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[54] **MATERIAL REMOVAL APPARATUS AND METHOD EMPLOYING HIGH FREQUENCY VIBRATIONS**
16 Claims, 15 Drawing Figs.

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ABSTRACT: An instrument for breaking apart and removal of unwanted material, especially suitable for surgical operations such as cataract removal, including a handheld instrument having an operative tip vibrating at a frequency in the ultrasonic range with an amplitude controllable up to several thousandths of an inch. The operative tip is itself hollow and is in turn surrounded by a tubular sleeve to form an annular passage. The handpiece includes transducer means for converting a high frequency alternating current into mechanical vibrations and an impedance transformer for coupling these vibrations to the operative tips. Connections are also provided on the handpiece to a source of treatment fluid and a pump. The treatment fluid may be coupled to either the hollow interior of the tool or the surrounding annular passage, while the pump is coupled to the other. During use, the vibration of the operative tip against the tissue to be removed causes the latter to break apart into small particles which are then dispersed in the fluid flowing over the operative region. Concurrently, the pump withdraws the suspension of the tissue particles in the fluid from the operative site. The fluid flow must be regulated so as to control the pressure within limits at the operative site. The instrument is thus suitable for removing tissue from an enclosed area whereby the opening to permit access to the tissue to be removed need only be large enough to admit the tip of the operative tool.

