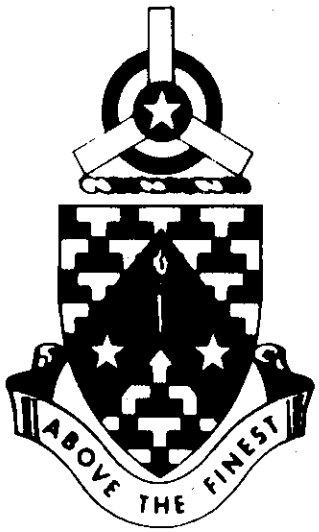
PROGRAMED TEXT

FLIGHT CONTROLS TH-55

AM-13-55



FEBRUARY 1968

UNITED STATES ARMY

PRIMARY HELICOPTER SCHOOL

FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO: AM-13-55

PROGRAM TITLE Flight Controls TH-55

POI SCOPE: Purpose, nomenclature, and function of the flight controls.

INSTRUCTOR REFERENCES:

HMI - HUGHES 269A

PREPARED BY:

CPT S. K. Johnston
Flt Subj Div
CPT G. L. Borchardt
TFPL

DATE: February 1968

REVISED BY:

DATE:

APPROVED BY:

FREDERICK B. WELLER, LTC
Chief, TP&A

DATE: June 1968

TABLE OF CONTENTS

PROGRAMED TEXT
FILE NO: AM-13-55

PROGRAM TITLE:
Flight Controls TH-55

PREFACE

As a student pilot it is necessary that you have a thorough knowledge of the flight controls and their various components.

Being familiar with the usage of each of the flight control systems and their operational units enables the pilot to:

a. Understand how the helicopter is controlled.

b. Better utilize the controls by knowing their functions.

c. Spot deficiencies during the preflight inspection.

d. Detect malfunctions in the controls while in flight.

Start with frame 1 and work each frame in succession. Each frame will usually ask you a question. The correct answer is printed on the top of the next frame. If you were incorrect, turn back and restudy the information before continuing on to the next frame. When you have finished the text, complete the self evaluation exercise. Now begin by studying the performance objectives on page 1.

FRAME 1

The TH-55A helicopter has three primary control systems:

1. Cyclic control system

2. Collective control system

3. Tail rotor control system

The collective control increases or decreases the lift force of the main rotor. The cyclic control tilts the main rotor blades and controls the helicopter laterally and longitudinally. The tail rotor is an antitorque device to compensate for the clockwise turning of the aircraft caused by the main rotor.

In the following, match the control systems with the appropriate resulting action.

1. Cyclic control system

2. Collective control system

3. Tail rotor control system

2 a. Provides vertical flight
2 b. Provides horizontal flight
3 c. Provides fuselage movement around the vertical axis

TURN TO FRAME 2 PAGE 4

ANSWER: b. Increase the angle of attack on one side of the rotor system and decrease the angle of attack on the other side of the system.

FRAME 12

Which statement best describes the purpose of the two swashplates that are in the main rotor system?

a. Change nonrotating movement to rotating movement.
b. Reduce the stress forces on the rotor system.

The three vertical push-pull rods transmit cyclic movements and collective movements to the lower swashplate.

The devices that provide for the mixing of these two controls are

a. cyclic and collective mixing levers.
b. lateral cyclic bellcranks.

TURN TO FRAME 13 PAGE 5

ANSWERS: 2 a. Provides vertical flight
1 b. Provides horizontal flight
3 c. Provides fuselage movement around the vertical axis

FRAME 2

The aviator controls the movements of the helicopter from the cockpit by moving either the collective stick, cyclic stick, or the pedals.

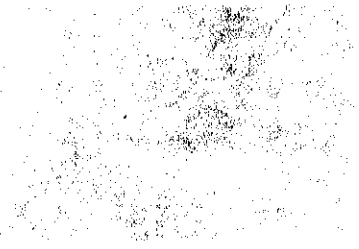
Through mechanical linkage the aviator controls the actions of the main rotor and the tail rotor.

Which control(s) provide for movement of the main rotor?

(a). Collective stick
(b). Cyclic stick
c. Pedals

Which control provides for movement of the tail rotor?

a. Collective stick
b. Cyclic stick
(c) Pedals



TURN TO FRAME 3 PAGE 6

ANSWERS: a. Change nonrotating movement to rotating movement.
a. cyclic and collective mixing levers.

FRAME 13

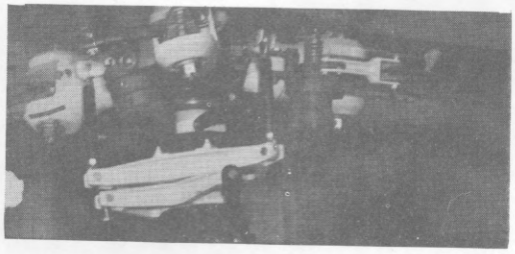
If the pilot applies up collective, it will cause the cyclic mixing lever to move down as one unit and move the three vertical push-pull tubes down an equal amount. This would cause

a. both swashplates to move up.
b. both swashplates to move down.

NOTE: Pitch change links are mounted on the back of the blades.

This down movement would cause the pitch angle of the blades to

a. increase.
b. decrease.

