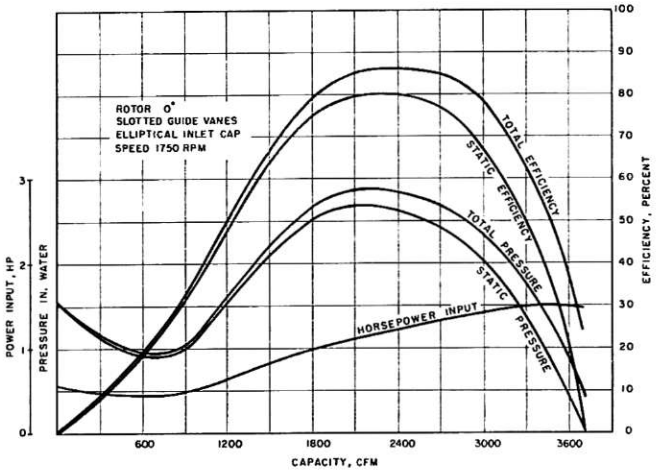


FIG. 17 BLOWER PERFORMANCE WITHOUT DIFFUSER

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# Discussion

J. R. ERWIN.[3] The design and investigation of the slotted-blade axial-flow blower is a promising development. It is gratifying to see that a very satisfactory performance of the test unit was obtained, particularly so in comparison with earlier attempts which were not successful. The question always arises as to whether the inner and outer case boundary layers will be able to undergo the static-pressure rise produced since they do not experience the boundary-layer control which is applied to the blades. This question seems to have been answered in the affirmative by the present investigation.

It would be of interest for the author to explain why the slotted-blade arrangement is better than two essentially separate blade rows so spaced that there would be little interference between the blade rows. Arrangements like this have been used previously, although the only applications which come to mind at present are the stator which was used with our first supersonic compressor and the double or triple-blade rows which are common at the exit from compressors used with axial-flow jet engines. In these applications, flow is usually turned from an inlet angle of from 50 to 60 deg to the axial direction at discharge.

The slotted-blade blower naturally invites comparison with the impulse axial-flow compressor.[4] The rotor of this compressor was designed for total pressure-rise coefficient of 2.5 with the static pressure-rise coefficient averaging 0.2. This rotor was tested alone and with a stator which did not remove all the tangential velocity imparted to the air by the rotor. The total pressure-rise coefficient measured at design-flow coefficient was 2.3 downstream of the rotor and 2.0 downstream of the stator. The static pressure-rise coefficient measured downstream of the stator was slightly over 1.2 at design flow. The efficiency of the rotor was unbelievably high, about 98 per cent. The efficiency of the stage was about 90 per cent when the measurements were taken within a chord length downstream of the stator, and about 83 per cent when measured five chord lengths downstream of the stator. Much of this difference was attributed to the inefficiency of a conical diffuser when a significant swirl exists in the flow. This same rotor was tested at several blade-setting angles to determine the relation between rotor static pressure-rise coefficient and rotor efficiency.[5] These results indicated that a rotor efficiency of about 94 per cent could be obtained with static pressure-rise coefficients of 0.4. However, subsequent tests of a symmetrical stage of this type showed rather poor stage performance.

An interesting and practical axial-flow blower might result from a combination of an impulse rotor with its very rugged blades, high total pressure-rise coefficient, and high efficiency when operated with a low static pressure-rise coefficient, and a slotted-blade stator with its ability to recover static pressure efficiently.

D. G. WILSON.[6] Blades of high camber or low stagger even working at a much lower pressure coefficient than those of the paper often show undue sensitivity to rotating stall. In addition, the stall induced by reducing the flow coefficient may persist in a hysteresis loop after the flow is increased to the value at which the blades usually operate stably. Did the author's blades show an equally dramatic improvement in these respects?

### AUTHOR'S CLOSURE

The author greatly appreciates the well presented comments of Mr. Erwin and Mr. Wilson. It must be remembered that the slotted blade is a relatively new development, whereas a great deal of time for research and analysis has been expended in the development of solid blade axial-flow blowers. Because of the discrepancy in the amount of data available, a comparison between the slotted blade and two, essentially separate, blade rows is difficult. Preliminary analysis has indicated that the slotted blades do have the potential of lower drag due to the extension of the laminar flow region. In addition, the slotted blade offers the possibility of space and weight saving when compared with separate blade rows.

The author is in complete agreement with Mr. Erwin's comment that the slotted blade would be ideally suited to a stator in combination with an impulse-type axial-flow rotor.

Mr. Wilson proposes the interesting question of rotating stall and hysteresis. The slotted blades of high camber showed no hysteresis within the range of stagger tested. However, tests at low stagger angles have not yet been performed. It should be noted, as shown in Fig. 17, that the stalling characteristics of the slotted blade are quite different from those of the standard axial-flow blower.

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[4] NACA RM L9JO5a, 1949.

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