United States Patent [19]

Bailey et al.

[11] **3,882,842**

[45] **May 13, 1975**

[54] **CYLINDER LINER SUPPORT**

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[73] Assignee: **Caterpillar Tractor Company**, Peoria, Ill.

[22] Filed: **Jan. 28, 1974**

[21] Appl. No.: **437,204**

[52] **U.S. Cl.** ..... **123/193 C**; 123/41.84; 92/171

[51] **Int. Cl.** **F01j 11/04**; F02f 1/02

[58] **Field of Search** ..... 123/32 AA, 41.84, 193 C; 92/169, 171; 29/156.4 WL

[56] **References Cited**

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Primary Examiner—Charles J. Myhre
Assistant Examiner—William C. Anderson
Attorney, Agent, or Firm—Phillips, Moore, Weissenberger Lempio & Strabala

[57] **ABSTRACT**

An internal combustion engine, having a cylinder head mounted on a cylinder block, is provided with means for supporting a cylinder liner therein, which comprises a yieldable spacer for compensating for excess loads exerted on the liner imparted by torqueing of the head to the block, together with a semi-resilient support sleeve, which acts as a stiff spring to accommodate thermal expansion and contraction of the cylinder liner occurring during normal operating cycles of the engine. The yieldable spacer is chevron-shaped in cross section and has a resilient annular positioner member associated therewith. Radial movement-preventing means in the form of an annular flange on the cylinder liner, closely fitted within a bore in the block, is also provided. Alternatively, the radial movement-preventing means is an annular flange on the outer periphery of the cylinder liner adjacent its topmost end, having a plurality of circumferentially-spaced slots therein, and fitted within the cylinder bore.