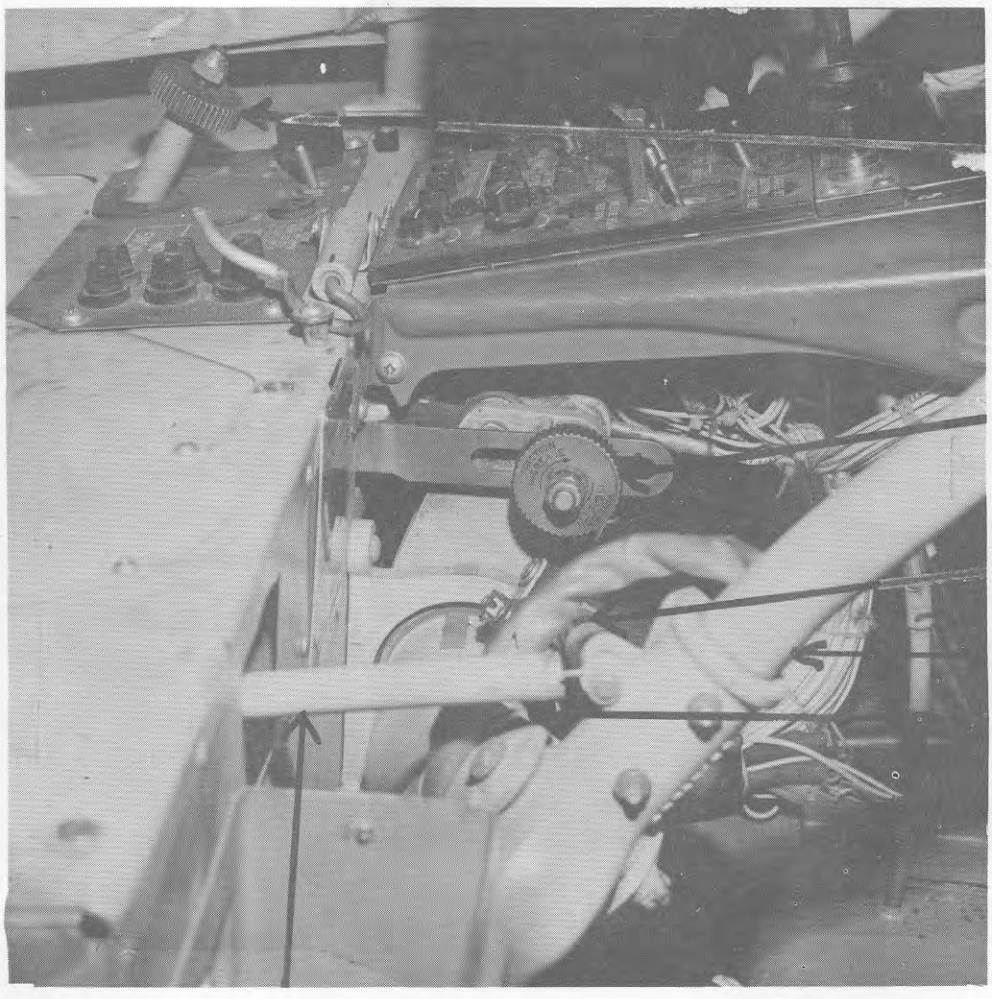


ANSWERS: a. Collective stick, b. Cyclic stick
c. Pedals

FRAME 3

The forces applied by the pilot to the cyclic stick are transmitted to the main rotor by a series of push-pull tubes and bellcranks.

In the photograph below study the cyclic linkage inside the cockpit. (Seats removed for clarity)



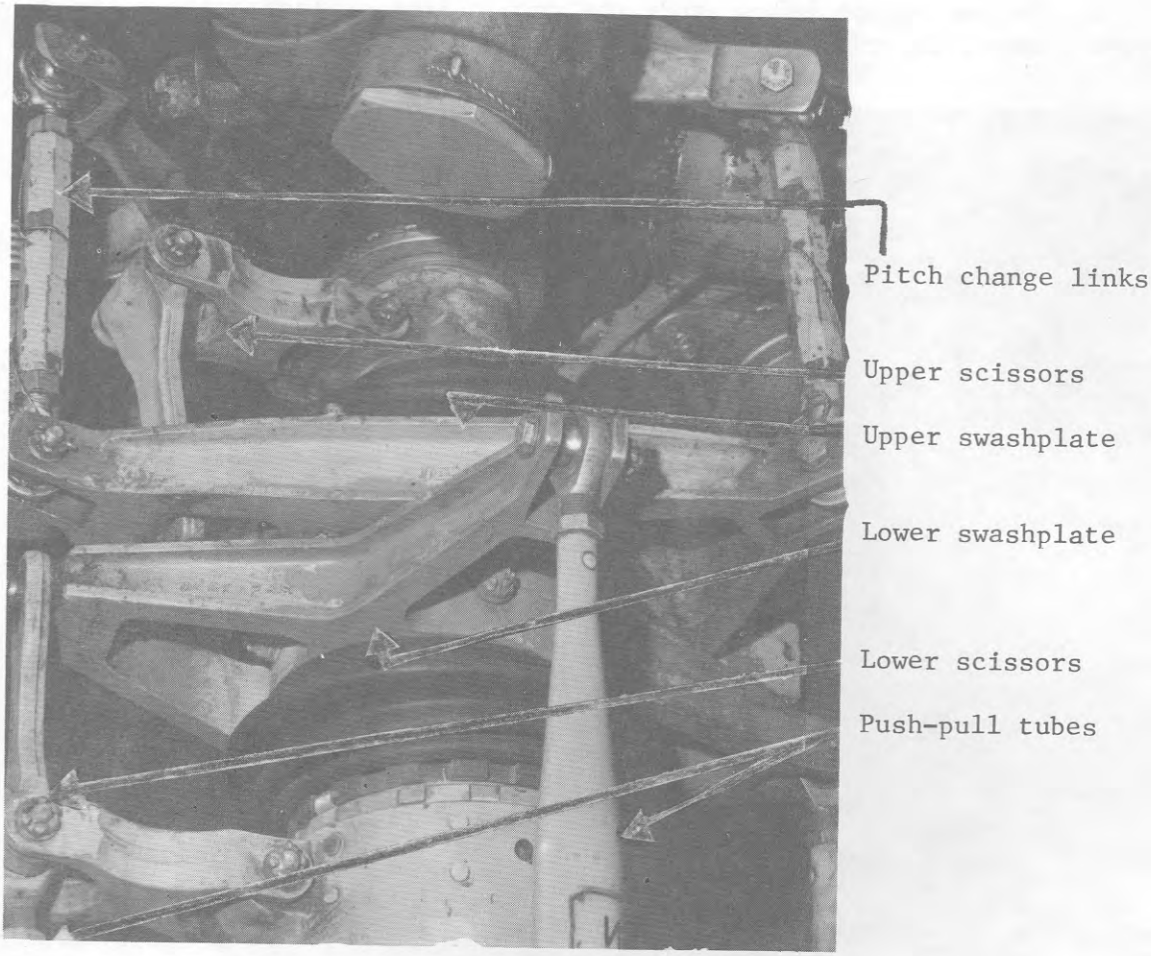
Which of the following would best describe the function of the cyclic friction system?

a. Provides a means to hold the cyclic stick in place mechanically
b. Increases the efficiency of the cyclic control

ANSWERS: b. both swashplates to move down.
a. increase.

FRAME 14

During the preflight inspection the aviator should inspect the following items:



1. Pitch change links for security, safeties, condition, radial play and end play.

2. The scissors for security and condition.

3. Swashplates for condition and safeties. With one hand hold the lower swashplate stationary and check for play between the upper and lower swashplate. Some play should exist and a great deal of play is allowed while working the upper swashplate radially.

