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Much variation in the physical and chemical character of deposits formed in the combustion chambers of cylinders of internal combustion engines is possible and is common. Differences in fuels, differences in operating conditions, differences in lubricants, and differences from materials added to fuels are factors for which an accurate checking of results has not been possible. And it has been much desired to be able to ascertain the nature of combustion deposits as formed in engine equilibrium, and avoiding exposure of sampling surfaces during unstable conditions of engine startup. From an accurate ascertaining of results, corrections and improvements could be greatly facilitated. By the present invention, it now becomes possible to collect samples of combustion deposits under desired conditions, and comparisons at desired time intervals can likewise easily be had, and deposits so obtained from combustion chambers can be subjected to minute examination, physically and chemically to the extent desired. Other objects and advantages will appear from the following description.

To the accomplishment of the foregoing and related ends, said invention, then, comprises the features herein-after fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is an axial sectional view, enlarged, of equipment in accordance with the invention;
Fig. 2 is a top plan view thereof; and
Fig. 3 is a bottom plan view.

For particular convenience, the device is of dimension corresponding to a spark plug but is received in its own opening provided in addition to the normal spark plug opening, and is used when the engine cylinder is firing. Thus, the body 2 having a screw threaded end 3, provides a hex-head 4 for application of a wrench as customary with spark plugs. Centrally of the body a shaft 5 is arranged, and a plurality of longitudinal bores are spaced laterally of said shaft. Desirably, these bores present two diameters of which the smaller is the inner end, and they thereby provide an intermediate shoulder 7. In each bore is a plunger which has a spaced opposed shoulder 8. Preferably, the plunger is in two parts 9, 10, one providing a reduced stem 11 spaced from the other part whereby an intermediate coil spring 12 is accommodate, and this normally tends to urge the plunger out, but its range of movement is limited by suitable means. Thus, to the inner end of the shaft 5 is secured a rotary plate 14 which has a perforation 15 dimensioned to admit the end 16 of a said plunger when in proper position. By the rotary or oscillately adjustable character of the plate 14, it is seen that the opening 15 can be turned into position to admit plungers as desired, and it is noticed that the flat end 16 of such plunger when exposed is flush with the surrounding sur-

face and thereby offers a representative collecting surface. Gas leakage is prevented by a leakage-preventing ring 17, on the order of a small scale piston ring, in a groove on the shaft 5 and each plunger.

It is noticed that normally, by the yielding of spring 12 the plunger is retracted back from its extended position and thereby the rotary plate 14 can freely turn to position the opening 15 to successively admit the plungers. Suitable means are provided for controlling exposure of a desired plunger, and such may be for instance an indexing lever 18 secured to the shaft 5 as by a set-screw 19, and a nut 20 if desired. Thus, by turning the lever the desired plungers are admitted to the opening 15.

The operation of sampling is as follows: With an equipment of a plurality of plungers thus in position, with the inner end of the device in the engine cylinder, and the engine started and allowed adequate warm-up to stabilization, the lever 18 is moved to release the first one of the plungers into deposit-receiving position for a determined time, for example, 10-30 minutes, and then after an interval, by further turning the lever the second plunger is released to collect deposit on its inner end, a similar collecting time being allowed. And after an interval as desired the third plunger is released for collecting. The engine is stopped and the sampler is removed and subjected to microscopic and chemical examinations as desired in any given case. The samples are, of course, accumulative; thus, for example, one collecting plunger contains a 30 minute sample, the next contains a 20 minute sample of the same period, and the third a 10 minute sample likewise of the same period. In some instances, merely one collection-sample is desired, and for this a one plunger device is suitable, and then the engine may be stopped and the sample be removed and the deposit be examined as mentioned.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

We therefore particularly point out and distinctly claim as our invention:

1. A sampler for deposits forming in internal combustion engines, comprising a body insertable in an opening provided therefor in such an engine, a rotary shaft extending axially through said body, a sealing ring on said shaft, a plurality of longitudinally spaced bores in the body spaced laterally of the shaft and having operatively inner end portions of reduced diameter, a plunger in each bore comprising inner and outer sections both fitted snugly but slidable in the enlarged outer end portion of the bores, the inner plunger sections having extensions which project through the reduced inner end portions of the bores and beyond the inner end of the body when fully inserted, coil springs between the several plunger sections, cover means obstructing the outer ends of the bores, a plate overlaying the inner end of the body and obstructing the plunger bore openings at such end, said plate being secured to the rotary shaft and having an opening into which all the plunger extensions may project for exposure within the engine upon predetermined rotation of the plate, and an indexing lever secured to the outer end of the shaft for selectively correlating the plungers and the plate opening.

