THE EFFECTS OF TUBING BORE ON STETHOSCOPE EFFICIENCY

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IN A previous communication,[1] we stated that stethoscope performance is dependent upon the length and caliber of the rubber tubing. Measurements were made to ascertain the actual change in efficiency of a binaural system by altering the length of the rubber tubing. Our data showed that below about 100 cycles per second, the efficiency is not affected materially by tubing length. From about 100 cycles per second to 1,000 cycles per second, tubing length exhibits a considerable effect upon stethoscope efficiency; that is, the efficiency decreases with increased tubing length. We concluded that the changes in the efficiency of an acoustic stethoscope which are caused by varying the length of the tubing, although not given any consideration by stethoscope users, produce an effect upon the quality of the heart sounds and the ability to hear low-intensity murmurs of medium and high frequency. For example, at 200 cycles per second there is a 15 decibel attenuation of the sounds when two rubber tubes, each 26 inches long (commercial stethoscope tubing, with a caliber of 3/16 inch), are substituted for two similar tubes 3 inches in length. The sound is about eight times as loud in the short tubing system. This attenuation occurs in the region where the low-intensity, high-pitched basal diastolic murmurs are present, and every possible increase in efficiency in this region is of utmost value.

Our analysis also indicated that the auscultatory sound pressure variations at the ear, produced by the motion of the skin or Bakelite diaphragm, are inversely proportional to the internal volume of the stethoscope, so that an infinitely small volume would theoretically exhibit a maximum variation in pressure, which, in turn, would manifest itself as a sound of maximum intensity. The skin diaphragm effect is produced when the open bell chest piece is placed on the surface of the chest, and the Bakelite diaphragm effect is produced by means of the Bowles chest piece. Obviously, therefore, the tubing, according to this form of reasoning, should be as short as possible and the caliber as small as possible. Also, the wall of the tubing should be sufficiently rigid for maximum efficiency, for any wall motion reduces the effective pressure variation transmitted to the observer's ear.

We also indicated that a factor that must be taken into consideration is the frictional resistance offered to the air column by the walls of the rubber tubing. That is, the efficiency of a stethoscope decreases as the resistance to the pressure variations is increased; the resistance is increased as the caliber is decreased. In eliminating the resistance component, we have still to consider that the greater the volume, the less the efficiency. Therefore, to obtain the most efficient tubing

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