\[ u^2 = \frac{\mu_0 \mu_r E^2}{4\pi} \left( \frac{E^2}{\rho_0} \right) \frac{2\sigma_0}{v_t}, \]  

while \( \sigma_0 \) and \( v_t \) correspond to the parameter values in the steady state discharge region \( \zeta = \infty \).

Evaluating \( u \) for \( P = 1 \) atm, \( E = 30 \) units yields \( u \approx 10^6 \) cm/sec. For the same parameter values \( 4\pi \sigma_0 / u = 0.41, \) \( v_t / v_e = 10^{-3}, \) \( (E^2 / P)^{1/2} = 3 \cdot 10^{-2}. \)

The model of discharge development considered above for a wave beam with subthreshold field intensity allows explanation of the rapid growth of filament-like breakdown regions across the wave beam described in [5]. The estimates presented are for the parameters of that experiment.

LITERATURE CITED

TESTS ON A LEA WITH HF GENERATOR ENERGY STORAGE

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Test are reported on a linear electron accelerator LEA whose high-frequency power supply stores energy, which raises the pulse power at the input to the accelerating section without raising the mean power consumed. The accumulation is provided by two high-quality cavities. The current load affects the beam characteristics, and the measurements are compared with calculations.

Measurements are reported on a linear electron accelerator in which the high-frequency power supply accumulates field energy, where the storage system is designed to raise the beam energy by raising the accelerating-wave power. The storage is provided by two high-quality cavities connected to the system via a three-decibel bridge. The maximum power level at the input to the accelerating section of about 55 MW is attained with a generator power of about 12 MW. With the maximum wave power, the increase in beam energy is about 70%.

INTRODUCTION

Recently, in the USSR and elsewhere there has been considerable interest in systems for raising pulsed HF power without increasing the mean power consumed by the generator. When such systems are applied to accelerators, they raise the beam energy by increasing the acceleration rate, which can be used to upgrade existing systems or in developing new ones. These systems also extend the beam energy-control range.
The storage system is based on raising the peak HF power by reducing the pulse length. The energy is stored in a high-quality cavity or several of them during the generator pulse (or much of it), with the stored energy used over a shorter period. There are three basic ways of transferring the system to use the stored energy: a) inverting the generator wave phase [1]; b) increasing the coupling coefficient between the storage cavity and the system [2]; and c) use of the first two together [3].

Only the first type has so far been used with linear electron accelerators (LEA) to raise the beam energies. The system was in part implemented with an LEA having a beam energy of 20 GeV in the SLAC laboratory at Stanford University (the SLED system) [1, 4, 5], and has also been used on an accelerator with a beam energy of 30 MeV at Moscow Physics Research Institute.

Figure 1 shows the structural diagram for an LEA using this type, which consists of the following main elements: injector 1, accelerating section 2, master oscillator 3, power amplifier 4, and a storage system, which includes the two storage cavities 5, which are connected to the HF system through the three-decibel bridge 6, together with the fast phase shifter 7. The two cavities and the bridge serve to decouple the input and output, so the waves reflected from the cavities and radiated from them pass only to the accelerating section. Also, that design halves the power level in each cavity, and thus reduces the field strength there.

The working cycle includes the following stages (Fig. 2): 1) energy storage in the cavities (0 ≤ t < t₁); 2) transient response during phase inversion (t₁ ≤ t < t₂); 3) use of the stored energy (t₂ ≤ t < t₃); and 4) dissipation of the energy remaining in the cavities (t ≥ t₃).

The storage cavities have coupling coefficients with the system β > 1. The electric field amplitude (subsequently merely termed the wave amplitude) radiated from the cavities may exceed the amplitude of the generator wave by a factor of - two, while the phase in that wave is opposite to that in the generator (the one reflected from the coupling elements). After the generator wave phase has been inverted by the fast phase shifter, the wave radiated by the cavities adds to the generator wave. The amplitude of the summed wave at the output is increased by a factor of up to - 3. The wave power is increased up by to a factor of - 9. In fact, the increase factor is somewhat less. The factor is substantially dependent on the cavity parameters (quality factor Q₀ and coupling factor β) and on the master-oscillator time parameters (pulse length tₚ) and those of the fast phase shifter (length of the transient response on phase inversion tᵦ).

**WORKING FORMULAS**

The radiated amplitude can be determined from the power balance equation [1]. The power P₀ arriving from the generator is consumed in dissipation in the cavity walls Pₐₐ₅, energy accumulation in the cavities Wₐₜ, and dissipation in the load Pᵣ, so