

Operating Principles of the Transmitter Distributor

IT IS MIDNIGHT and you have just received a frantic call for help from your buddy who is the night shift chief in the local communications center. The XD on the weather circuit has “gone wild” and he has a report due out within the next 30 minutes. The only spare XD arranged to operate at 60 words per minute is in the shop, and all the other spare XD’s in the center are set up to operate at 100 w.p.m.

2. As you head for the center, on the double, with your toolbox banging your heels, you try to think of all the troubles that might have developed. Your buddy did give you a clue when he said that the tape stepped through the transmitter unit as it should, but the outgoing message was garbled. He also mentioned that the machine had been cleaned late that afternoon.

3. Now, it’s up to you to get your buddy “off the hook.” This calls for some very shrewd troubleshooting; therefore the reason why you should study this course is quite obvious. However, the reward for your efforts will be twofold; you will get your buddy out of trouble and also help qualify yourself for that next stripe.

4. So, let’s get on with our story of the XD. You will note that this is a short chapter because we have purposely limited the information to the basic construction and operating principles of the Model 14 transmitter distributor. The chapter is not intended to tell you “how” to shoot every possible trouble, but it does give you the basis for making an accurate analysis of any malfunctions that might develop in the XD.

5. The transmitter distributor (XD or TD), shown in figures 54 and 55, is used to transmit messages originated on tape by the PEX keyboard or to retransmit messages received on the nontyping reperforator. Its use on the TT-7/FG is only one of the many uses of this versatile piece of equipment. It is used in the field with portable equipment as well as in fixed stations with classified transmitting equipment. In fact, you will find it in a large number of Air Force communications centers, either as an individual unit or as a component of a teletypewriter set.

6. In this chapter we are primarily interested in the Model 14 (XD-82), which is used on tactical teletypewriter equipment, and in the Model 14 (XD-86), which is used with fixed plant installation. The only difference between these two machines is that XD-82 uses plugs and jacks to complete the electrical connections to the associated equipment, while the XD-86 uses slip terminals to complete these connections.

7. There are numerous other transmitter distributors used with teletypewriter equipment, but most of them are similar to the Model 14. If you gain a good understanding of the XD’s discussed here, the others should cause you little difficulty since all XD operating principles are similar.

16. Major Components of Transmitter Distributor

16-1. The Model 14 transmitter distributor consists of four major components, each of which can be broken down into individual pieces of equipment. These four major components are: (1) transmitter unit, (2) distributor unit, (3) motor, and (4) base. These components are identified in figure 54. In some TO’s and manuals you will find five major components listed. These listings include the cover. However, since the cover contains no working parts and requires no adjustments, it will not be considered in this course.

16-2. **Transmitter Unit.** The primary functions of the transmitter unit are to interpret the perforations in the tape and to connect the electrical circuits in the machine so that they will correspond with these perforations. In addition, the transmitter unit is equipped to step the tape through the unit so that a new combination of perforations is positioned over the tape pins for every character to be transmitted.

16-3. **Distributor Unit.** The distributor unit is mounted directly behind the transmitter unit as shown in figure 55. This unit takes the electrical circuits (connected by the transmitter unit) and connects them to the signal line in the proper sequence and for the correct length of time. This

