drawings, wherein like characters indicate like parts throughout the several views:

Fig. 1 is a fragmentary perspective view of one cylinder-containing bank of the cylinder block of a Ford V8 engine;

Fig. 2 is a fragmentary transverse sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary bottom perspective view of the cylinder block of a Ford V8 engine;

Fig. 4 is a detail fragmentary sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a detail fragmentary sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary top perspective view somewhat similar to Fig. 1, but showing the opposite side of the engine cylinder bank of the block;

Fig. 7 is an enlarged fragmentary detail view taken on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary detail view illustrating on an enlarged scale a small portion of the block shown in Fig. 6 but showing this portion of the block as it appears after a channel has been cut along the line of the crack;

Fig. 9 is a detail sectional view taken on line 9—9 of Fig. 8;

Figs. 10 and 11 are views similar to Fig. 9, but illustrating different steps in the method of mending cracks of the type exemplified in Fig. 6; and

Fig. 12 is a view similar to Fig. 8, but illustrating the same after the crack has been completely repaired.

The engine block herein illustrated, for the purpose of example, and which is indicated as an entirety by 13, happens to be the cylinder block of a Ford V8 engine. This cylinder block 13, which, of course, includes two angularly disposed cylinder bank sections, each containing four cylinders 14. However, for the purpose of illustration in this case it is only necessary to show one bank of cylinders, and hence the other bank thereof has been omitted. In accordance with conventional practice, this block is a cast structure formed to provide the cylinders 14, and valve seats 15 and valve ports 16. The cylinders 14, and valve port 16 are surrounded by a cooling fluid circulating chamber 17. The flat top surface of the cylinder block, upon which the cylinder head is applied, is provided with tapped cylinder-head bolt-receiving holes 19, and water passages or ports 20. By particular reference to Fig. 3 it will be seen that in this engine, as in most engines, the lower portion of the cylinder block below the cylinders forms the upper portion of the crank chamber, which is normally closed by a removable crank-case completing oil pan, not shown. The marginal bottom edge portions of the cylinder block are provided with tapped holes 21 for reception of oil pan retaining bolts, not shown and, as will be seen particularly by reference to Figs. 3 and 4, the walls of the block are double nearly down to this lower edge so as to extend the cooling fluid circulating chamber nearly to the bottom of the block. In Fig. 3, one-half of an end crank-shaft main bearing is shown at 22, and one-half of a central crank-shaft main bearing is shown at 23. The bearing 23 is in a partition-like main bearing support 24 that extends transversely across the interior of the cylinder block within the crank portion thereof and which is an integral part of the block. The engine's cam shaft is shown at 24a in Fig. 3.

The type of cracks shown in Figs. 1 and 2, and the method of mending or repairing the same, will first be described. By reference particularly to Fig. 1, it will be seen that there are three cracks identified as *a*, *b*, and *c* respectively, in one side wall of the block. This type of cracking in a cylinder block is usually caused by freezing of the cooling fluid, and causes bulging of that portion of the block lying between cracks *a* and *b*. Hitherto, this type of crack has been very difficult to seal up by means of sealing fluids because of the relatively wide open condition of the cracks and because of the relatively great vibrating movement between the walls on opposite sides of the crack. However, the novel method presently to be described in detail has been found to make a very permanent repair of such cracks at low cost.