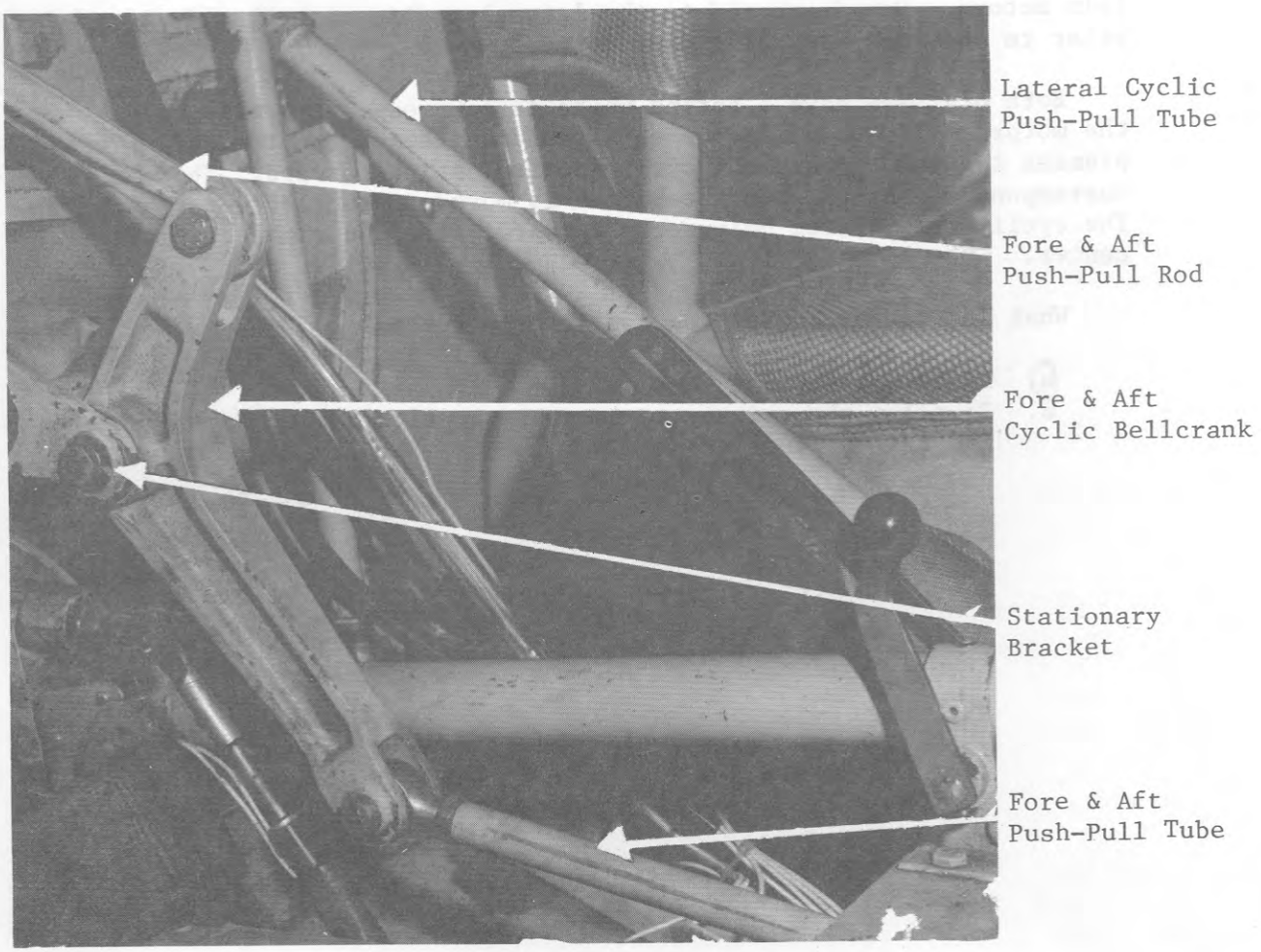
ANSWER: a. Provides a means to hold the cyclic stick in place mechanically

The pilot has access to the cyclic linkages in the preceeding photograph; these should be inspected for security and condition as well as operation of the frictions during the preflight inspection.

FRAME 4

The cyclic control linkage then runs from beneath the seats to a point between the pilot and copilot seats before moving outside the cockpit.

Study the photograph below.



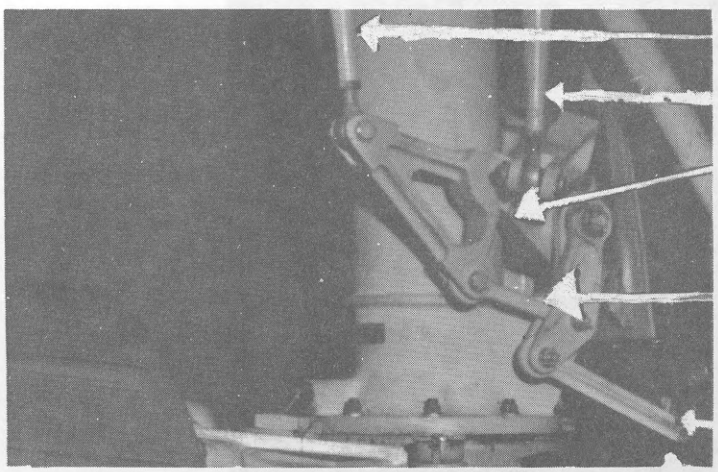
(Right seats removed for illustration)

FRAME 5

The cyclic control linkage then moves outside the cockpit to a point between the cabin firewall and the main rotor mast.

NOTE: At this point the fore and aft cyclic linkage is mounted on the right hand side of the main rotor mast; the lateral cyclic linkage is on the left hand side of the mast.

The bellcranks are utilized to connect the push-pull tubes and rods when angles prohibit direct connections.