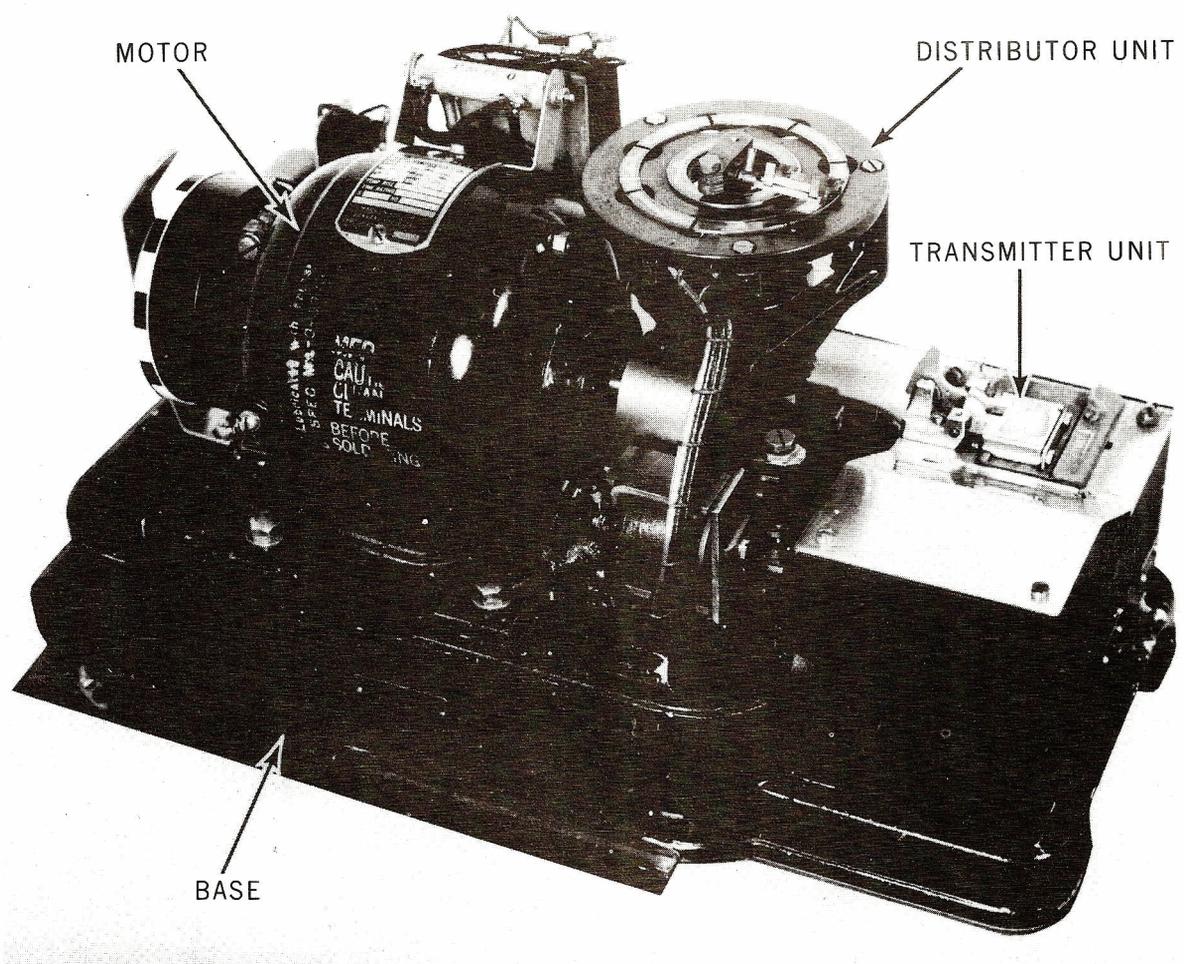


Figure 54. Four major components of the transmitter distributor.

arrangement allows the electrical impulses carried by the circuits to be interpreted by the receiving machine in the form of a message.

16-4. **Motor.** The motors used with the transmitter distributor are the same type as those used with the typing unit. The synchronous motor needs no adjustment and maintains an exact speed of 1800 r.p.m. when used with a regulated power input of 60-cycle, 110 v.a.c. The series-governed motor is equipped with an adjustable governor for adjustment to the proper speed. This permits operation in areas where 60-cycle a.c. power is not available.

16-5. As a general rule, the synchronous motor is furnished with the Model 14 (XD-86), which is used with fixed plant installations, while the series motor is furnished with the Model 14 (XD-82), which is used with tactical equipment. However, keep in mind that the conditions at a location dictate a particular motor application. For example, some installations use a governed motor that operates at 2102 r.p.m. instead of 1800 r.p.m., so don't get caught napping when you check the motor speed.

16-6. **Base.** The base is the metal casting upon which the other three components are mounted. The connections and much of the wiring for the XD are mounted on the bottom of the base. Slip terminals are on the base of the Model 14 (XD-86) to provide for easy removal and substitution of equipment. Other types of transmitter distributors have screw type terminals for permanent wiring connections.

17. Theory of Distributor Disk Operation

17-1. The distributor disk assembly consists of two conducting rings, mounted on a disk of insulating material, and a pair of carbon brushes. The brush holder arm is mounted on the upper end of the main shaft. The brushes are held in the metal brush holder so that one rides on the inner commutator ring and the other on the outer commutator ring, thus completing the circuit between the rings. When the stop magnet is energized, the brush assembly revolves with the main shaft.

17-2. **Construction of the Disk.** The outer commutator ring is divided into seven segments which correspond to the seven impulses required

