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MC DONNELL AIRCRAFT CORP., ST. LOUIS, MO. (REPORT 1893)

RAM JET HELICOPTER ROTOR DEVELOPMENT - PROGRESS REPORT
NO. 50 - MONTH OF OCT 1950

A.C. BALLAUER 15 NOV 50 12PP PHOTOS, DIAGR

USAF CONTR. NO. AF-33(038)-9845

HELICOPTER ROTORS, JET
ENGINES, RAMJET
H-20

ROTATING WING AIRCRAFT (34)
ROTOR DESIGN AND DYNAMICS (4)

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ATTN: Mr. M. J. G. J.
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ENGINEER'S REPORT 1943
19 NOVEMBER 1943

RAMJET ENGINE TEST REPORT
PROJECT REPORT NO. 1, MARCH 1943

TRACT AF 33(734)-9648

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MCDONNELL *Aircraft Corporation*
ST. LOUIS 3, MISSOURI

PROGRESS REPORT NO. 50

MONTH OF OCTOBER 1950

RAM JET HELICOPTER ROTOR DEVELOPMENT

SUBMITTED UNDER Contract AF 33(038)-9845

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1. ROTOR DEVELOPMENT

1.1 General

During October no further autorotational flights were made using the 20 foot diameter rotor. Major effort was directed toward preparing the 27 foot diameter rotor for whirl tests.

1.2 18 Foot Diameter Rotor

The 18 foot diameter 8 inch chord rotor was assembled with Ram Jets Nos. 22 and 23 and prepared for early November shipment to N.A.C.A. Langley Air Force Base.

1.3 20 Foot Diameter Rotor

The 20 foot diameter rotor was left installed on XH-20 No. 1 and kept ready for flight.

1.4 Modifications to XH-20 No. 2

Approximately 50% of the rotor gear box parts required for operation of the XH-20 No. 2 with the 27 foot diameter rotor were completed. The modification is one of strengthening the upper part of the gear box and fuselage to take the higher gross weights made possible by the larger diameter rotor. Although the gear box has been redesigned for an 1800# gross weight it appears that difficulty will be encountered, unless a major redesign is made, in strengthening the fuselage for gross weights of 1000# to 1300#.

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1.5 27 Foot Diameter Rotor

The work on assembling the 27 foot diameter rotor continued and while the hub was being completed, strain gauges were installed on one blade for a check of bending moments during initial whirl stand tests. Flapwise bending gauges are located at points 11.00, 29.25, 81.75 and 125.75 inches from the rotor center on one blade. A chordwise bending gauge is located at 11.00 inches from the center. One blade torsion measuring gauge is attached to the pitch control arm.

The strain gauge leads for the blade have been run through the blade aft of the spar closure channel and only one set of holes has been made in the trailing edge skin to bring the leads to the blade surface. As a result, a bundle of leads extends between station 81.75 and 125.75 on the lower surface of the blade. It is believed that this set-up will be satisfactory for preliminary frequency and bending moment checks, but a cleaner installation will be required when maximum tip speeds are to be attained. Figures 1 and 2 show the instrumented blade.

While preparations for testing the first rotor are progressing, studies are being made of improved trailing edge constructions. Fabrication of several test sections is planned. These sections will consist of two variations of honeycomb construction, one cellular cellulose acetate filler and one corrugated inner skin arrangement. All these sections are designed for attachment to the existing type of extruded spar by means of adhesive.

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2. RAM JET DEVELOPMENT

2.1 High Speed Ram Jet

The 7.25" diameter high tip speed ram jets for the 27 foot diameter rotor were completed and tested in the free airstream. After minor adjustments the performance was satisfactory, but under some operating conditions a severe vibration of the shell occurred and resulted in fatigue cracks. An investigation of the phenomena is being made and steps will be taken to eliminate the difficulty.

The second set of 7.25" diameter ram jets of Inconel "X" will be completed early in November.

An experimental flameholder was tested in the high speed ram jet test shell to evaluate the possibility of using an aluminum fuel cooled unit. The aluminum flameholder was an exact duplicate of the stainless steel design. Exceptionally good results were obtained, in that there was no sign of deterioration of any kind after approximately 45 minutes of operation. The aluminum unit results in a weight reduction of .9 pounds. Further studies are planned on the use of aluminum on the ram jets.