6 Claims, 3 Drawing Figures

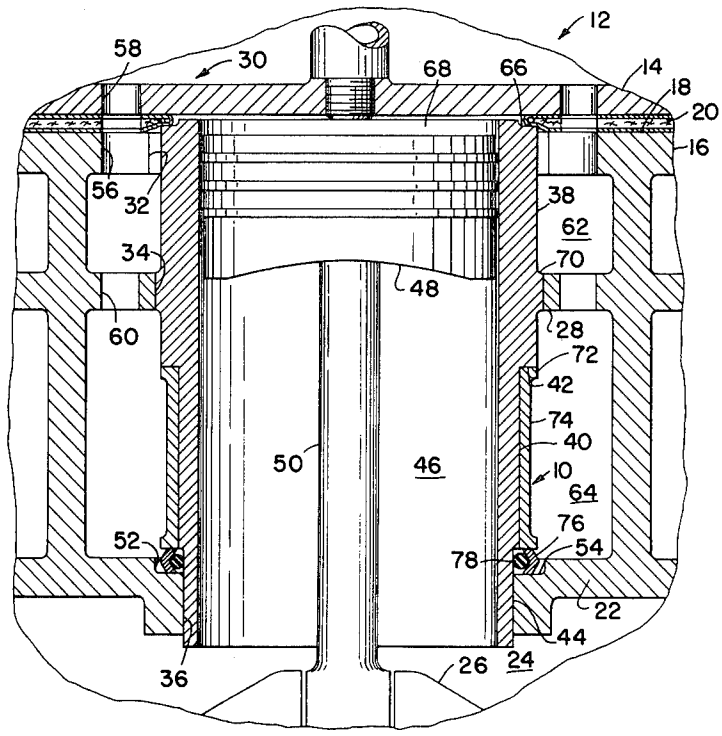

Fig. 1

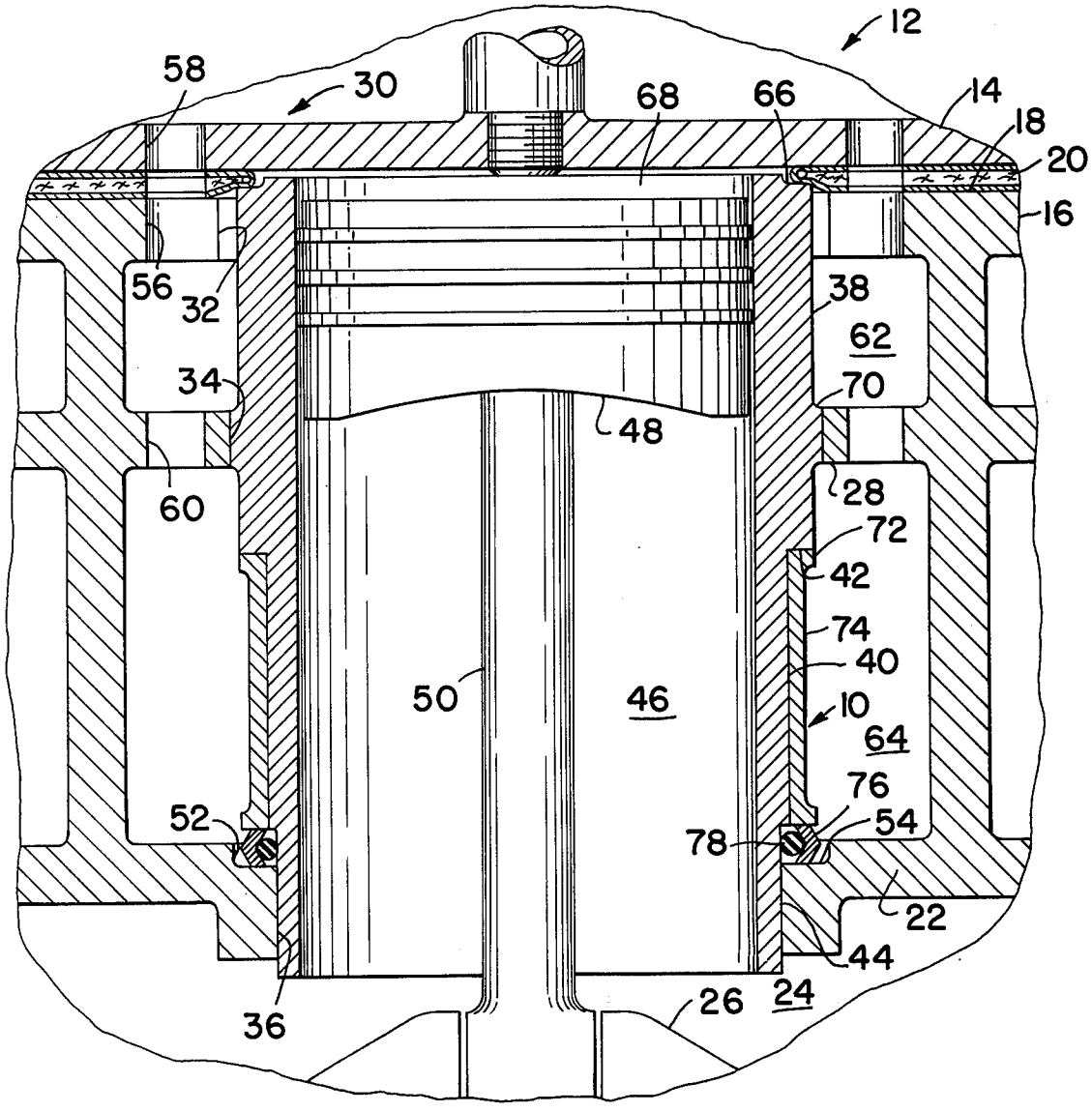
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Fig. 2