2. A sampler for deposits forming in internal combustion engines, comprising a body insertable in an opening provided therefor in such an engine, a rotary shaft extending axially through said body, a sealing ring on said shaft, a plurality of bores in the body spaced laterally of the shaft, a plunger in each such bore comprising outer and inner sections and a coil spring there-
between, cover means obstructing the outer ends of the bores, a plate overlying the inner end of the body and obstructing the plunger bore openings at such end, the plungers being held in compressed condition between the plate and the cover means, said plate having an opening into which all the plungers may enter upon predetermined rotation of the plate, the plate being secured to said shaft for rotation therewith, stop means for limiting the projection of the plungers so that the ends thereof are flush with the exposed plate surface when extended, and an indexing lever secured to the outer end of the shaft for selectively correlating the plungers and the plate opening.

3. A sampler for deposits in internal combustion engines, comprising a body insertable in an opening provided therefor in a combustion chamber of such an engine, a plurality of longitudinal bores in the body which open at the inner end of the same, a collecting element within each such bore, means for moving said elements individually within the body to positions in which they project from within the bores beyond the inner end of the body, whereby to be exposed within the combustion chamber for deposit collection, a rotary plate overlying the inner end of the body and normally obstructing the bore openings at such end, a shaft connected to said plate and extending through the body, said plate having an opening into which all the collecting elements may enter upon predetermined rotation of the plate, and an indexing lever secured to the outer end of the shaft for selectively correlating the bores and the plate opening.

4. A sampler for deposits in internal combustion engines, comprising a body having size and screw-threads to fit in a receiving opening provided therefor in an internal combustion engine, a shaft axial in said body, a longitudinal bore spaced laterally of said shaft, a plunger therein, means urging the plunger inwardly, a rotary plate carried by the inner end of said central shaft having an opening permitting the plunger to enter to present its end flush with the plate surface in the engine combustion chamber, and an indexing lever secured to the outer end of said central shaft to control the plunger position.

5. In a sampler for deposits in internal combustion engines, a body insertable in an opening in an engine combustion chamber, a shaft axial in said body, a plurality of longitudinal bores laterally of said shaft, spring-urged plungers in said bores, a rotary plate carried by the inner end of said shaft normally blocking said plungers but having an opening permitting all plungers to enter for each to expose its end to the engine combustion chamber, and means on the outer end of said axial shaft to rotate the shaft and rotary plate, thereby exposing the plunger ends.

6. In a sampler for deposits in internal combustion engines, a body insertable in an opening in an engine combustion chamber, a rotary shaft in said body, a longitudinal bore laterally of said shaft, a plunger in said bore, a rotary plate carried by the inner end of said shaft normally blocking the plunger but having an opening registerable to permit the plunger to enter to present its end flush with the plate surface in the engine combustion chamber, and means urging the plunger against said plate.

7. A sampler for deposits in internal combustion engines, comprising a body insertable in an opening provided therefor in a combustion chamber of such an engine, said body being provided with a passageway which has an open end at the inner end portion of the body, a collecting element carried by the body in such passageway, motion-impacting means carried by the body and having a connection with said element for moving the latter along the passageway to a position in which it projects from such open end of the same, whereby to expose the element in the combustion chamber for deposit collection, shield means mounted at the inner end portion of the body movable between positions respectively blocking and exposing such end of the passageway, and actuator means connected to said shield means for controlling such positioning thereof, said actuator means extending through the body to the outer end portion of the same for actuation of the shield means externally of a combustion chamber within which the body may be inserted.

8. A sampler for deposits in internal combustion engines, comprising a body insertable in an opening provided therefor in a combustion chamber of such an engine, said body being provided with plural passageways having open ends at the inner end portion of the body, a collecting element in each such passageway, motion-impacting means carried by the body and connected to such elements for moving the latter along their respective passageways to positions in which they project from such open ends of the same, whereby to expose the elements in the combustion chamber for deposit collection, shield means mounted at the inner end portion of the body normally blocking such ends of all the passageways, said shield means being movable to expose the passageway ends progressively until all are in exposed condition, and actuator means for thus moving the shield means, the actuator means extending through the body to the outer end portion of the same for manipulation externally of a combustion chamber within which the body may be inserted.

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