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2.2 Whirl Stand Preparations

The whirl stand has been modified to accommodate the 27 foot diameter rotor by extending the shaft somewhat and adding bearings for increasing the rigidity of the shaft. Figure 3 shows the modification. It is expected that the first whirl stand operation of the new rotor will take place about mid-November.

3. WORK PROGRAM FOR NOVEMBER

3.1 27 Foot Diameter Rotor

The 27 foot diameter rotor will be assembled, and after checks of static bending frequencies, will be installed and operated in the whirl stand.

3.2 Ram Jet Development

Development of the high speed ram jets will continue in the blower and on the whirl stand.

3.3 General

Studies and tests of improved blade construction will continue. Static and fatigue tests of test samples corresponding to the No. 1 27 foot rotor will begin.

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J1 HELICOPTER TEST DATA

DATE: 5 October 1950 OPERATOR: C. Wood

TEST STAND: No. 1

ROTOR: 20 Foot Rotor with 10 Inch Chord Blades and with
No. 28 and 29 Jets

PURPOSE: The purpose of this test was to autorotate the test stand
from progressively higher altitudes.

TEST SET-UP: The test set-up was the same as was previously used for
autorotation tests. The ignition wire which came loose
during the last flight was cemented and taped to the fuel
line.

REMARKS: Autorotation landings were made from the following
approximate altitudes: 180 feet, 210 feet, 230 feet and
230 feet.

A moving picture record of the instrument panel was made
of each autorotation landing. See text for discussion of
landings. (Report 1880, Progress Report #49 September 1950)

Flight time required for test: 20 minutes

Running time required for test: 27 minutes

Total flight time to date: 28 hours 11 min.

Total running time to date: 119 hours

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J1 HELICOPTER TEST DATA

DATE: 6 October 1950 OPERATOR: C. Wood

TEST STAND: No. 1

ROTOR: 20 Foot Rotor with 10 Inch Chord Blades and with
No. 28 and 29 Jets.

PURPOSE: The purpose of this test was to autorotate the test stand
and to make a flight demonstration for Mr. Armbruster,
Major McDonald and Major Oswalt.

TEST SET-UP: The test set-up was the same as was previously used for
autorotation tests.

REMARKS: Several autorotation landings were made from low altitudes.
No moving picture record of the instrument panel was made
during this test.

Both Major McDonald and Major Oswalt hovered the test stand.

Flight time required for test: 15 minutes
Running time required for test: 24 minutes

Total flight time to date: 28 hours 26 min.
Total running time to date: 119 hours 24 min.

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J1 HELICOPTER TEST DATA

DATE: 10 October 1950

OPERATOR: C. Wood

TEST STAND: No. 1

ROTOR: 20 Foot Rotor with 10 Inch Chord Blades and with
No. 28 and 29 jets

PURPOSE: The purpose of this test was to autorotate the test stand
from progressively higher altitudes.

TEST SET-UP: The test set-up was the same as was previously used for
autorotation tests. A crack in the exit of No. 28 jet
was welded prior to this test.

REMARKS: Autorotative landings were made from approximately the
following altitudes: 250, 270, 270, 300, 320, 320 and
300 feet. A moving picture record of the instrument panel
was made of the various landings; however, due to faulty
camera operation part of the film record was incomplete.
See discussion in test for evaluation of test.

Flight time required for test: 18 minutes

Running time required for test: 29 minutes

Total flight time to date: 28 hours 44 min.

Total running time to date: 119 hours 53 min.

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J1 HELICOPTER TEST DATA

DATE: 19 October 1950 Operator: C. Wood

TEST STAND: No. 1

ROTOR: 20 Foot Diameter with 10 Inch Chord Blades and with
No. 28 and 29 Jets

PURPOSE: The purpose of this test was to check out the test stand
and to demonstrate it for Captain P. H. Ramsey and
Colonel E. A. Montgomery.

TEST SET-UP: All autorotation special test equipment was removed from
the test stand prior to this test.