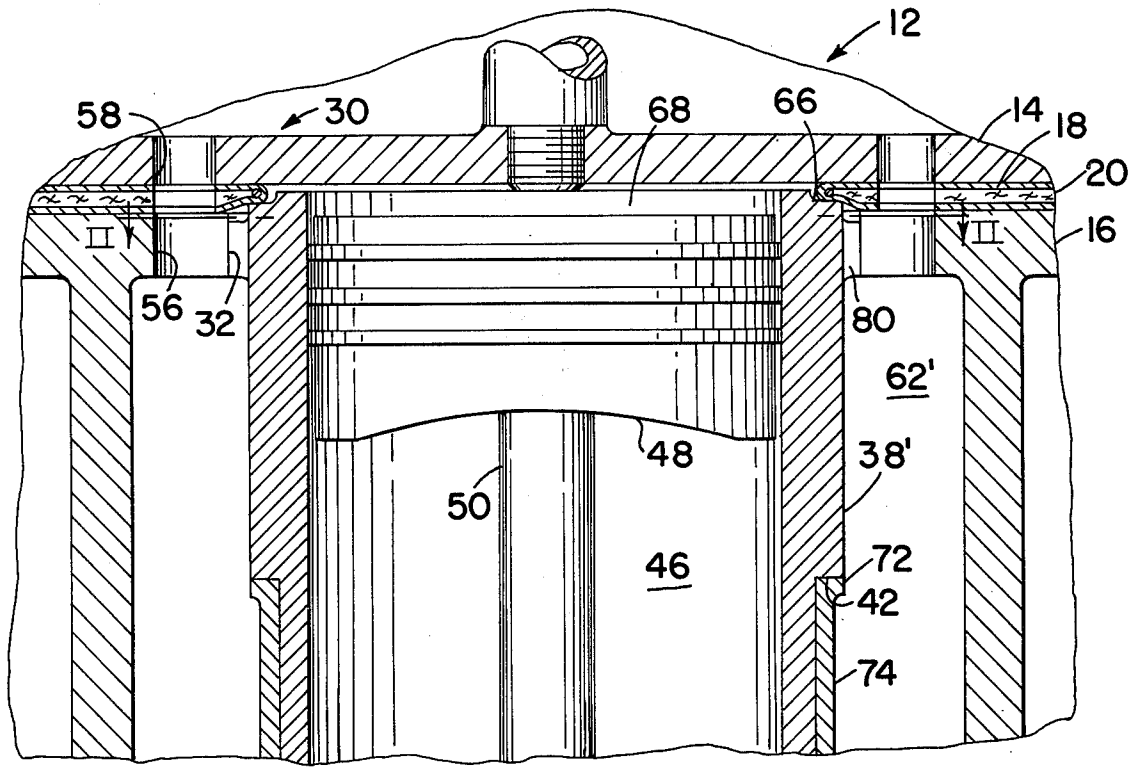
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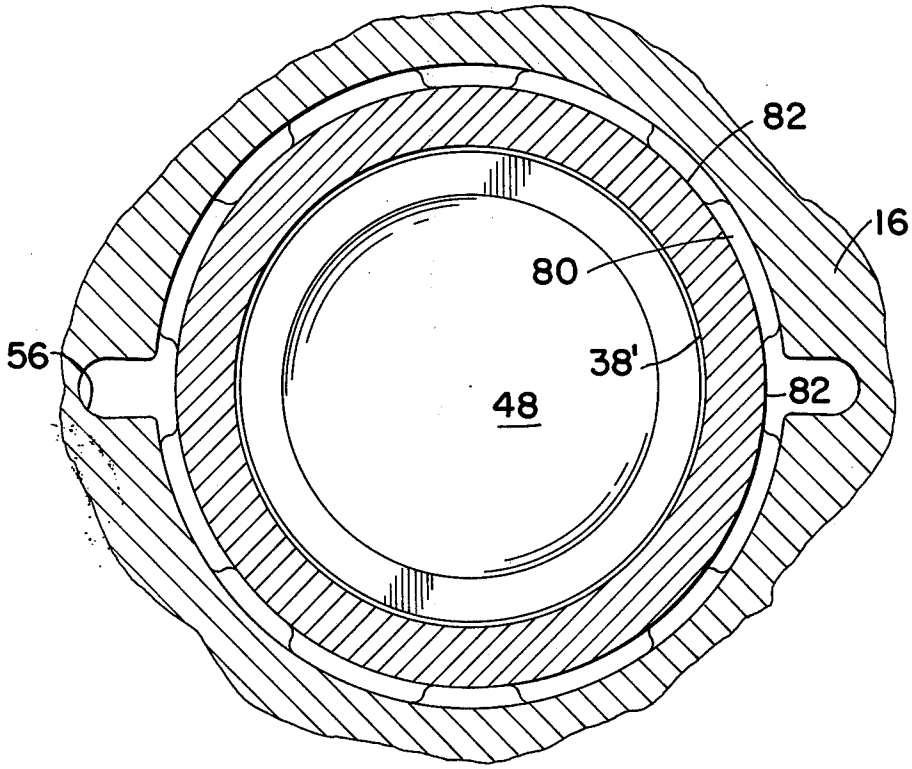
Fig. 3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CYLINDER LINER SUPPORT