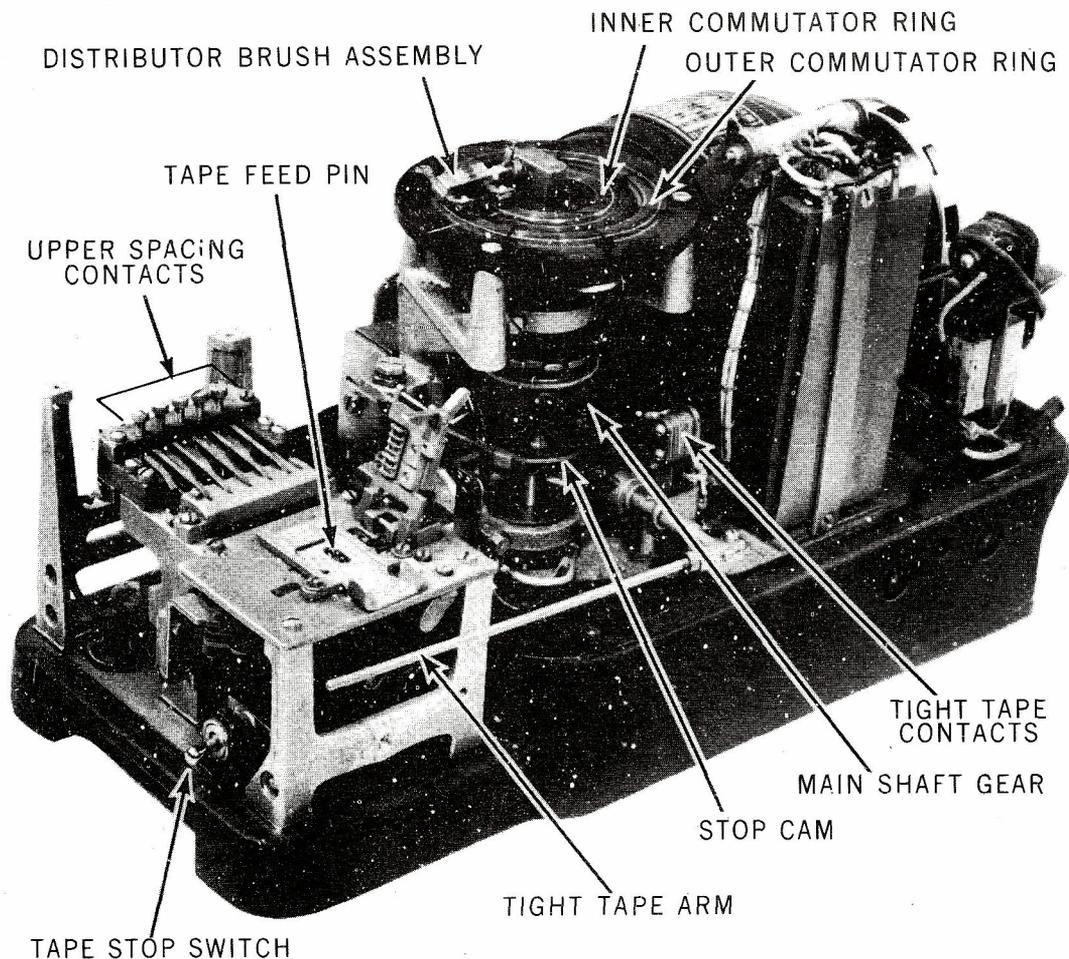


Figure 55. Parts of the major components of a transmitter distributor.

for each character (start, stop, 1, 2, 3, 4, and 5). The inner commutator ring is solid and is permanently connected to one side of the signal line. Each of the five code segments is connected to a contact tongue located between the upper and lower contact screws of the contact bridge assembly. The stop segment is connected to the lower set of contact screws, and the start segment has no connection when the machine is wired for neutral operation. If the machine is wired for polar operation, the start segment is connected to the upper contact screws.

17-3. **The Brush Assembly.** When the machine is not transmitting, the commutator brush assembly is at rest at the stop segment. Using figure 56, you can trace the signal line from the lower contacts of the contact bridge assembly to the stop segment, through the brush assembly, to the inner commutator ring.

17-4. You will notice on the left side of figure 56 that there are five switches which represent the contact bridge assembly. The upper arrows represent the upper (spacing) contact screws, and

the lower arrows represent the lower (marking) screws. The movable switches represent the contact tongues which determine whether a "current" or "no current" impulse will be transmitted.

17-5. When the tape stop magnet is energized, the main shaft is released and starts to revolve. Before the outer brush moves off of the stop segment, the five contact tongues are positioned according to the perforations in the tape. As shown in figure 56, the code combination is set up to transmit the character "Y" (code impulses 1, 3, and 5 marking). As the outer brush leaves the stop segment, it moves to the start segment. Since the start segment is not connected for neutral operation, the signal line is broken, and a spacing impulse is transmitted.

17-6. The speed of the main shaft and the distributor brush assembly is 368 r.p.m. The lengths of the segments are such that when the brushes are revolving at this speed, they will remain on the start, 1, 2, 3, 4, and 5 code segments for .022 second. (This is the length of the

