5 miles. A pilot using such a measurement however, could not determine, for example, whether he was at 5, 10, 15, or 20 miles.

By combing the low-frequency measurement with the higher-frequency measurement, a coarse and fine system is achieved. This coarse frequency will resolve the five-mile ambiguity and, at the same time, the higher frequency will give a more precise measurement of distance. This general technique improves the distance accuracy by the ratio of the frequencies. In this case, the improvement is approximately 18 times. In practice, both coarse and fine systems are used simultaneously and jointly. The automatic servo shaft positions out the coarse system and then switches to the fine system. No action on the pilot's part is required for any of these operations. The pilot merely knows the distance more accurately by the two-frequency method.

Made by Sperry: Physical equipment based on these principles has been constructed by the Sperry Gyroscope Company and is now undergoing flight trials by the All-Weather-Flying Division of the USAF. By such a means, as the basic course fine system, ambiguities are resolved and the necessary accuracy acquired. The addition of a second or even a third frequency does not complicate the system much over the simple single-frequency system since almost all parts of the radio loop, transmitters, receivers, servos, etc., are common to the two-frequency or three-frequency systems. Thus, an increase in accuracy to almost anything required operationally can be achieved, including the extremely high accuracy required for the final approach.

It is important to note that discrete fixed frequencies are employed for the measurement, thus permitting the use of narrow-band filters adjusted to the measurement frequencies. In this manner, the over-all bandwidth of the distance measurement system is reduced and the signal-to-noise ratio is improved. These discrete frequencies utilize only a small percentage of the available modulation spectrum of the air ground ratio transmission and reception equipment.

It is therefore possible to supply part of the radio loop by using another facility. The DME herein described has been integrated with a 5,000-mc omni-range system[1] so that the omni range transmitter supplies a radio channel to all aircraft employing the system, and the omni-range receiver in the aircraft receives both the distance-measurement signal and the omni-range signal. Modulation for these functions and several other functions are filtered off at the aircraft's receiver and treated independently by measurement circuits. Thus, economy of radio spectrum and equipment are an important part of this DME technique.

Multiple Use of the DME: It is obvious that if 50 aircraft are all transmitting a continuous distance-measuring tone distance-measuring tone modulation on the same radio channel, interference between signals will be encountered. To avoid interference, each aircraft utilizes the radio channel only a fraction of one percent of the time, thus reducing this problem to a point where it no longer can affect the system in operational use. If each aircraft used the radio channel one-third of one percent of the time, 300 time intervals would be available. By scheduling the transmission time of each aircraft, a multiple aircraft service is provided.

In practice, this scheduling is accomplished by azimuth scanning of the terminal area in a manner similar to a rotating searchlight beam. As the scanning device passes through North, a signal is transmitted to all aircraft employing the service to notify them that they are to transmit at a time proportional to their azimuth position. The azimuth scan is made in six seconds. The aircraft employ their omni-range receiver for determining their azimuth and thus the time at which they can measure distance. For example, an aircraft at North responds instantly. An aircraft at 90 degrees responds 1.5 seconds later, an aircraft at 180 degrees 3 seconds later, and so forth.

Procedure: The response time is 1/60th of a second, during which the radio loop between the air and ground is closed and a distance measurement is made. This permits 18,600/60 or 310 separate cycles of the higher-frequency modulation to be measured in the phase-comparing circuit. The phase-measurement circuit receives a signal for each cycle so that, essentially, the distance is the average of the 310 consecutive measurements during the 1/60th of a second. This signal is then stored in an electrical circuit and the next few seconds are used to [illegible] the control motor to the new p[illegible]

Since a precise measurement [illegible] tance is made each six second[illegible] possible, after four or five [illegible] ments, to establish the rate of [illegible] of distance. This signal is als[illegible] the servo motor to smooth ou[illegible] dication. If a measurement is [illegible] cause of interference or loss [illegible] the rate of change of distance [illegible] bered" in the electrical circui[illegible] ployed to move the phase measuring device to the new assumed position. This can continue for as many as four or five consecutive missed measurement periods. Thus, smooth and accurate data are fed to the pilot's display. By the time-sharing process described and the employment of rate and rate memory in the servo systems, a distance-measurement system is provided which will not be saturated under the highest possible anticipated utilization rate.

Instrumentation: It is possible to present distance data to the pilot in several forms. These include such standard-type indication as multiple-hand clock-type indicators, Veeder-Root counters, electrical meter movements, synchro repeaters, etc. In the terminal area, complex configuration of the flight tracks under dense traffic conditions is more the rule than the exception. It appears impossible for the pilot to fly a track as illustrated in the accompanying figure by means of an independent azimuth dial, distance dial, and heading dial.

For example, in figure 3 if the aircraft proceeds down the track as illustrated at point "A", the azimuth is

Jetliner Dropped

The Avro Canada Jetliner project is to be put aside indefinitely insofar as the Canadian Government is concerned, Minister of Defence Production C. D. Howe told the Commons recently. However, Avro Canada is still considering carrying on with the development of the aircraft, and company officials say that there remains a good chance that the USAF will order a number for military transport use. Said Mr. Howe . . . "Unfortunately, in times like these, with the urgent need for war planes, it has been decided to put the work aside . . . If the opportunity offers a little later, we hope to complete the work, and produce a Canadian designed air transport plane powered by Canadian jet engines".