Fore and aft push-pull tube

Lateral push-pull tube

Fore and aft cyclic bellcrank

Fore and aft idler assembly

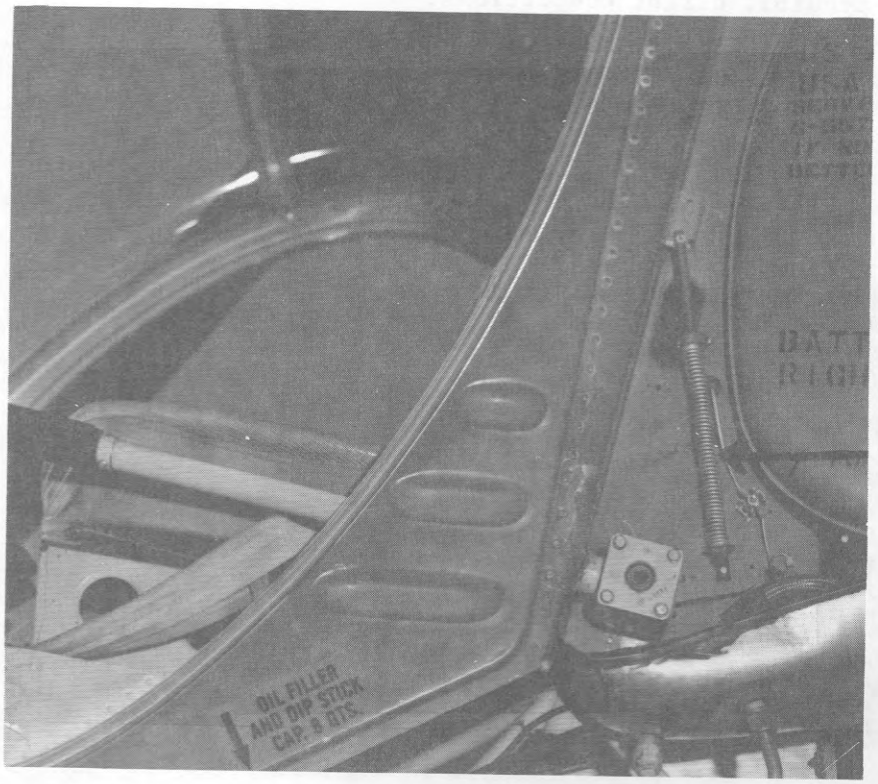
Push-pull rod

ANSWER: a. Relieve the pilot

FRAME 16

The collective pitch stick also has a type of trim system called the bungee.

The purpose of the bungee is to increase or decrease the collective pitch forces. This, in turn, controls the "light" or "heavy" feel of the collective pitch stick.



Bungee Spring

If the collective pitch stick had a tendency to move up during flight, where should the adjustment be made by the mechanic?

a. Bungee spring
b. Collective pitch friction

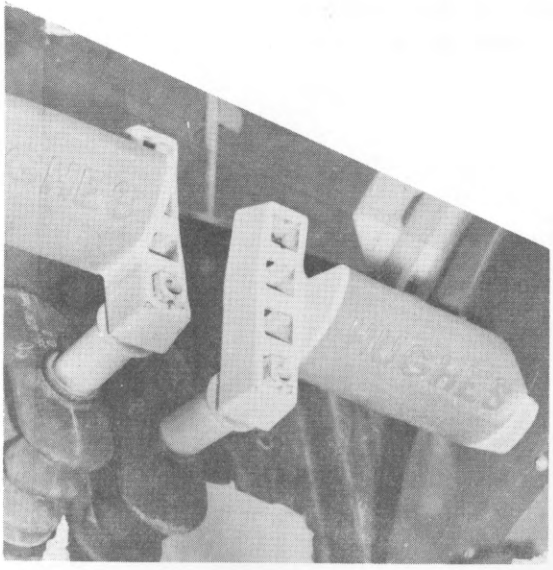
FRAME 5 (con't)

Which of the following would best describe the function of a bellcrank?

a. Affords solid support for push-pull tubes
(b) Changes the direction of a force

ANSWER: a. Bungee spring

FRAME 17



In the photograph above you see the antitorque pedals. If the left pedal is applied, it increases the pitch angle of the tail rotor blades and the nose of the aircraft turns to the left.

If the right pedal is applied, it decreases the pitch angle of the tail rotor blades and the nose of the aircraft turns to the right.

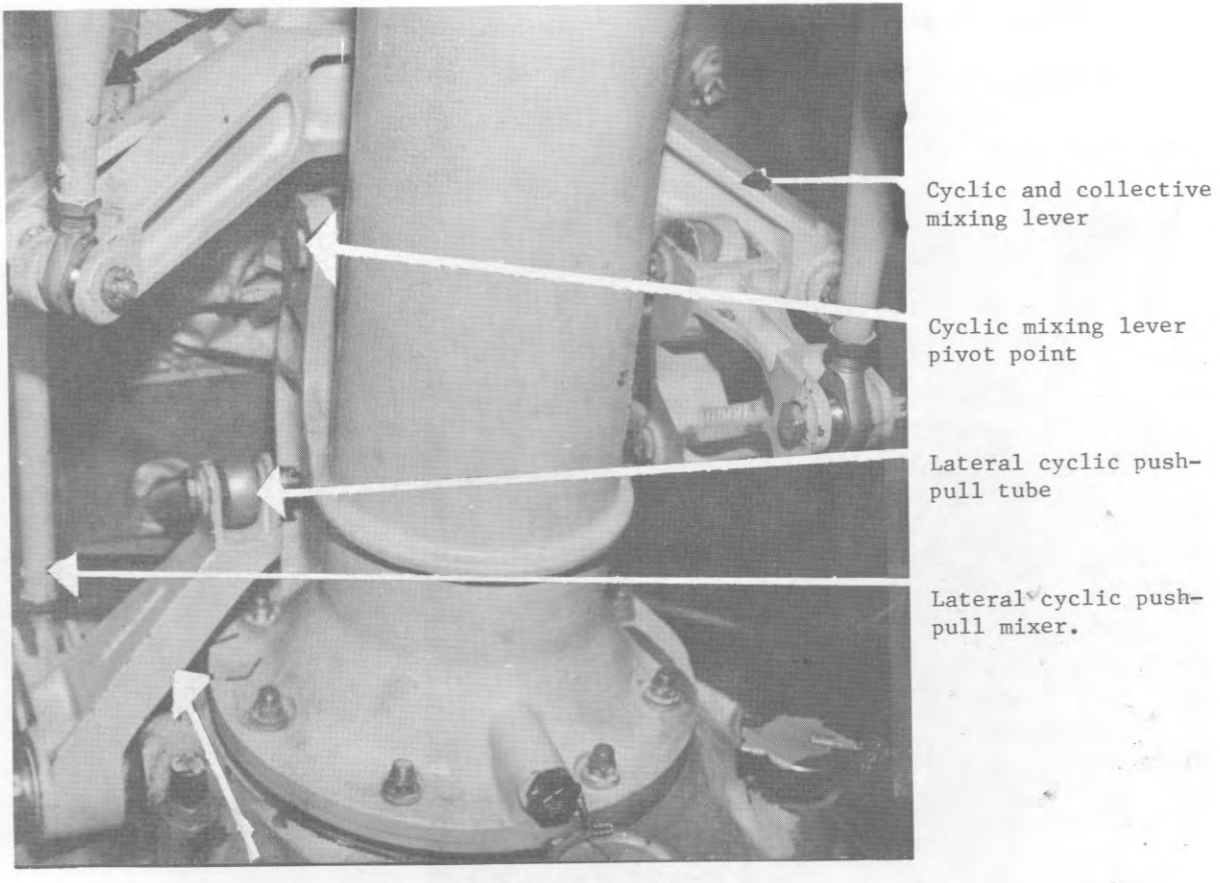
Which of the following would best describe the function of the antitorque pedals and the tail rotor system?