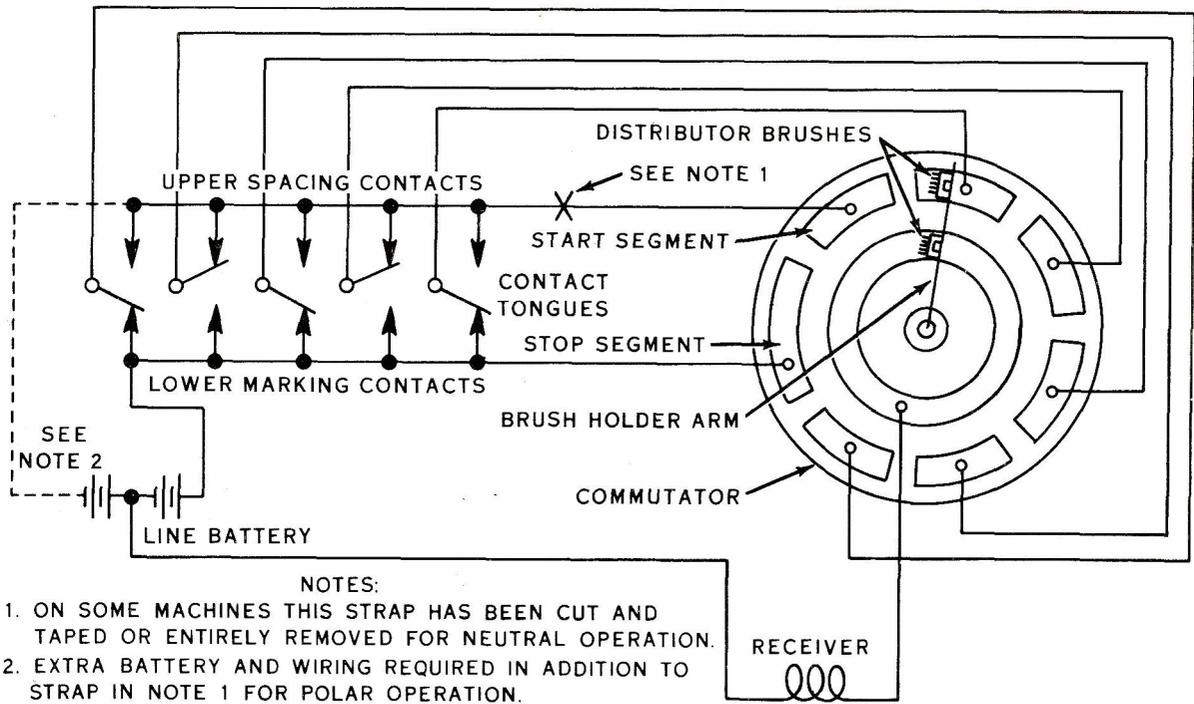


Figure 56. Schematic wiring diagram of the signal circuit within the transmitter distributor.

code impulse for 61.3-word-per-minute operation.)

17-7. Since we have chosen the code for the letter "Y" to illustrate our point, there is a connection from the first segment to the contact tongue and then to lower (marking) contact No. 1. This contact completes the signal circuit within the machine. The brush remains on the first code impulse segment for .022 second, and thus we have a marking impulse in the line during that time. The brush then moves to the second segment, which is connected to another contact tongue. This time the tongue has been positioned to upper contact No. 2. As you remember, the upper contacts are not connected for neutral operation. Thus, with the brush on the second segment, we have a spacing impulse in the signal line for .022 second. When the brush contacts the third segment, we have another marking impulse; on the fourth, we have a spacing impulse; and on the fifth, another marking impulse, each of which lasts .022 second. When the brush reaches the stop segment, we again have a marking impulse, since there is a direct connection from this segment to the lower contacts. At this time, there is a new code combination presented to the tape sensing mechanism, and the machine is ready to transmit the next character. If the machine is to continue transmitting, the brush will remain on the stop segment for .031 second. But if the machine is to stop transmission, the tape stop magnets will be deenergized; and the stop

arm will engage the stop cam lug, preventing the rotation of the main shaft, as shown in figure 57. When the main shaft is halted, the brush rests on the stop segment. Thus, there is a complete signal circuit within the machine when no transmission is taking place.

18. Operation of the Mechanical Components

18-1. The mechanical operation of the transmitter distributor, as with the printer unit, starts with the main shaft.

18-2. **Main Shaft.** Although the main shaft is mounted vertically on this machine, the gear connections between the main shaft and the motor are the same as those on the printer. There are two points of power distribution: the brush assembly mounting arm on the upper end, and the transmitter operating cam at the bottom. The main shaft gear is connected to the main shaft by a friction clutch similar to the spacing friction clutch on the printer unit. The stop cam, connected directly to the main shaft, is located just below the main shaft gear. When the stop magnet is energized, the stop arm is moved away from the stop cam, allowing the main shaft gear to turn the main shaft through the operation of the friction clutch.

18-3. Since we discussed the operation of the transmitter brush assembly in Section 17, we will say no more about the upper end of the main shaft at this time.