The first step or series of steps in the preferred method of repairing blocks cracked in the manner shown in Fig. 1, consists in drilling a hole, indicated by 25 in Fig. 2, in an outer wall of the cylinder block, and which wall forms one of the outside walls of the fluid chamber 17, at a point preferably intermediate the cracks *a* and *b*, if there be two such cracks, and at point preferably intersecting the intermediate crack *c*, if this crack *c* is also present. However, in case there be but one crack, this hole *c* would be made either through the single crack or through the wall at the side thereof that was most in need of support. For example, if only crack *a* or crack *b* was present, the hole could be made substantially as shown, since it would then be through the weakest portion of the block. Also in case only crack *c* was present, or a combination of cracks *a* and *c*, or *b* and *c*, the hole could be located substantially as shown, preferably intersecting the crack *c*. By reference to Fig. 1, it will be seen that that portion of the block wall lying between cracks *a* and *b* is entirely broken loose, since both of these cracks terminate in the port 20. After a hole 25 has been drilled, a similar hole is drilled in the opposite outside wall of the block cylinder bank located at the opposite side of the line of cylinders 14 and forming the other extreme outside wall of the water chamber 17. This second hole, indicated by 26, is preferably placed in line with the space between two adjacent cylinders 14, and this regardless of whether it is in true alignment, transversely of the block, with the hole 25. This second hole 26 will probably be located in as nearly as possible, in the same spaced relation from the top of the block as is the hole 25, but if necessary, or more convenient, it can be located at a different position with respect to the top block, as is shown, for example, in Fig. 2. When these holes have been drilled, a long bolt, preferably having a rounded head, is inserted through the hole 24, passed entirely through the fluid chamber 17 between two cylinders, and through the hole 26. Depending on the relative positions of the holes 25 and 26 longitudinally and vertically in the block, this bolt, indicated by 27, may require more or less bending, and a quite extreme example of such bending is shown in Fig. 2. A nut 28 is now applied to the outer screw-threaded end of the bolt 27 and this nut is screwed up on the bolt gradually until the bulged portion lying between cracks *a* and *b* is pulled up firmly against the adjacent portions of the block, so as to very nearly close the cracks and firmly support that portion against vibration. In practice, it has been found that this tightening operation may be carried out most effectively by tapping with a hammer on the head end of the bolt while tightening the nut. It has been found advisable in many instances to dip the head and screw threaded end portions of the bolt 27 in a suitable sealing compound such as the one forming part of this invention, and hereinafter described, before application of the bolt to the holes. This sealing compound will tend to seal up the clearance between the bolt and holes before the final sealing process is started. Another sealing product valuable for this particular purpose is obtainable on the market under the trade name "Permatex No. 1," and this substance can also be worked into the holes around the parts to be engaged between bolt head and nut. Also it is sometimes further desirable to wind a little soft yarn or string around the bolt beneath the head and nut to aid in the initial sealing of these points.

The next step or steps in mending the crack, exemplified in Figs. 1 and 2 includes filling the engine's fluid circulating system, inclusive of the engine block chamber **17**, with a liquid having the required sealing qualities such, for example, as the primarily fluid sealing compound of this invention, and which is hereinafter disclosed. Assuming that this step of the process is to be carried out with my improved fluid sealing compound, this is mixed with water in the fluid circulating system to the approximate proportions given in connection with the formula hereinafter recited. When this has been done, the engine is set in operation and permitted to idle until the circulating fluid, including the sealing compound, has reached the boiling point and boiled for a short period of time. During this time, the fluid containing the sealing substance will seep through the nearly closed cracks *a*, *b*, and *c*, and perhaps to some extent around the head and nut of bolt **27**, and will gradually build up a deposit on opposite walls of the cracks of other openings until the same have become completely sealed or healed, at which time all seepage or leakage of water from the circulating system will cease. By running the motor up to the boiling temperature of the fluid, the cracks are expanded to the maximum which will be encountered in engine service. Therefore, it will be evident that by running the motor at this temperature until the cracks are completely sealed it will provide a seal of very permanent nature, since the sealing substance thereafter will normally be placed under somewhat of a pressure by the opposite walls of the crack.

In accordance with the preferred practice, the engine will be run for a total of about two hours, with a fluid compound in the fluid circulating system. Afterwards the fluid system may be drained and refilled with a suitable cooling medium such as water or any of the popular types of anti-freeze solutions. In this manner, the cracks shown in Figs. 1 and 2 can be permanently repaired without disassembling the engine to any material extent.