BACKGROUND OF THE INVENTION

This invention relates to a cylinder liner support means for internal combustion engines. More particularly, this invention relates to such a support means comprising a yieldable spacer in combination with a somewhat resilient support sleeve, which are disposed between the engine block and the cylinder liner.

Currently, engine blocks utilizing cylinder liners therein are usually provided with counterbores in the top deck portion of the engine block for receiving flanges of the cylinder liners for mounting and location thereof. Frequently, the uppermost face of each cylinder liner flange projects slightly above the top deck portion plane to enable a head gasket to be compressed between the cylinder head and the cylinder liner flange and thereby provide an effective seal for combustion gases generated within the cylinder. A problem arises in that, with engines having a plurality of cylinders and corresponding cylinder liners, machining tolerances of the counterbores and liner flanges results in some of the liners projecting above the top deck portion plane further than others. When this happens, the torqueing of the head to the block causes liners with a greater projection to subject their respective counterbores to greater loads than liners having a lesser projection. The relatively high bolt torque which is required to insure adequate sealing of the head gasket often results in excess stress in the counterbore, and during engine operation, load and thermal stresses cause cracking of the block counterbores, with an accompanying loss of liner protection and failure of the combustion seal.

In attempting to overcome these problems, some designs employ a yieldable spacer disposed between a shoulder of the cylinder liner and an annular column which is integrally cast as part of the cylinder block, e.g. U.S. Pat. No. 3,628,427 issued Dec. 21, 1971 to Bailey; U.S. Pat. No. 3,568,573 issued Mar. 9, 1971 to Bailey et al, both of common assignment herewith. These designs have not been entirely satisfactory, since although experimental testing has shown that such an arrangement functions satisfactorily, it has not proved to be practical for the mass production of engine blocks. One of the reasons is that the integral columns are formed by casting around cores which are part of the casting mold for the engine block. These cores have a tendency to shift slightly during processing of the mold and the subsequent pouring of the casting. This results in side walls of the column being irregular after the bore for the liner is machined within the column in the block. This, in turn, causes unequal loading on the cylinder liner and results in leakage around the seals used therewith. Another cylinder liner support arrangement is that of utilizing a support sleeve for supporting the cylinder liner within the block, e.g. U.S. Pat. No. 3,481,316 issued Dec. 2, 1969 to Olson et al, also of common assignment herewith. However, neither the support sleeve nor the yieldable spacer have been entirely satisfactory as a means for supporting a cylinder liner for the above and other reasons. This is the case, since the support means must both compensate for excess loads exerted on the liner due to torqueing of the head during assembly, as well as accommodating thermal expansion and contraction of the cylinder liner occurring during the normal operating cycles of the engine in a practical sense. In addition to the above noted problems, it is also of concern to prevent unwanted radial movement of the cylinders in the cylinder bores which may occur.

SUMMARY AND OBJECTS OF THE INVENTION

The invention provides in an internal combustion engine having a cylinder head mounted on a cylinder block, a means for supporting a cylinder liner. The cylinder liner support means comprise a support sleeve circumscribing a reduced diameter portion of the cylinder liner and a yieldable spacer also circumscribing the reduced diameter portion. The support sleeve and yieldable spacer accommodate excess loads on and thermal cycling of the cylinder liner. Means for preventing radial movement of the cylinder liner in the form of a radial flange are also provided.

Accordingly, it is a primary object of this invention to provide a cylinder liner support which accommodates both excess loads exerted on the liner due to assembly of the head to the block, as well as those caused by thermal expansion and contraction of the cylinder liner during normal operating cycles of the engine.