a. Counteract torque reaction of the main rotor and provide directional control at a hover
b. Turn the aircraft during flight

ANSWER: b. Changes the direction of a force

FRAME 6

Lateral cyclic push-pull tube



Lateral cyclic bellcrank (idler mixer)

If the aviator moved the cyclic forward, the main rotor would

a. tilt sideways.
b. tilt forward.
c. remain stationary, but the helicopter would tilt.

ANSWER: a. Counteract torque reaction of the main rotor and provide directional control at a hover

---

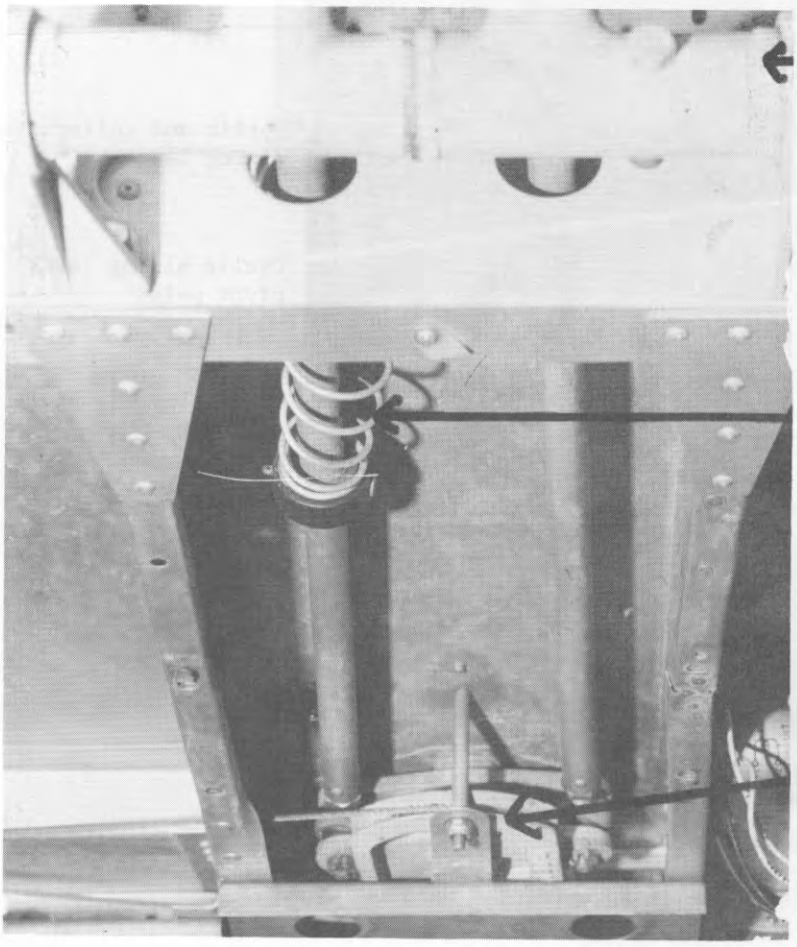
FRAME 18

The antitorque pedals run through the floor of the aircraft and are installed on and pivot around a rod located beneath the floor of the aircraft.

From this point they are attached to a bellcrank and pulley assembly, also located beneath the cockpit floor. These are normally covered by an inspection plate and are not accessable during the preflight inspection.

See photo below

Front of aircraft



Torque pedal installation

Spring

Bellcrank and pulley assembly

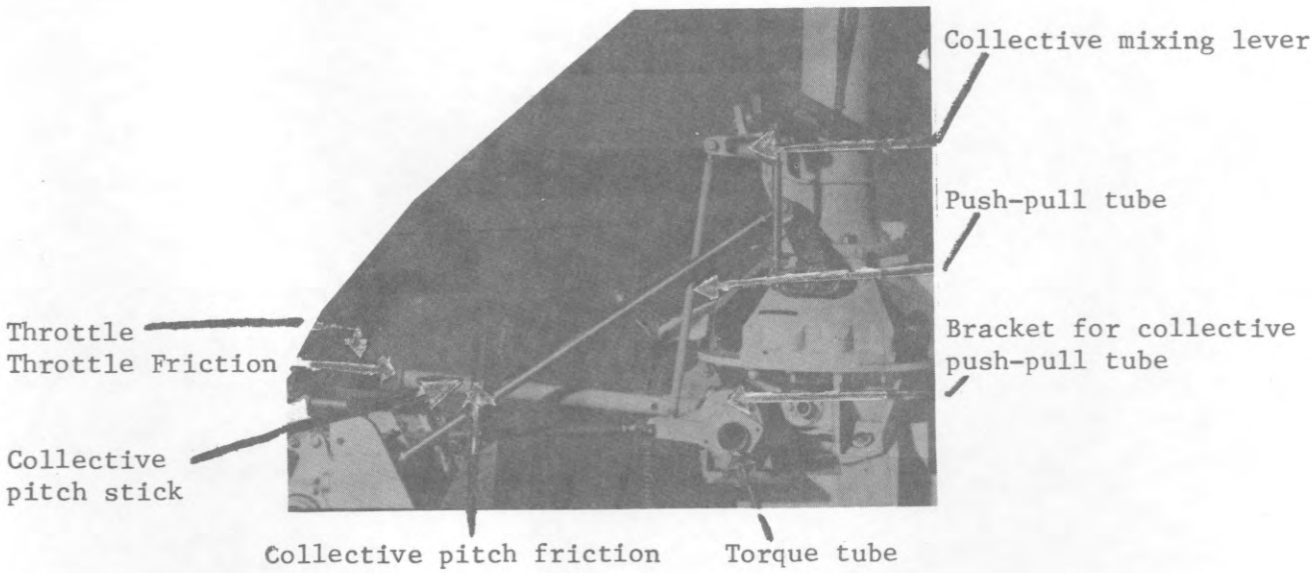
ANSWER: b. tilt forward.