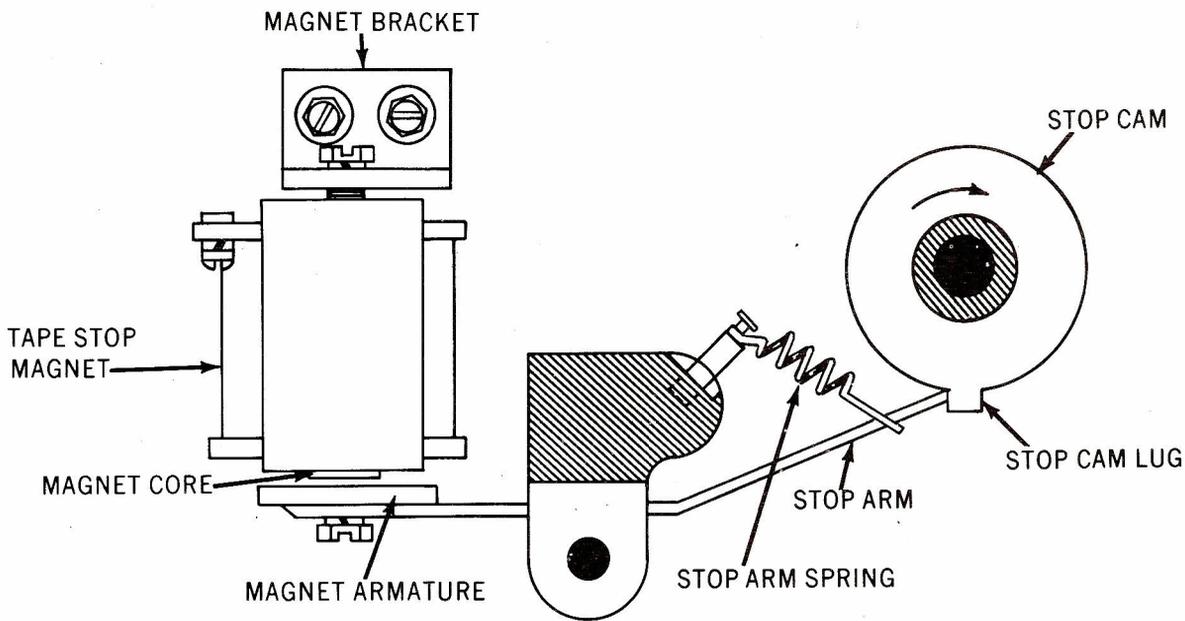


Figure 57. Stop magnet armature and stop cam.

18-4. Mounted on the lower end of the main shaft is the transmitter operating cam which controls the mechanical action of the transmitter unit. This cam, which is egg shaped, may be seen with the operating lever in figures 58 and 59. As the operating cam is rotated by the main shaft, it moves the operating lever, which is pivoted near its center. Because of the shape of the cam, the rotary motion of the main shaft is changed to a reciprocating (back-and-forth) motion of the

front end of the operating lever. The front end of the operating lever acts on the contact lever bail, and it is this bail which provides the direct mechanical linkage for the operation of the transmitter unit.

18-5. There is a definite relationship between the position of the operating cam and the position of the distributor brush assembly. The operating cam is adjusted so that the operating lever just starts to move off of the high part of the cam

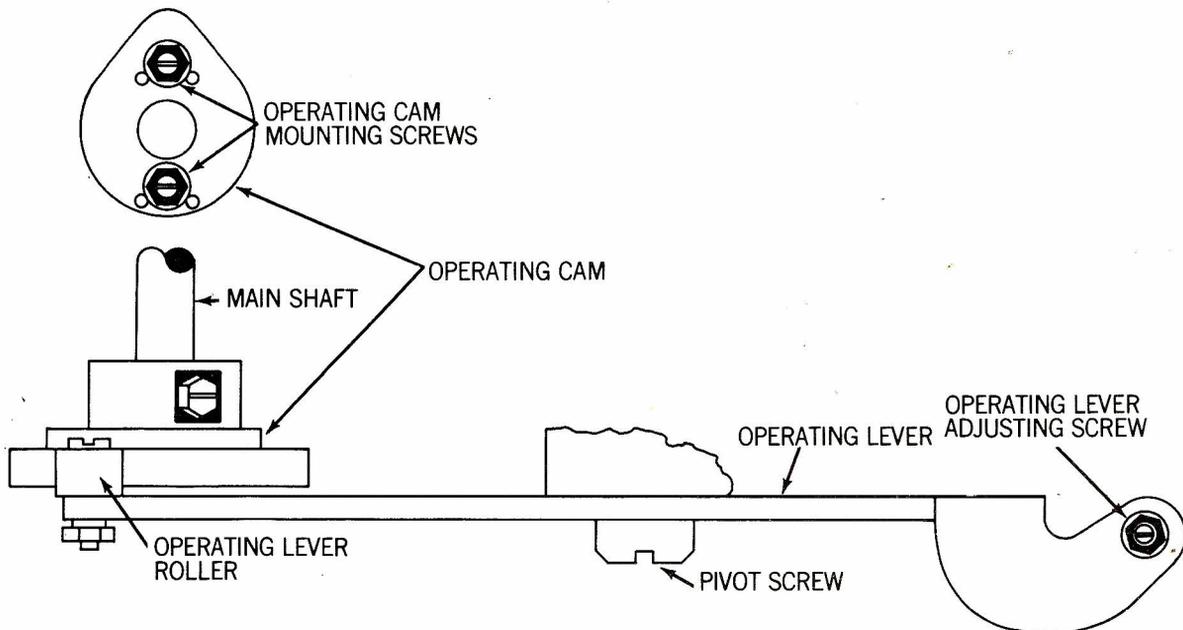


Figure 58. Model 14 XD operating lever and cam.