It is a further object to provide such a device in which the yieldable spacer compensates for excess load exerted on the liner during assembly, while a semi-resilient support sleeve contracting therewith accommodates thermal expansion and contraction of the cylinder liner during normal operating cycles of the engine.

It is a further object to provide a means for preventing radial movement of the cylinder liner with respect to the block.

Other objects of the invention will become obvious in reading the following detailed description of the invention.

BRIEF DESCRIPTION

FIG. **1** is an enlarged cross-sectional vertical elevation view of a cylinder liner support and means for preventing radial movement of this invention shown in an internal combustion engine;

FIG. **2** is an alternate embodiment of the device shown in FIG. **1**, which differs only in having an alternate means for preventing radial misalignment; and,

FIG. **3** is a cross-sectional view taken along lines II—II in FIG. **2**.

DETAILED DESCRIPTION

Referring now to FIG. **1**, a cylinder liner support means of this invention is shown generally at **10**, within an internal combustion engine partially shown at **12**. The engine comprises a head portion partially shown at **14** mounted on an engine block, partially shown at **16**. Intermediate the head portion **14** and the top deck portion **18** of the engine block **16** is a head gasket **20**. Other than the top deck portion, the engine block includes a lower wall **22** which partially defines a crankcase cavity **24** for containing the crankshaft partially shown at **26**. The engine block also includes a cast shelf **28** disposed intermediate the top deck portion **16** and lower wall portion **22**. A cylinder bore **30** is formed within the block by a plurality of concentric bores **32**, 34 and **36** individually formed in the top deck, cast shelf, and lower wall, respectively. Received within the bores in close-fitting relation therewith is a cylinder liner **38** of generally cylindrical configuration, having a reduced diameter portion **40** at the lower end thereof

which defines an annular shoulder 42 therearound. A second reduced diameter portion 44 is provided at the lowermost end of the cylinder liner 38. The liner itself defines a piston bore 46 for reciprocatingly conataining piston 48 which is connected to connecting rod 50. A counterbore 52 is contained in lower wall 22 and defines a radially extending shelf 54.

A plurality of coolant passages 56 are formed in top deck portion 18 in alignment with similar passages 58 in the cylinder head and gasket 14 and 20. Additional passages 60 are formed in the cast shelf 28. The cylinder head 14 is secured to the engine block by conventional means such as bolts (not shown).

The cylinder liner 38, which may be of cast iron, extends through bores 32, 34 and 36 to form a pair of annular coolant cavities 62, 64 circumscribing a cylinder liner on opposite sides of cast shelf 28. An annular recess 66 is provided on the uppermost end of the cylinder liner adjacent to the cylinder head 14 for the purpose of receiving a matching portion of the head gasket 20 for sealingly separating the coolant from combustion chamber 68 formed by head 14, piston 48 and cylinder liner 38. Intermediate the upper and lower ends of the cylinder liner is a radially extending annular flange 70, closely fitted within bore 34 for the purpose of preventing radial movement of the liner.

The cylinder liner support means 10 comprises a similar resilient support sleeve 72 circumscribing a reduced diameter portion 40 of the cylinder liner. Support sleeve 72 has a peripheral groove 74 therearound and is relatively thin compared to the thickness of the cylinder liner. The sleeve, which may be made of metal, is relatively thin-walled so that it has a lower spring rate relative to the thicker cylinder liner.

The support means further comprises a chevron-shaped yieldable spacer 76 which may be made of resilient material. Disposed between the spacer and the cylinder liner is a resilient annular ring member 78, which may be made of rubber or other resilient material, for the purpose of radially positioning the spacer. The spacer also serves as a seal to prevent coolant from entering the crankcase cavity 24.