In Figs. 3, 4, and 5, a long crack *d*, is illustrated as running along the lower edge of the inner wall of the engine block and through the main bearing support **24**. This type of crack is frequently found in particular in Ford V8 engines and hitherto has caused the discarding of a great many of these blocks. This crack is through the inner wall of the lower extreme portion of the fluid chamber **17** below the cylinders and does therefore result not only in leakage of water into the engine's crank chamber, but also produces a serious weakening of the main bearing support **24**. To repair this type of crack, the crack is first drawn together as much as possible and mechanically supported against vibration of its opposite walls, to this end a double series of holes are drilled through the cracked and adjacent wall of the block. The inner series of holes each intersect the crack *d* and each hole of the outer series is in co-axial alignment with one of the holes in the interior wall. Also one or more holes are drilled through the main bearing support intersecting crack *d* therethrough. When this is accomplished, a series of nut-equipped bolts are passed through the aligned holes in the walls of the block and a bolt or bolts are also passed through the hole or holes in the main bearing support **24**. Mainly for the sake of appearance the side wall bolts, indicated by **28**, have round and preferably quite thin heads, which are located on the outside of the block, while the nuts are applied to the inside thereof. The bolts of the motor support, indicated by **29**, are preferably provided with angular heads, and are extended outwardly through the holes in the main bearing support with the nuts **30** applied on the outer ends, and washers **31** applied under the nuts. In this case also, the bolts and nuts and the holes through which the bolts have passed should have some of the sealing compound applied thereto before application of the bolts and nuts as directed in connection with the application of bolt **27**. The nuts of these bolts, **28** and **29**, are alternately tightened until all thereof have been drawn up to the maximum permissible extent, which act may be aided considerably by pounding on the head ends of the bolts while tightening the nuts. Also this pounding on the heads of the bolts will cause them to be more or less adapted to the shape of the engaged block wall, which aids in the sealing and final appearance. When this operation is complete, the crack will be closed to a minimum and opposite walls thereof will be rigidly supported against relative vibration.

The final step in repairing this crack consists in filling the circulating system with a fluid containing the proper sealing ingredients and running the motor in the same manner as described in the matter of repairing a crack in Figs. 1 and 2.

Another type of crack which has hereto resulted in discarding of a great many engine blocks, and which can be inexpensively and permanently repaired by a modification of the above described method or methods, is shown particularly in Figs. 6 to 12 inclusive. This type of crack extends from a valve port **16** through the valve seat **15** and into the upper portion of an adjacent cylinder **14** and is identified by *e*. Since this crack is through the outer wall of the fluid chamber **17**, water or circulating fluid will, of course, leak both into the cylinder and valve port.

The first step in mending such a crack is to form in the upper surface of the block, along the line of the crack and through the valve seat **15** and into the cylinder **14**, a channel **32** which is shown best in Fig. 8. This channel is usually formed by use of a small cape chisel, and made about ¼ inch wide and about ⅛ inch deep. This channel should follow the contour of the valve seat and extend somewhat below it.

The next step in this modification of the method includes drilling a series of holes identified by numerals **33**, **34**, and **35** respectively. These holes are preferably made with about a $\frac{5}{32}$ drill. Hole **33** is preferably drilled straight through the valve seat approximately at a right angle thereto, hole **35** is drilled at a right angle to the top of the block, and hole **34** is drilled at an angle about half way between the angles of holes **33** and **35**. Usually these holes are drilled about ¾ of an inch deep and terminate at approximately a common point, each intersecting the other.