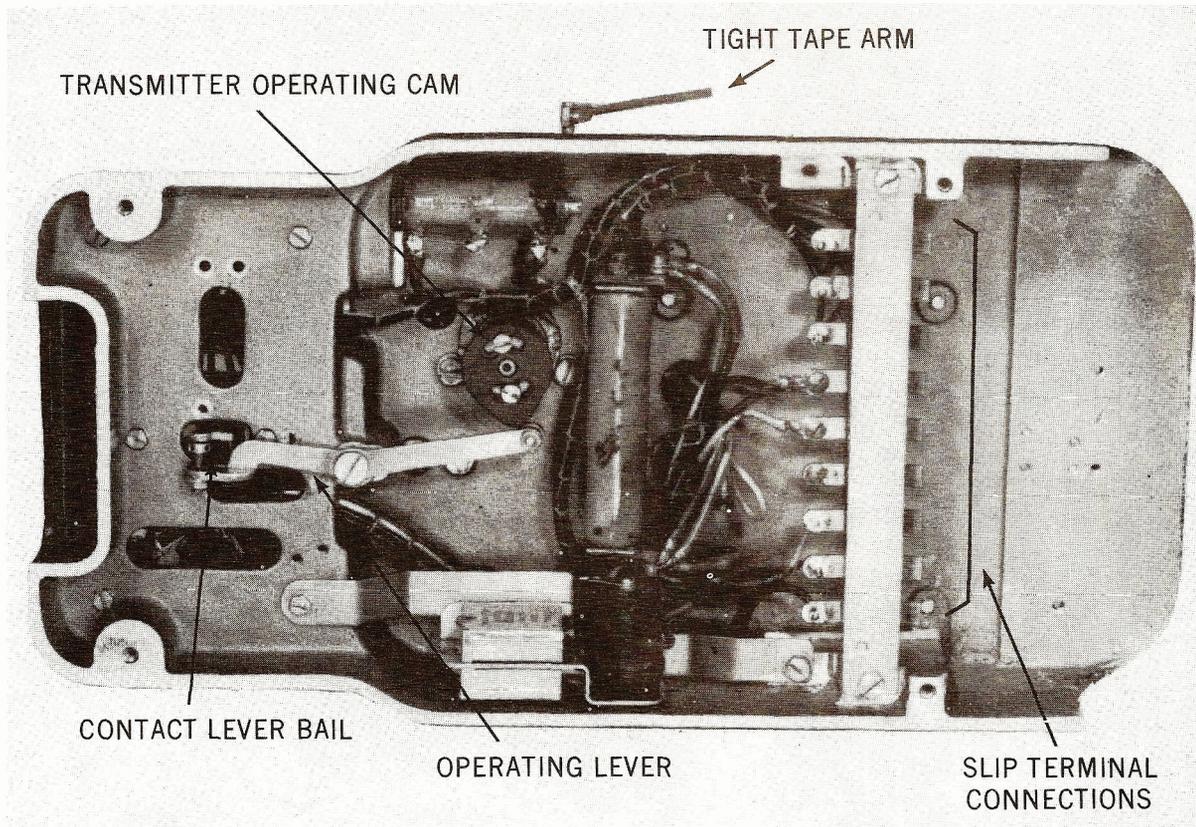


Figure 59. Transmitter distributor, bottom view.

when the brush assembly is approximately half-way through the stop segment. As the lever moves off the high part of its cam, the contact lever bail is moved to the left, moving the top of this bail to the right.

18-6. **Contact Levers.** The contact lever bail is mounted so that its upper end is in contact with the lower extension of the five contact levers (part of the tape sensing mechanism) and the lower extension of the feed lever. One contact lever and its associated mechanisms are shown in figure 60. Each of the five contact levers operate in exactly the same manner and will be discussed in the following paragraphs.

18-7. As the upper end of the contact lever bail is moved to the right, the contact lever spring exerts its force on the left-hand extension of the contact lever. This causes the lower extension (B) to move to the right with the contact lever bail, causes the right extension (C) to move up, and causes the left-hand extension (A) to move down.

18-8. When the C extension moves up, the tape pin protrudes through a slot in the bottom of the tape guide. If a tape is in the tape guide and there is not a perforation in the tape above the tape pin, the pin strikes the tape and prevents the contact lever from moving further. Thus the B extension will not follow the contact lever bail.

If there is a perforation in the tape above the tape pin, the B extension will follow the movement of the contact lever bail.

18-9. Attached to the left-hand extension (A) are the contact tongue and the contact lever spring. If there is a perforation in the tape and the C extension moves up, the A extension moves down, moving the contact tongue with it. The contact tongue then strikes its associated lower contact screw. If there is not a perforation in the tape above the tape pin, then the A extension moves down only a little, and the contact tongue does not leave its associated upper spacing screw. You will remember from Section 17 that when the contact tongue strikes the lower contact and the distributor brush is on its associated segment, the signal line is complete.

18-10. The contact lever spring used to move the contact lever is also used as an electrical connection between the contact tongue and the associated code segment wiring, as shown in figure 60. Positioned directly above the slot in the tape guide for the tape pins is a tape retaining lid which prevents the pins from pushing the tape up when there is no perforation in it. When a tape is to be inserted or removed, the lid is raised on its hinge.

18-11. **Tape Feed.** The sixth lever operated by the contact lever bail is the tape feed lever,