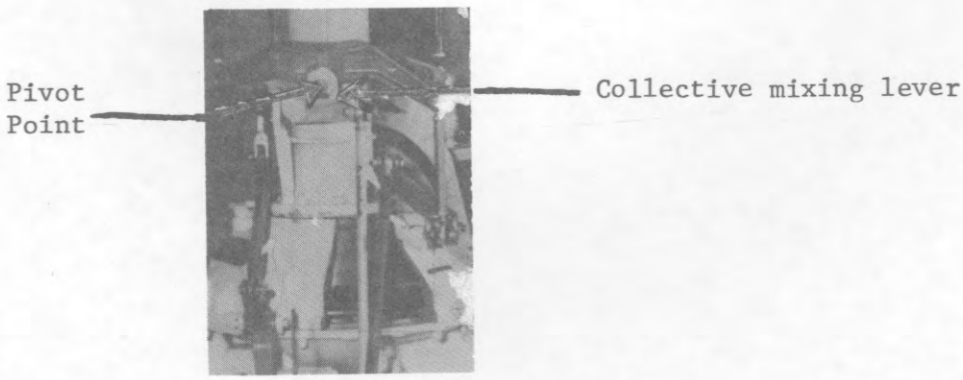
FRAME 7

The collective pitch control system linkage originates between the pilot and copilot seats.

The center collective pitch stick has a twist type throttle grip and a starter button mounted on the end of the stick.

The collective pitch stick is mounted solidly on a collective pitch torque tube. Study photos below

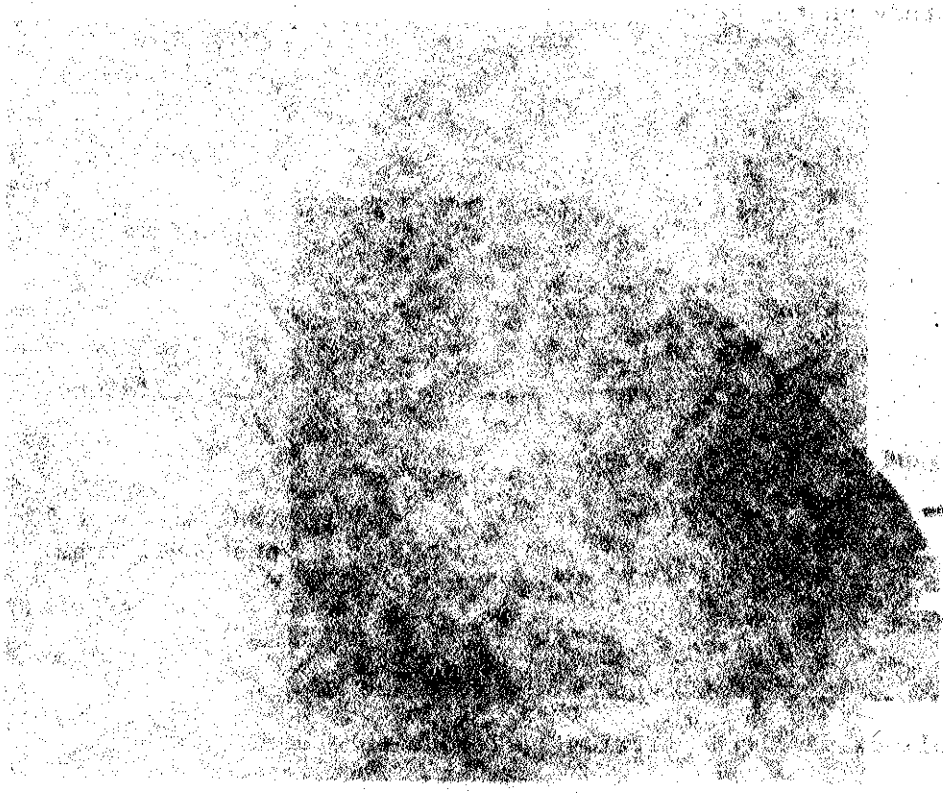




FRAME 19

In the preceeding photograph what would be the function of the spring?

a. Neutralize the pedals and add control sensitivity that the pilot can feel.
b. Dampen the vibration feedback from the tail rotor.



FRAME 8

Which of the following are incorporated as part of the center collective pitch stick?

a. Electric trim
b. Starter button
c. Twist grip throttle
d. Collective friction
e. Hover button
f. Ejection seat control

In the TH-55A, dual collective stick controls are installed.

a. True
b. False

ANSWER: a. Neutralize the pedals and add control sensitivity that the pilot can feel

---

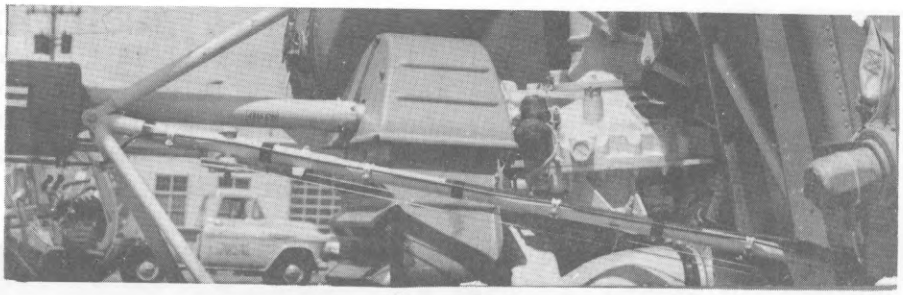
FRAME 20

From underneath the cabin and running along the right hand side of the engine are two cables. These cables transmit the movements of the antitorque pedals to a push-pull tube inside the tail boom of the aircraft.