Next these holes are tapped and relatively soft and ductile metal screws **33*a***, **34*a***, and **35*a***, are screwed into these holes. These screws **33*a*** to **35*a*** inclusive are bottomed into their respective holes or against others thereof. Many cracks through valve seats do not extend to the top of the cylinder and in this case screws **33*a*** to **35*a*** are all that is necessary, but in some of those cases where the crack does extend to the top of the cylinder, it is desirable to drill one hole across to the cylinder and provide an additional screw indicated by **36***a*, as illustrated. The screws **33***a* to **36***a* inclusive are preferably made from bronze welding rod available on the market under the trade name "Tobin." Lengths of such rod are preferably cut to length and tapped to the approximate depth of the holes. In fact that the screws are made longer than necessary and the tops thereof are bent over as shown by dotted lines in Fig. 10, is to provide wrench engaging heads. Preferably these screws will be predipped in sealing compound such as disclosed herein, which will make the process of screwing in easier and aid in the forming of a seal. After these screws are tightened into the holes, they are cut off materially above the tops of the channel substantially as shown in Fig. 10. Now the projecting ends of the screws are pounded down and deformed until they tightly fill the complete channel, this being accomplished most readily by use of the peen end of a hammer. When the screw material has been worked into the channel to tightly fill it, the surplus material still projecting above the channel is filed or ground off even with the top of the block and the valve seat is reamed or ground out so as to form a complete new valve filling surface over the channel which will match up perfectly with the adjacent portions of the valve seat. The finished product will now appear much as shown in Figs. 11 and 12. With this done, the crack will be sealed very nearly fluid tight, and the valve seat will be rendered serviceable for a long period of time. Also, of course, the block portions on opposite sides of the crack will mechanically be held against relative movement. It has been found that "Tobin bronze" not only makes a very durable valve seat, but apparently has substantially the same expansion and contraction qualities of the cast block material.

The final step in sealing up the crack of Figs. 6 to 12 inclusive consists in applying a primarily fluid sealing substance and running the motor while the substance is in the fluid circulating system, substantially as described in connection with other figures.

The preferred form of the sealing compound of this invention, which is preferably employed in carrying out the method or methods herein described, is made up of ingredients in proportions given in the following formula.

Preferred formula

5 gallons or 70 pounds silicate of soda
1 pound of pulverized ginger
2 pounds of pulverized flaxseed
1 pound of aluminum powder

It has been found that the best results are obtained by mixing the above ingredients as follows:

1. Pour four gallons of the silicate of soda into a container and start agitation through means of a mechanical mixer, which should be maintained in operation throughout the mixing operation.
2. Slowly sift two pounds of the ground flaxseed into the solution.
3. Slowly sift in one pound of the ginger.
4. Slowly sift one pound of aluminum powder into the mixture.
5. Add the remaining one gallon of silicate of soda to the mixture.
6. If desired, three quarts to a gallon of water may be added, but this is not essential.

With all ingredients now in the mixture, agitation should be continued for about two hours, after which agitation should be maintained while pouring into cans or other air-tight containers, for distribution. The above will fill about 70 16-ounce cans.

One 16-ounce can of the solution is sufficient for repairing motors whose circulating system has a capacity of not over about six gallons, and when greater capacity is encountered, two cans can be used. For making the repair, the solution should be mixed only with plain water in the circulating system.

What I claim is:

The method of repairing a crack formed by bulged apart portions in a metal engine block of an internal combustion engine having a cooling system and a cooling fluid therein in communication with an engine block chamber, that includes the following steps: drawing and clamping together said bulged apart portions of said block on opposite sides of said crack until said crack is nearly closed, without removing the engine from the vehicle in which it is installed; holding said portions clamped in said nearly closed position against vibration with respect to each other during the remaining steps; adding to said cooling fluid sufficient fluid containing a metal sealing compound hardenable when heated to cover said crack during the remaining steps; subsequently circulating said fluid and said compound in said system and said chamber by operating said engine with said fluid and said compound at the boiling point for an extended period of time until said bulged apart portions and said engine reach maximum operating temperature; maintaining said portions at said maximum temperature until the resulting expansion of said portions causes said crack to reach its maximum enlargement at said temperature, and continuing the circulation of said fluid and said compound throughout said chamber until said compound fills and hardens in said thus enlarged crack.

CLARENCE ANTONIO KERKLING.