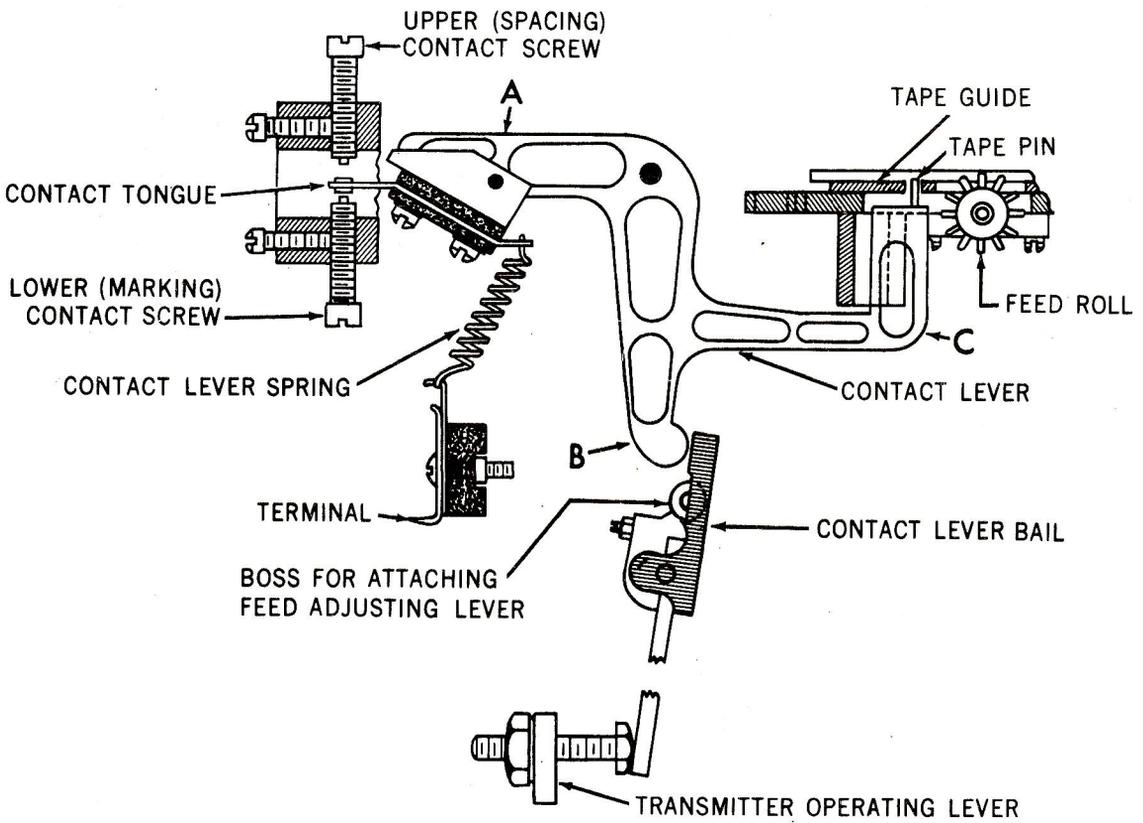


Figure 60. Tape sensing mechanism.

illustrated in figure 61. As the contact lever bail moves to the right, the feed lever spring causes the B extension to follow the contact lever bail, and the C extension of the feed lever is moved up. The feed pawl attached to the C extension is also moved up. As the feed pawl reaches its topmost position, it engages a tooth on the feed roll ratchet.

18-12. After each of the five contact levers

and the feed lever have been positioned, the outer commutator brush passes over the start segment and the five code segments, transmitting the code combination selected. During transmission, the operating lever is riding on the low part of its cam.

18-13. As the brushes pass from the fifth code segment to the stop segment, the operating lever

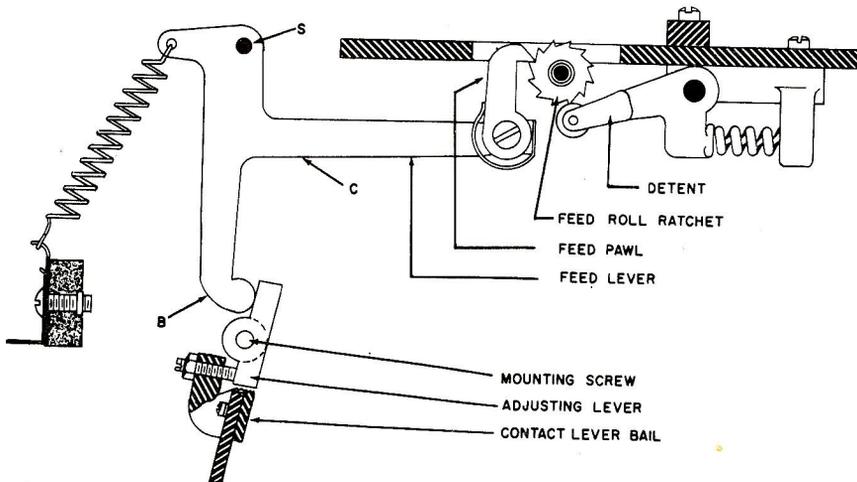


Figure 61. Tape feed mechanism.

starts to ride onto the high part of the operating cam. As this happens, the operating lever moves the contact lever bail to the left. The contact lever bail strikes the B extension of the contact levers, pulling the tape sensing pins below the level of the tape guide. The contact lever bail also moves the lower extension of the feed lever, to the left. As the lower extension of the feed lever moves to the left, it pulls down the C extension, causing the feed pawl to move the feed roll ratchet and feed roll one notch.

18-14. The feed pins are spaced at one-tenth-of-an-inch intervals around the outside of the feed roll. As the feed roll is moved, the tape is moved forward one-tenth of an inch, causing the next set of perforations to be positioned over the tape pins.

18-15. To insure proper and even spacing of the tape, the feed roll mechanism is equipped with a feed roll ratchet detent. This detent is positioned just opposite the feed pawl and is attached so that when it is resting between the points of the ratchet, the perforations are positioned exactly above the tape pins.