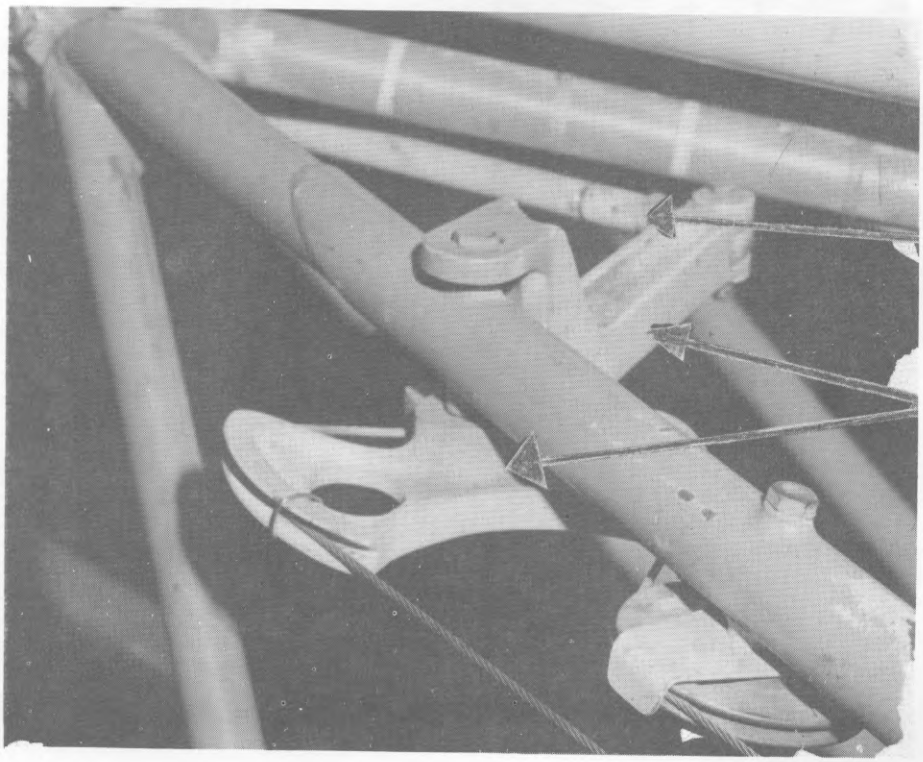
ANSWERS: b. Starter button, c. Twist grip throttle, d. Collective friction
a. True

NOTE: If the aviator moves the collective stick it will move the collective mixing lever which will in turn move the cyclic mixing lever as one unit. It will not pivot the cyclic mixing lever about its pivot point. However, if he makes a cyclic application then the cyclic mixing lever will pivot about its pivot point.

FRAME 21



Cables



Push-pull tube runs inside tail boom

Bellcrank and pulley assembly

Should these cables be inspected during the preflight inspection?

(a) Yes
b. No

FRAME 9

The controls of an aircraft are extremely important to an aviator and should be carefully inspected when access to these parts exists.

The aviator should, during the preflight inspection, inspect the parts in the preceeding photographs.

During the preflight the pilot finds a discrepancy in the flight controls, such as excessive play laterally in a rod end bearing, his action should be:

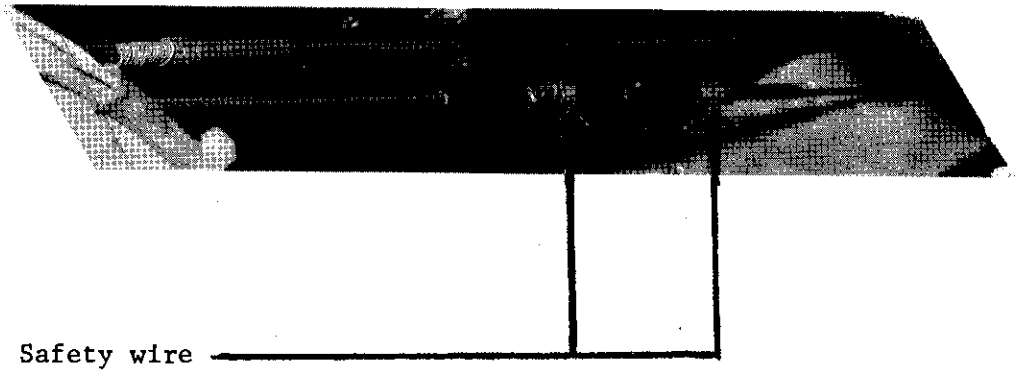
a. Refuse the aircraft
b. Check the rod end bearing on another aircraft for comparison
c. Have a technical inspector inspect the rod end
d. Take the aircraft and have an IP inspect it during the break

ANSWER: a. Yes

FRAME 21 (con't)

The pilot should inspect the cables to insure they are properly fitted on the pulleys and they should be snug, not tight, to the pilots feel.

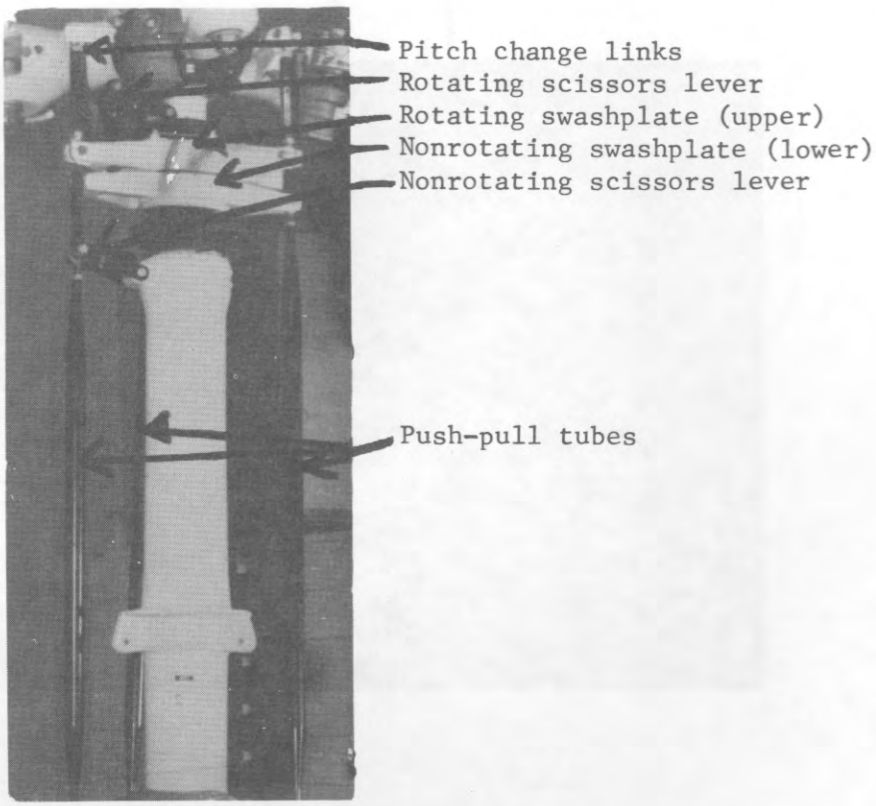
In addition to this inspection requirement, he should also inspect the turn barrels to insure they are properly safetied.