REMARKS:

Flight time required for test: 6 minutes

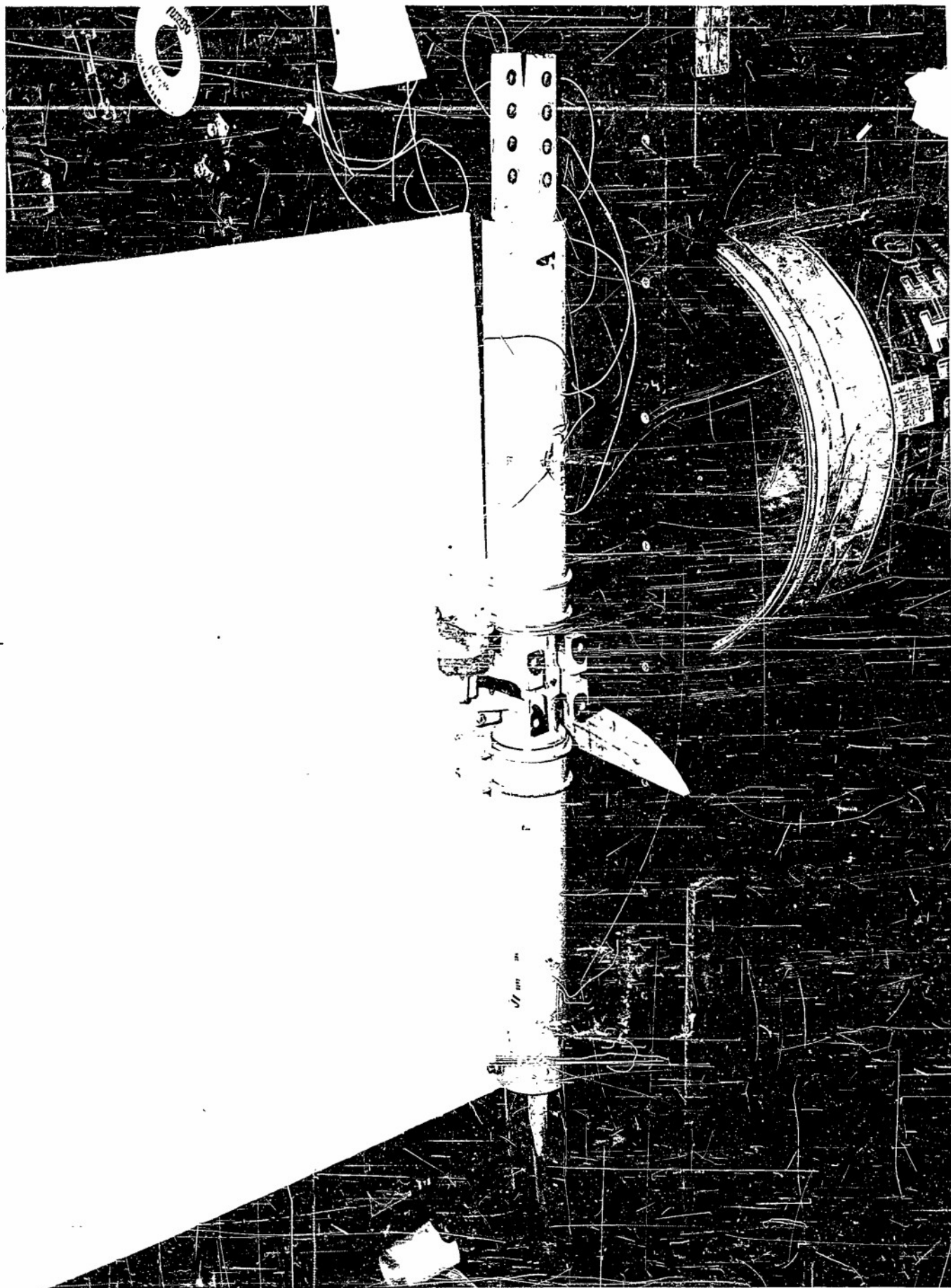
Running time required for test: 9 minutes

Total flight time to date: 28 hours 50 min.

Total running time to date: 120 hours 2 min.



FIGURE 1 - FLAPWISE BENDING STRAIN GAUGE INSTALLATION ON BLADE



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Figure 3