19. Special Transmitters

19-1. The transmitter distributor TT-26/FG is a two-channel machine and includes two tape sensing and two transmitting mechanisms and a special distributor commutator. This commutator has 13 segments: 5 pairs of segments for the transmission of intelligence impulses; a start segment; a stop segment; and an X segment, which is located between the start and stop segments. Since no distributor clutch is provided, the distributor brush is rotated continuously with the motor. This arrangement requires constant attention, for the operator must insert the message tape and start and stop the transmitter manually. No tight tape or end-of-tape stop mechanisms are provided on this machine. A switch on the front portion of the unit switches the distributor circuits in preparation for either single-channel or two-channel transmission. A send-stop lever associated with each transmitter mechanism controls the transmission on individual channels. During single-channel operation only the A channel transmitter is used. The idling channel B then transmits blank signals if the XD-91 type is used or letters combination if the XD-93 type is used. A toggle switch controls the starting and stopping of the motor.

19-2. Another transmitter distributor, the TT-21/FG, known as the receiving transmitter distributor, is used in conjunction with confidential code transmitting equipment. In most respects this transmitter distributor is like the XD-82 and XD-86 types of single-channel transmitter distributors studied in this chapter. However, the

face of the distributor disk in a receiving transmitter distributor is considerably different; instead of 7 segments on the face of its disk, a receiving transmitter distributor has a disk face equipped with 15 separate segments. This arrangement permits a special type of code room operation for which the receiving transmitter distributor is used.

19-3. Transmitter distributor TT-21/FG, known also as types XD-100GW and 14ABM-1, differs from other receiving transmitter distributors in that it incorporates a tape feed suppression mechanism. The tape feed suppression mechanism is mounted in the tape transmitter on the base casting and connects with the contact lever bail and tape feed lever.

19-4. A more detailed discussion of the TT-21/FG and its associated equipment is included in a previous volume of this CDC.

Review Exercises

The following exercises are study aids. Write your answers in pencil in the space provided after each exercise. Use the blank pages to record other notes on the chapter content. Immediately check your answers with the key at the end of the text. Do not submit your answers to ECI for grading.

1. What do you think caused the XD, referred to in the introduction to this chapter, to send out a garbled message? Write down all the troubles you can think of before looking at the answers to review exercises. (Intro.)
2. For the purpose of organization in our review, the XD was divided into its four major components: distributor, transmitter, motor, and base. What function does each of these components perform in the operation of the XD? (16-2,3,4,6)
3. What function does the brush holder and the two carbon brushes in the distributor unit perform? (17-1)
4. You have been directed to change a Model 14 XD from a neutral circuit to polar circuit.

- What must you do to the XD to arrange it for polar operation? (17-2; fig. 57)
5. How are the commutator rings of the distributor unit arranged? (17-2)
 6. When the XD is not transmitting, what is the condition of the stop magnet and how is the commutator brush assembly positioned? (17-3)
 7. The text stated that the contact tongues determine whether a "current" or "no current" impulse will be transmitted. How do the contact tongues perform that function? (17-4,7)
 8. When the main shaft is turning 368 r.p.m., how long does it take the outer brush to move from the stop segment to the first code impulse segment? (17-6)
 9. While checking an XD you find that the main shaft continues to rotate when the machine should be in a stop condition. A check with the test meter indicates that the stop magnet control circuit is open. After studying figure 57, what do you think is the most probable trouble? (17-7)
 10. The main shaft of the XD distributes power at two different points. What parts or assemblies receive power at those points? (18-2)
 11. Since the main shaft gear rides "free" on the main shaft, how is the power transferred from the gear to the shaft? (18-2)
 12. What function does the transmitter operating cam perform in the operation of the XD? (18-4)
 13. You have been instructed to lubricate the roller on the operating lever of the XD. What must you do to gain access to the roller? (18-4; fig. 59)
 14. What is the purpose of the contact lever bail? (18-4)
 15. What is the relationship between the position of the operating cam and the position of the distributor brush assembly? (18-5)
 16. What are the six parts that are controlled by the upper end of the contact lever bail? (18-6)
 17. What action should you expect of the contact lever when the top of the contact lever bail moves to the right? (18-7)
 18. If there is no perforation in the tape above the tape sensing pin, what happens to the contact lever? How is the contact tongue positioned? (18-8,9)

19. In addition to moving the contact lever, what other purpose does the contact spring serve? (18-10)
20. Where is the operating lever positioned in relation to its cam during the transmission of a character? (18-11,12)
21. In which direction does the feed lever move when the feed pawl is moving tape through the machine? (18-11-14; fig. 61)
22. What is the result of the action of the contact lever bail at the time the distributor brush moves from the fifth code segment to the stop segment? (18-13)
23. You have found that the tape pins in an XD are tearing the tape as it steps through the machine. After a study of figure 60, what do you think is the most probable cause of the trouble? (18-13,14)
24. When the feed roll ratchet detent is positioned so that it is resting between the points of the ratchet, what is the position of the tape in the tape guide? (18-15)
25. You have been instructed to set up a TT-26/FG (a two-channel machine) for single-channel operation. Which channel transmitter should you use in this case? (19-1)
26. Under what conditions would you use a tape transmitter that is referred to as a receiving transmitter distributor? (19-2)