ANSWER: c. Have a technical inspector inspect the rod end

FRAME 10

The problem now arises of how to transmit the vertical movement of the push-pull tubes, which are not rotating, to the pitch change links on the rotor hub, which is rotating. This movement (force) is transferred through the upper and lower swashplates.



In the above photograph you see that as the pilot makes a cyclic application it will cause the lower swashplate to tilt because it induces movement of the three vertical push-pull tubes.

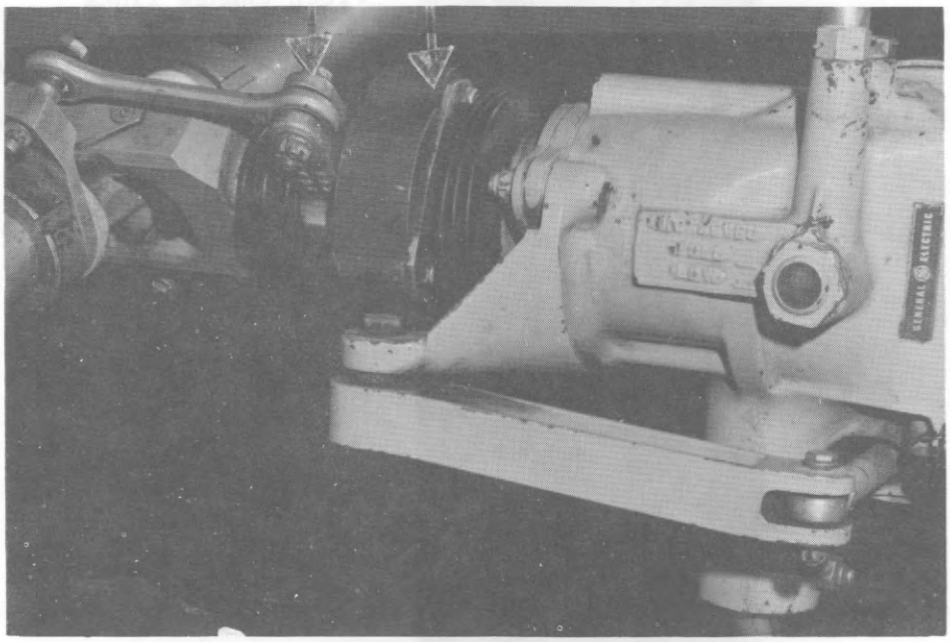
As the lower swashplate tilts it causes the upper swashplate to

a. tilt.
b. remain unaffected.
c. rotate.

FRAME 22

The push-pull tube from the bellcrank and pulley assembly extends the length of the tail boom and is fitted to another bellcrank mounted on the aft end of the tail boom.

As the bellcrank moves it will move the tail rotor swashplate bearing housing which in turn moves the swashplate.



From studying the photograph, how does this affect the tail rotor?

a. Causes the tail rotor hub to slide in and out
b. Move pitch change links, therefore changing blade pitch

ANSWER: a. tilt.

FRAME 11

The upper (rotating) swashplate is connected to the main rotor blades by means of the pitch change links. Therefore, as the upper swashplate tilts it will

a. alter the angle of attack of all blades simultaneously and in the same direction.

b. increase the angle of attack on one side of the rotor system and decrease the angle of attack on the other side of the system.

STOP RETURN TO FRAME 12 PAGE 3

ANSWER: b. Move pitch change links, therefore changing blade pitch

---

FRAME 23

Again bellcrank and pitch change links should be inspected for security and condition. Check the pitch change link bolts to insure they cannot be turned by hand and have safeties.

CONTINUE TO THE SELF EVALUATION EXERCISE

FLIGHT CONTROLS TH-55
SELF EVALUATION EXERCISE

1. Control forces are transmitted from the aviator to the main rotor through the use of

   a. push-pull rods.
   b. rotor drums.
   c. rotor shafts.
   d. pullies and cables.

2. A bellcrank is used to

   a. change the direction of a force.
   b. simplify construction.
   c. decrease overall weight.
   d. track the main rotor blades.

3. The purpose of the tail rotor system is to

   a. increase engine torque.
   b. counteract torque.
   c. control rate of descent.
   d. control rate of climb.

4. What is the purpose of the helicopter cyclic control system?

   a. Control rate of descent
   b. Control rate of ascent
   c. Control horizontal movement of the aircraft
   d. Counteract torque

5. Which of the following is the most important to check on the flight control systems?

   a. Peeling paint
   b. Linkage safeties
   c. Type lubricant
   d. Torn dust covers

6. The purpose of the collective system is to control the helicopter

   a. vertically and laterally.
   b. longitudinally.
   c. laterally.
   d. vertically.

7. Application of the left tail rotor pedal forward of neutral position will

   a. move the tail left through blade pitch change.
   (b) move the tail right through blade pitch change.

8. If during flight the collective pitch stick is moved up, this would

   (a) increase lift.
   b. decrease lift.

9. During the preflight inspection the aviator checks the tail rotor cables to insure

   a. they are well oiled so as to allow them to slide freely.
   b. quick disconnects on the turn barrels are operating properly.
   (c) turn barrels are properly safetied.
   d. (no inspection requirements are necessary.)

10. What method would the aviator employ to hold the cyclic stick in place during the runup procedure?

   a. Use the trim button
   b. Grip the cyclic stick between his knees
   (c) Apply cyclic friction
   d. Push the cyclic stick forward until it hits the stop, so it will not be in his way during the runup procedure

11. The mixing levers in the control system provide for the mixing of

   a. cyclic and antitorque control.
   (b) cyclic and collective control.
   c. collective and antitorque control.
   d. cyclic, collective and antitorque control.

12. The TH-55 has two swashplates. These swashplates are used to

   a. reduce the stress forces of the main rotor.
   b. reduce the torque reaction created by the main rotor.
   c. track the main rotor blades.
   (d) change nonrotating vertical movement to rotating vertical movement.

INTENTIONALLY LEFT BLANK

FLIGHT CONTROLS TH-55
ANSWERS TO SELF EVALUATION EXERCISE

1. a
2. a
3. b
4. c
5. b
6. d
7. b
8. a
9. c
10. c
11. b
12. d

pitch - main rotor
(yaw) - tail rotor
(roll)

L2550 Army-Ft. Sill, Okla.