In operation, when the cylinder head 14 is torqued on to the engine block 16, the load is applied to the cylinder liner through head gasket 20. The load is transmitted through to the support sleeve 72, which causes the support sleeve to be slightly, axially compressed, as well as the yieldable spacer 76 yielding at a predetermined load. Further tightening of the cylinder head to the block will cause the spacer to continue to yield without significantly increasing the load on support sleeve 72 or cylinder liner 38. When the engine is fully operating, coolant flowing through cavity 64, passages 60, cavity 62 and passages 56 and 58 flows into the cylinder head 14. Heat generated through the engine operation will cause the cylinder liner to expand axially further deforming the yieldable spacer 76 which takes a permanent set in the yielded position. However, since the predetermined yield point of the spacer has created a compressed condition of the support sleeve, the sleeve acts as a stiff spring and serves to continuously urge the liner against the head gasket as the engine cools and the liner contracts. This stiff spring effect causes the support sleeve to act in a resilient manner.

Turning to FIGS. 2 and 3, there is therein illustrated an alternate embodiment which differs from the primary embodiment shown in FIG. 1 only in that the radial movement of the liner is prevented in a different manner. With this embodiment, no intermediate cast shelf is provided. Rather, radial movement is prevented by an annular guide flange 80 on the outer periphery of the cylinder liner 38' adjacent to its topmost end. This flange 80 is closely fitted within bore 32, adjacent top deck portion 18. In order to permit coolant in cavity 62' to flow freely, a plurality of axially aligned, circumferentially spaced slots 82 are formed in the flange 80 to permit free coolant flow to passages 56 and 58, in the top deck and head portions, respectively.

Although the invention has been described in terms of specific embodiments, it is apparent that other embodiments may be resulted to without departing from the spirit and scope of this invention. Thus, the invention is not to be otherwise limited, except as specifically pointed out in the claims hereto appended.

What is claimed is:

1. In an internal combustion engine, a cylinder head mounted on a cylinder block, said block defining a top deck portion, a cylinder bore in said cylinder block, a generally cylindrical cylinder liner disposed within said cylinder bore, a reduced diameter portion of said cylinder liner defining an annular shoulder intermediate said top deck and said shelf, means for supporting said cylinder liner comprising a support sleeve circumscribing said reduced diameter portion of said cylinder liner having an end thereof in abutment with said annular shoulder, wherein said support sleeve is relatively thin walled with respect to said cylinder liner whereby it possesses a relatively lower spring rate with respect to said sleeve, and further including means for preventing radial movement of said cylinder liner in said block comprising a shelf in said block intermediate said top deck and lower wall defining a bore, and an annular flange on said cylinder liner closely fitted within said last-named bore.

2. In an internal combustion engine, a cylinder head mounted on a cylinder block, said block defining a top deck portion, a cylinder bore in said cylinder block, a cavity in said block including a lower wall defining a shelf located intermediate the top deck and the lower wall, a generally cylindrical cylinder liner disposed within said cylinder bore, a reduced diameter portion of said cylinder liner defining an annular shoulder intermediate said top deck and said shelf and means for supporting said cylinder liner comprising a support sleeve circumscribing said reduced diameter portion of said cylinder liner having an end thereof in abutment with said annular shoulder, and a yieldable spacer circumscribing said reduced diameter portion and in abutment with the other end of said support sleeve and said shelf whereby excess loads on and thermal cycling of said cylinder liner are accommodated, wherein said support sleeve is relatively thin walled with respect to said cylinder liner whereby it possesses a relatively lower spring rate with respect to said sleeve, and further including a resilient annular member disposed between said reduced diameter portion of said liner and said yieldable spacer so as to radially position said spacer.

3. The invention of claim 1 wherein said yieldable spacer is chevron-shaped in cross-section.

4. The invention of claim 1 wherein said shelf is formed in a counterbore in said lower wall whereby said yieldable spacer is fitted within said counterbore.

5. The invention of claim 1 wherein said radial movement-preventing means comprises an annular guide flange on the outer periphery of said cylinder liner adjacent to its uppermost end, said guide flange being closely fitted within said cylinder bore.

6. The invention of claim 5 wherein said annular guide flange has a plurality of circumferentially-spaced slots therein.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,882,842
DATED : May 13, 1975
INVENTOR(S) : John M. Bailey, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Title Page, Item [73], change the spelling of the assignee's corporate name from "Caterpillar Tractor Company" to ---Caterpillar Tractor Co.---.

Signed and Sealed this

twenty-eight Day of *October 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks